Innovation of Tourism Mobility Systems in Historic City Centres: The Case of Austria

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“Yet the past is not dead […]; it is not even sleeping. A mass of memories and records, or relics and replicas, of monuments and memorabilia, lives at the core of our being. And as we remake it the past remakes us.”

(Lowenthal, 2015, p.1)

Abstract

Fundamentally, tourism involves people on the move. Although controlled and well-managed tourism mobility can facilitate the sustainable touristic utilisation of places, uncontrolled touristic movement often creates significant challenges for host destinations. Developments in technology and digitalisation, such as the ubiquitous use of smartphones, are changing not only the way tourists move and behave while visiting historic cities, but also the evolution and management of tourism mobility systems in cities. Therefore, it is crucial to understand these changes and their effects on existing tourism mobility systems to benefit from digitalisation.

This thesis develops a detailed understanding of the configuration of existing tourism mobility systems to analyse and model digitally induced innovations in tourism mobility systems in tourist-historic cities in Europe.

This study employs the multi-level perspective (MLP) as an analytical tool. This approach enables a holistic analysis of innovation processes within tourism mobility by incorporating both internal and external factors that may influence system change.

A two-step empirical approach was adopted. First, a scoping study was employed to identify the current innovation status of tourism mobility systems in United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage City Centres in Europe. Based on these findings, in-depth expert interviews were then conducted for the Austrian case cities of Vienna, Salzburg and Graz to develop a detailed understanding of stepwise innovation within digitally penetrated tourism mobility systems.

The main contribution of this study is the development of an analytical five-phase innovation model of tourism mobility systems in tourist-historic cities. This model provides a detailed understanding of the general characteristics of each innovation phase of the tourism mobility system and the drivers and constraints of innovation. The five-phase model can be used as an assessment tool to establish the current innovation status of a local tourism mobility system and to evaluate the readiness of the system to innovate (further). In addition, for the tourism mobility systems investigated in the research, a detailed understanding of the actor configuration was revealed, including the roles and responsibilities of the actors. This thesis also contributes to the conceptual discussion of tourism mobility as a joint objective for research and will be of utility to practitioners in developing more sustainable tourism mobility systems.

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1. Introduction

The touristic utilisation of built environments has a long history (Turner and Ash, 1975). Heritage tourism comprises a significant share of Europe's touristic valorisation and is a key economic pillar that creates jobs and income, including for otherwise structurally weak regions. In 2003, tourists to the European Union numbered 622 million, whereas in 2019 the number had risen to 966 million (World Bank, 2021), with around 40% of these travellers (386 million) visiting Europe to explore cultural and heritage sites (EC, 2021). Especially for touristic utilized historic cities, tourism often constitutes a key income source and thus, significantly contributes to the economic vitality of these sites (Ashworth and Tunbridge, 2000).

However, tourism is also considered an invasive industry that requires a holistic appraisal of the benefits and challenges of the touristic utilisation of a place. Tourism is often referred to as an invasive, insidious, and destructive force (Johnston, 2015). On a global level, tourism is responsible for 8% of the world's carbon emissions (STI, 2021), and on the local level, tourism often entails a deep transformation of social, environmental, and physical structures. The key challenges of tourism range from increasing traffic volumes to overcrowding, as well as rapidly increasing prices of goods and land values and the commodification of local culture. These issues are only a few well-known impacts of unbalanced tourism (Shiv, Sagar and Shishir, 2020).

To ensure balanced tourism, in which the benefits outweigh the negative impacts, well-informed, sophisticated, and effective tourism management must be introduced to retain the "delicate balance between tourism being a support to conservation and tourism becoming the reason for conservation" (Orbasli, 2000).

Tourism management seeks to plan, organise, and manage all tourism-related aspects and activities at a destination. Thus, tourism management is not only a highly cross-sectoral pursuit, deeply interwoven within local structures, including political, social, and business matters of tourist-historic cities, it is also a multidisciplinary field. Tourism management, among other aspects, initiates marketing and sales activities to attract visitors to a site, as well as interpreting the local cultural and natural heritage to tell a story, convey the meaning of the site, and thus create a unique visitation experience. In addition, tourism management is meant to coordinate and attune the cooperation of tourism-related local businesses and facilities to enhance the added value of the destination and connect tourism businesses and local government and administration to warrant a continuous and aligned development of the destination.

On close inspection of the key aspects of tourism and tourism management, the role and importance of mobility and movement become apparent. In a classic touristic journey, it is

central for travellers to depart their home, visit distant places, and explore the destinations on-site. As such, touristic mobility lies at the heart of each touristic endeavour. Tourism can be basically considered a form of mobility (Hall, 2004). The majority of touristic activities revolve around mobility and the movement of goods, people, or messages. Therefore, it is crucial to emphasise the importance of tourism mobility and incorporate it into the planning and management activities of destinations and sites to warrant a sustainable utilisation of environments.

Tourism mobility constitutes a highly dynamic sub-system within the destination or city system of the individual site. As the term already indicates, tourism mobility comprises two individual sectors within a city, namely the tourism and mobility sectors. However, as outlined above, tourism cannot take place without mobility – be it on a macro-level (e.g. air travel) or on a micro-level (e.g. walking visitors exploring a site). To enable a sophisticated and holistic approach towards the planning and management of tourism mobility at a destination, it is crucial to take a cross-sectoral approach that jointly considers tourism and mobility aspects and practices. Sheller and Urry (2004, p. 5) reflect that,

> "there are not two separate entities, 'tourism' and 'mobilities', bearing some external connection with each other. Rather they are part and parcel of the same set of complex and interconnected systems, each (re)producing the other."

As such, tourism mobility is considered a system of systems embedded in a city system.

Therefore, a tourism mobility system not only includes a wide range of actors, equipment, facilities and is subjected to diverse policies and regulations, it is also affected by a range of external factors, such as globalisation and digitalisation, that continuously impact and change local and global tourism mobility systems. To maintain resilient and sustainable tourism mobility systems at destinations, it is crucial to be aware of these influencing factors, the changes they trigger, and to allow the systems to evolve in the changing environments they are embedded in.

Especially globalisation developments constitute the continuously increasing tourist volumes in European cities and sites, which sometimes even leads to an 'over-touristic' use of sites (UNWTO, 2018). Salzburg (AT) or Venice (IT) are two popular examples that suffer from severe 'over-touristic' exploitation (Roland Berger, 2019).

The essence of unsustainable touristic exploitation of natural or built environments hinges on the management and control of touristic mobility to or within sites. The key challenges for the management of tourism mobility involve addressing the necessary management strategies to oversee or even control touristic traffic to and within destinations: for example, to avoid overcrowdings at touristic key areas, to find solutions for the 'last/first mile' problems

(Zehetgruber, 2019), or address climate change issues (Guehnemann, Kurzweil and Mailer 2021) (see 2.10.3 for greater detail).

Concerns regarding the impacts of increasing touristic mobility on historic built environments are not new (Glasson, Goodey and Godfrey, 1995; Orbasli, 2000). However, approaches to incorporate tourism mobility management into destination management or even city management strategies to create a sustainable touristic utilisation and balance regarding the emerging pressures on urban living environments are largely theoretical, with little practical applicability (Straaten, Borg and Trumbic, 2001; Jovicic and Dragin, 2008).

With the breakthrough of new technologies, especially online mobile technologies (OMTs), unprecedented possibilities to influence, and thus steer and control, touristic mobility at sites are finally available (Tung, Cheong and To, 2019).

These novel technological possibilities are driven and enabled by global digitalisation developments that are rapidly changing people's everyday lives. These digitally induced changes open not only new doors to enhance the management and planning of tourism mobility at sites and in cities (Albrecht, 2017), but also significantly alter the mobility and site-consumption behaviour of visitors (Kidd, 2019; Jen, 2018). Ubiquitous online access to large amounts of information empowers individuals to negotiate their day-to-day mobility with increasing fluidity and encourages ad-hoc decision-making on the go (Dickinson et al., 2012). Local tourism mobility systems must be adjusted and learn to deal with these emerging and rapidly evolving changes in user behaviour.

UNESCO (2015), for example, considers mobile technologies as both a threat and an opportunity for historic sites, encouraging management organisations to reconsider their strategies and proactively incorporate and adapt to new technologies.

Digitally enhanced tourism mobility systems are envisaged to provide unprecedented possibilities to generate real-time, micro-mobility data of visitors (Scuttari, 2019). These data are used not only to provide visitors with highly personalised and location relevant information to enhance the visitation experience, but also to enable a dynamic tourism mobility management based on real-time data of moving visitors to counteract, for example, overcrowding. However, the findings of this timebound study, which is looking at tourism mobility systems in the period of 2017 to 2019, show that this optimised utilisation of OMTs within digitally enhanced tourism mobility systems is only in its infancy and requires far-reaching changes and significant innovations in contemporary tourism mobility systems (see in more detail in Section 2.10 and in findings of the online survey Section 5.2 and case studies Section 7.5 and 8.4).

The innovation of digitally enhanced tourism mobility systems has only just started but is progressing rapidly. This thesis investigates tourism mobility systems in Europe, particularly focusing on the historic city destinations of Vienna, Salzburg and Graz in Austria. These case cities were found to have different levels of innovation of their local tourism mobility systems within the scoping study despite being subject to similar landscape pressures, such as growing visitor numbers and global 'digitalisation' developments (see Section 5), as well as being situated within the same national frameworks (e.g. national institutions and policy frameworks; see Section 5). Therefore, these three heterogenic cases within one country were selected to gain insight into the innovation dynamics and processes that occur at the local level.

In addition, pragmatic issues were considered, such as Vienna being my hometown, so I am very well acquainted with the overall touristic setups, economies, history, figures, regulatory frameworks and political structures of the city, as well as those of Salzburg and Graz. This information provided a basis and context for the comprehensive analysis of the local tourism mobility systems. Furthermore, I considered it beneficial to interview the experts in their mother tongue German.

This thesis unravels tourism mobility as a complex 'system of systems' and provides insights into the setup and stakeholder configuration of contemporary tourism mobility systems. These insights are essential to begin a conceptual discussion of the cross-sectoral field of tourism mobility and to continue an in-depth investigation into the innovation path of tourism mobility systems. This thesis zooms in from a Europe-wide discussion on the current state of tourism mobility systems in historic cities to a detailed discussion of the innovation pathways of three Austrian case cities. This approach generates detailed insights into individual innovation processes and dynamics and reveals how local actors and frameworks address digitalisation developments. This thesis also includes a more generalised discussion regarding innovation phases and pathways, which highlights overall challenges and problems, but also the drivers and potential of an innovated tourism mobility system.

This thesis contributes by providing an initial analytical framework for academia and practice to understand better the setup of tourism mobility systems and to obtain a detailed understanding of the individual innovation phases and their characteristics that tourism mobility systems in Europe must undergo.

In addition to the detailed analysis of the innovation of tourism mobility systems, a conceptual discussion of the cross-sectoral topic of tourism mobility is pursued. This cross-sectoral character is considered a key obstacle to the final breakthrough of tourism mobility as an objective of management and development agendas, and it hinders the integration of tourism mobility considerations into governance structures. Therefore, this thesis also seeks to close this gap by discussing the socio-technical system of tourism mobility in a unified explanatory

framework and outlines the co-evolutionary developments towards a synergised tourism mobility system. For this, the analytical tool called the multi-level perspective (MLP) is used to assess the innovation pathways of socio-technical systems (Geels, 2002). The MLP innovation phases and the overall innovation pathway are used to analyse the digitally induced innovation pathways of tourism mobility systems. The MLP provides a framework that facilitates deep insights into the configuration and change mechanisms of tourism mobility systems. This framework enables the identification of case-specific transition pathways and their underlying change dynamics, providing an outlook on innovation trajectories.

As a foundation for this novel, conceptual approach toward a joint tourism mobility system, notions of the 'new mobilities paradigm' are used. This approach is used to understand contemporary tourism mobility, by integrating the notion of transition (Geels, 2005b), the analysis of how mobilities fit in and form social practices (Verbeek and Mommaas, 2008), and the overall system change of transforming urban systems (system innovation; (Geels and Kemp, 2007). These notions do not seek to provide a totalising, reductive description of the contemporary world but suggest a set of questions, theories, and methodologies for a new configuration of applied mobilities research (Sheller and Urry, 2016).

These conceptual considerations highlight the need to depart from the 'business as usual' mentality in urban and transport planning (Sheller and Urry, 2006) and the end of the 'predict and provide' model to understand digitally diffused transport behaviour and underlying systems (Grieco and Urry, 2011). This thesis seeks to take such an alternative approach toward the study of increasing digitalised tourism mobility systems.

1.1. Research Aims and Objectives

Tourism mobility is pivotal for a sustainable touristic utilisation of built environments. However, neither a conceptual nor a systemic understanding of tourism mobility systems has been established, meaning insights into innovation processes are missing. The aims of this research are therefore:

- the identification and analysis of the innovation pathways of tourism mobility systems in the three Austrian case cities as the basis for the development of an initial, generalised model of the innovation phases of tourism mobility systems in Europe (Research Aim 1 - RA1) and
- to further advance the conceptual understanding of tourism mobility systems in historic cities (Research Aim 2 - RA2)

A set of four objectives underpin these two aims and are illustrated in Figure 1. The objectives complement and build upon each other. The research objectives were designed to explore tourism mobility systems in Europe. Therefore, the first research objective (RO1) offers a general picture of the current state of tourism mobility systems of UNESCO World Heritage Site (WHS) city centres in Europe. These findings provide input for an initial draft of the socio-technical system of tourism mobility in Europe and act as a scoping study for the in-depth investigation of the Austrian case cites.

For the elaboration of the overall innovation process of tourism mobility systems in the three Austrian case cities of Vienna, Salzburg, and Graz, a detailed discussion is conducted on external factors, including tourism induced pressures and the growing effects of novel digital tools, that pervade the tourism mobility systems of the cities (RO2A). In parallel research objective RO2B is designed to identify actors and the actor setup, of relevant actors within the local tourism mobility systems and their roles and responsibilities. These findings are interrelated to gain an in-depth understanding not only on the current setup of tourism mobility systems, but also on dynamics and processes that influence and shape the system setup and innovation.

Based on the generated insights, a systematic discussion regarding the innovation steps and pathways of each tourism mobility system in the respective case city is conducted (RO3).

The findings of the scoping study and the case discussions are synergised to comply with the overall research aim (RA1) and to develop a transferable model in which the characteristics, triggers, and challenges of each innovation phase are analysed, but also to provide conceptual insights into a contemporary tourism mobility system (RA2).

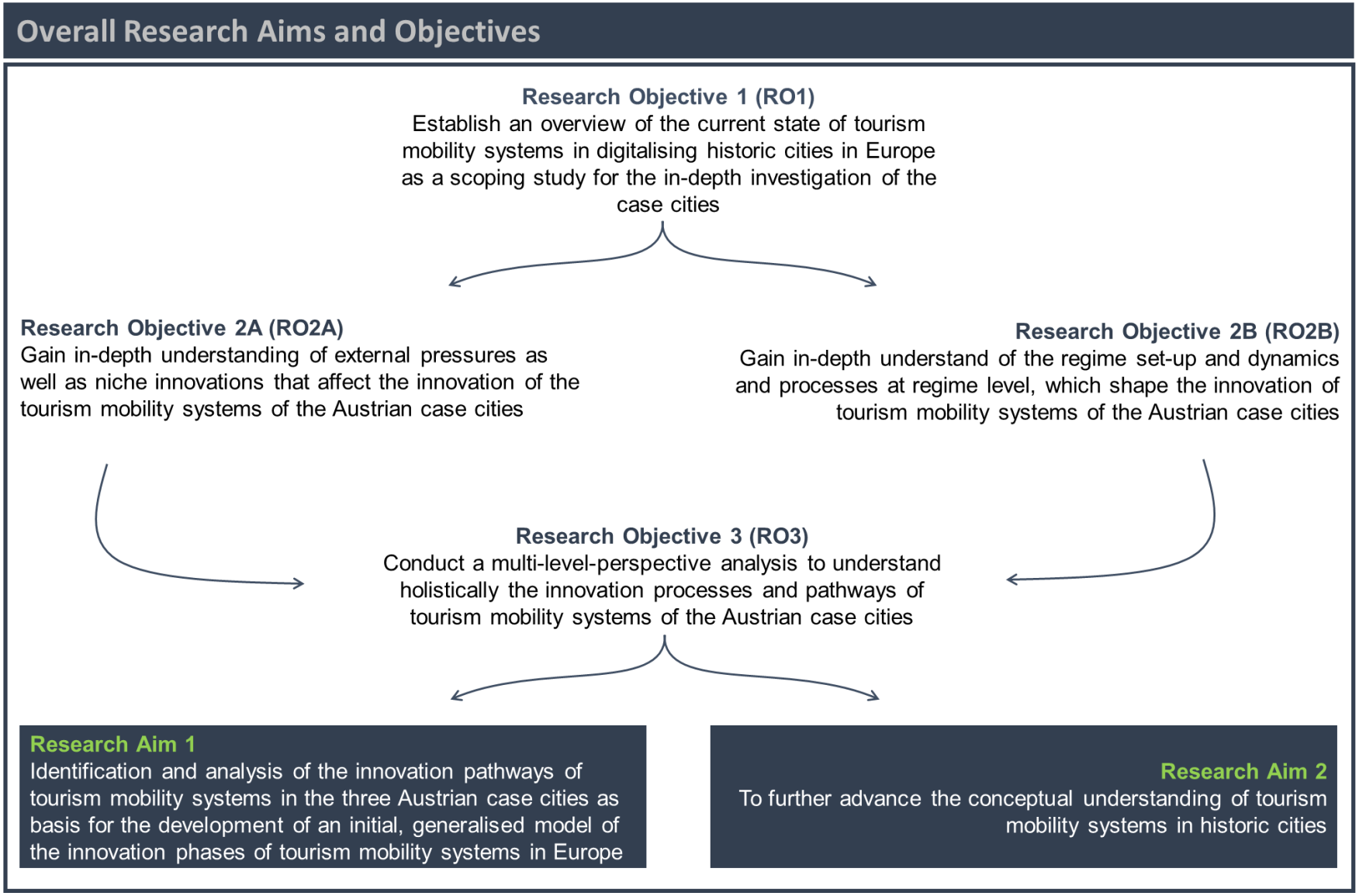

Figure 1 Research aims and objectives

1.2. Contribution to Knowledge

This thesis develops a novel conceptual framework that explains the innovation phases and the overall innovation pathway of tourism mobility systems in selected tourist-historic cities in Austria. The knowledge gained in this study feeds into the research literature in the following fields:

(1) Tourism research – this thesis adds a mobility focus to studies of innovating touristic systems involving the movement of visitors at historic sites. Furthermore, the thesis highlights the interconnectedness of tourism and mobility.

(2) Mobility research – adding innovating tourism mobility systems as a further case can help to understand the transformation of mobility systems and contribute case-specific examples to the 'shifting mobilities' debate.

(3) Innovation studies – contributing a detailed examination of tourism mobility to the literature on MLPs of transforming socio-technical systems. By examining the context-specific innovation pathways of Austrian cities, this research partly responds to the existing critique of the MLP (see Section 3.3.6), notably regarding the relevance of a spatial scale within the analysis and the influence of the 'city' or 'region' as part of the MLP.

(4) Urban studies – this thesis provides a better understanding regarding innovating the tourism mobility system of places with relevance to urban planning, city management and urban development and governance.

However, the analytical model also provides reference points that characterise different innovation phases within tourism mobility systems that are relevant to both practitioners and researchers. For practitioners, the analytical model can be used as a tool to identify the current state of innovation of the local tourism mobility systems as well as to optimise, upgrade and adjust existing tourism mobility structures.

Furthermore, this conceptual approach provides knowledge of the stakeholder setup and power distribution of actors of contemporary tourism mobility systems. These findings add to urban studies, especially urban planning, and also establish a novel perspective on policy, regulation, and decision-making structures that shape the urban configuration and utilisation of touristic historic cities and their effects on the built and living environments.

The use of the MLP as analytical tool also complements existing literature on MLPs, which emerged mainly in innovation studies and research on the sociology of technology, and adds a novel case discussion, namely the innovation of tourism mobility, to the diverse cases analysed using the MLP.

The second key contribution is the study's approach to considering tourism mobility as a single, joint socio-technical system. Thus, this study departs from the isolated discussion of either the tourism, mobility or urban studies angle and seeks to contribute to the development of a unified concept of tourism mobility.

This cross-sector approach analyses (re)alignment dynamics when two socio-technical systems merge, enabling a discussion on the shifting or blurring of system boundaries of cross-sectoral systems. These insights contribute to the discussion on the paradigm shift and the emergence of a new mobilities paradigm.

Furthermore, the investigation of tourism mobility in historic cities expands the understanding of micro-mobilities in urban environments, which are subject to digital transformation dynamics.

This study highlights the relevance and transformation of interpretation and guidance techniques in digitalising tourist-historic cities, contributing to heritage studies, communication, and tourism research. Tourism studies mainly approach research on interpretation and guidance methods from a marketing and e-commerce perspective. However, the socio-technical discussion on the underlying effects and sustainability potentials of interpretive methods expands the literature, namely via the role of mobility-focused interpretive solutions for visitor-impact management and sustainable destination planning. In particular, the digital transformation of interpretive and guidance methods is decisively significant for the innovation of tourism mobility systems because OMTs provide unprecedented communication possibilities but also entail substantial changes regarding visitor movement and consumption behaviour.

This study is only a starting point for contemporary research on the unified subject of tourism mobility. This thesis provides insights into the constantly and rapidly changing tourism mobility system in the digital age. The developed model only illustrates and discusses transformation developments in the short period of this study in European tourist-historic cities. Thus, this model is not complete or finished. However, this unfinished state exemplifies the ongoing, rapidly changing, and unfinished state of digitally transforming urban systems. This realisation and learning to deal with enduring fluidity and the infinity of innovation, is also a cross-sectoral contribution.

1.3. Chapter Synopsis

The first parts of the study provide the relevant theoretical background on tourism mobility and the analytical framework used:

Chapter 2 discusses existing literature and provides the theoretical and conceptual background of the study. Chapter 3 outlines the analytical framework that is used for the design and analysis of the subsequent scoping study (Chapter 6) and Multi-Level-Analysis on system innovation dynamics in the Austrian case studies (Chapters 7 to 9). In addition, the analytical framework also supports the formulation of the socio-technical system of tourism mobility.

Chapter 4 covers the methodological design, outlining the theoretical, conceptual, empirical, and analytical phases of the study. This chapter also includes details on the sample and case selection process.

Once the theoretical background and analytical framework are set out, the empirical parts (scoping study and case studies) 'operationalise' the developed analytic framework in the empirical parts of the study.

In Chapter 5, the findings of the scoping study are compiled and analysed to establish the current state of tourism mobility systems of touristic historic cities in Europe. Furthermore, the current level of the utilisation and integration of new technologies is established, and the level of technology acceptance and awareness within sites is investigated. These parameters and findings provide an initial overview of the status quo of contemporary European tourism mobility systems and their system setup, as well as offering insights into innovation dynamics, components, challenges, and potentials. The findings form the basis for the in-depth case studies in the following chapters.

In Chapter 6, an overview on relevant aspects of Austria's tourism and mobility systems are given, which provide context for the subsequent case studies as well as the scoping study.

Chapters 7 to 9 include the case studies of the three Austrian case cities: Vienna (Chapter 7), Salzburg (Chapter 8), and Graz (Chapter 9).

The general discussion regarding the findings of the scoping study (Chapter 6) and the three case studies (Chapters 7–9) is conducted in Chapter 10. In this chapter, the five-phase innovation model of tourism mobility is developed. Influencing factors such as landscape pressures and niche innovations that penetrate and shape the innovation of tourism mobility systems are discussed in detail and their direct and indirect impact and effects on innovation processes and dynamics of the overall tourism mobility system is highlighted. Furthermore,

the conceptual aspects of tourism mobility systems are summarised, and an overall system setup of a socio-technical tourism mobility system is provided.

Chapter 11 concludes the study and summarises the findings. In addition, implications of the results of the study for the underlying conceptual discussion on the shifting mobilities paradigm are outlined. Based on the overall results of the study, an outlook for further research is also provided.

2. Literature Review

The review of literature focused on two key aspects relevant to this study's research aim and objectives.

First, existing literature on the conceptualisation of tourism mobility was investigated. To sketch the existing conceptual understanding of tourism mobility, literature concerning underlying concepts but also the relation and interlinkage of tourism and mobility were discussed (see Sections 2.2 and 2.6). Furthermore, to be able to understand the current relevance of tourism mobility within city and destination systems but also contemporary living, urban environments, it is crucial to also take a step back and discuss tourism mobility in the context to overarching, paradigmatic considerations (see Section 2.1).

The second key focus of the literature review investigates digital-induced innovation and change processes of and within tourism mobility systems (see Section 2.10). The analysis revealed that the innovation of tourism mobility systems follows thematic focal areas, which first prioritises the exploration and integration of novel technology into local tourism mobility systems and thus, trigger change (see Section 2.10.1). This techno-centric focus is broadened by a user-centric discussion on the usability of novel technologies in existing tourism mobility systems and the effects on relevant social practices of 'connected' visitors (see Section 2.10.2). However, with an increasing adoption of novel digital tools, hence a progressing innovation and change of local tourism mobility systems, the importance to adapt and digitally up-grade local management and governance structures to fit the digitalising tourism mobility systems comes into focus in reviewed literature (see Section s 2.10.3 and 2.10.4).

2.1. Shifting Mobilities Paradigm

> All the world seems to be on the move. Asylum seekers, international students, terrorists, members of diasporas, holidaymakers, business people, sports stars, refugees, backpackers, commuters, the early retired, young mobile professionals, prostitutes, armed forces – these and many others fill the world's airports, buses, ships and trains. (Sheller and Urry, 2006, p. 207)

One key word in spatial studies is 'globalisation', which describes a situation in which "the world system […] has become so generalised that all aspects of economic, and consequently, social life are interconnected on a global scale." (Byrne, 1998, p. 91). The progressive ease and frequency with which people, goods, and information can travel great distances undermine conventional concepts of time and space. Harvey (1990) formulated the notion of 'space-time compression', arguing that, based on the decreasing costs and increasing usage of electronic information exchange, a "shared immediacy and 'virtual' togetherness"

(Osterhammel, Petersson and Geyer, 2005, p. 8) is created. This togetherness provides the basis for worldwide social relations, networks, and systems, within which the effective distance is considerably smaller than the geographical distance.

The tourist is one manifestation of globalisation (Urry, 2002). Overall, travel has never been cheaper and easier than it is today; nevertheless, the sojourn of a person is “still a matter of fate” (Osterhammel, Petersson and Geyer, 2005, p. 149) between people with the opportunity to embrace mobility voluntarily, those who are limited by financial, political, or social constraints, and those who are forced to move.

In 2018 there were 1.4 billion tourist arrivals (UNWTO, 2019a), 4.3 billion air passengers (ICAO, 2019), 68.5 million people forcibly displaced from their homes (UNHCR, 2019), and 21.3 million refugees (UNHCR, 2016).

The phenomenon of mass movement accelerated during the 1990s (Sheller and Urry, 2016) and triggered a reconsideration of spatial mobility, its patterns, and manifestations. What is now considered the ‘mobility turn’ was manifested in a ‘mobilities’ perspective on the ‘network society’ (Hannam, Butler and Paris, 2014; Faist, 2013; Castells, 2001). Geographical space was replaced by highly complex spaces of corporeal but also immaterial and virtual flows.

However, the boundaries of corporeal, immaterial, and virtual movement are increasingly blurring, as is the meaning of mobilities. Therefore, it is vital to distinguish movement from mobilities and gain insights into the paradigm behind the notions.

Cresswell (2006, p. 2) considers the factum, type, strategies, and social implications of ‘movement’ and defines it as “the idea of an act of displacement that allows people to move between locations”. Thus, ‘mobility’ refers mainly to the socially produced motion Cresswell understands through three relational moments:

- Mobility as potentially observable motion, a “brute fact” (Maksim, Bergman and Ohnmacht, 2016, p. 37)
- Mobility conveyed through representational strategies (literature, laws, films, medicine, etc.) that make sense of the movement through a common ideological production of meaning
- Mobility as an “irreducible embodied experience; it is a way of being in the world” (Cresswell, 2006, p. 4)

Urry and Sheller’s (2006) ‘new mobility paradigm’ questions and incorporates these new, anomalous ‘facts’ of mass movement and multiple mobilities – facts that did not make sense within, and indeed challenged, the ‘old’ paradigm. Following Kuhn’s (1996, p. 46) notion that “paradigms may be prior to, more binding, and more complete than any set of rules for

research that could be unequivocally abstracted from them", Urry and Sheller's (2006) new paradigm tried fundamentally to recast the debate: "if the paradigm changes, so too will the methods of that science." (Sheller and Urry, 2016, p. 11).

While the 'old' mobility paradigm emphasised that,

> "all places are tied into at least thin networks of connections that stretch beyond each such places and mean that nowhere is an island, the 'new mobility paradigm' argues against the ontology of places and people" (Hannam, Butler and Paris, 2014) and is intended to be a part of a […]"

broader theoretical project aimed at going beyond the imagery of 'terrains' as spatially fixed geographical containers for social processes" (Sheller and Urry, 2006, p. 209).

Mobilities in this paradigm cover a broad-ranging generic sense of physical movement, movement embraced by technologies, multimedia movement of images and information, and even "immobile infrastructures that organise the intermittent flow of people, information, and image, as well as the borders or 'gates' that limit change and regulate movement or anticipate movement" (Sheller and Urry, 2006, p. 212).

Thus, the 'new' mobility paradigm does not seek to provide a totalising, reductive description of the contemporary world but suggests a set of questions, theories, and methodologies for a new configuration of applied mobilities research.

When considering social practices and mobilities, Sheller and Urry (2016, p. 13) emphasise the "unstable and ever-changing interrelation of places, persons, technologies and nature connected through performances and practise". Integrating these notions into mobilities research enables the investigation of the transformation of a wider set of social practices regarding mobility changes in the past, the present, and the future, far beyond mere transportation behaviour and choice. The 'new mobilities' approach is emphasised to understand holistically the movement of people, objects, capital, and information on a global scale, and to interrelate the global with the local processes, daily routines, and everyday movement of material goods (Hannam, Sheller and Urry, 2006).

The global underlies a prolonged and wieldy 'placeless' evolution, but influences and potentially pressures the local, which is subject to rapid changes and is highly interdependent with places. Robertson and White (2003) adopted the term *glocalization* to emphasise that global trends always impact on local communities that are required to 'absorb' trends and find ways to integrate them into their local system.

This research responds to the need to take a holistic approach to studying mobility systems comprehensively and their functioning on multiple levels and across diverse social practices.

2.2. Tourism and Its Mobilities

> […] those studying tourism neglected cities, while those studying cities neglected tourism (Ashworth and Page, 2011, p. 2)

The tourism and transportation sectors have traditionally pursued separate goals. Transportation (and urban planning) typically consider tourism as a peripheral phenomenon that is more an economic pursuit and only one of many forms of urban utilisation. The significance of the city as a gateway and destination is largely ignored (Ashworth and Page, 2011).

> Although tourism plays a major role in the management of cities as both instrument and outcome of policy, it is thus doubtful if urban tourism planning exists in the same discrete sense as other sectoral planning, such as for transport or housing. (Ashworth and Page, 2011, p. 13)

The tourism sector perceives transportation as a logical prerequisite rather than an integral part of the touristic utilisation of a place, and often simply relies on the provision of functioning infrastructures by other actors. Even the touristic upgrade of mobility solutions onsite is mainly considered mere investment and not an opportunity for visitor management (Scuttari, Lucia and Martini, 2013a).

Although the existence of relationships between tourism and mobility seems self-evident (Lew and McKercher, 2006), corporeal touristic mobility seems so obvious that it is often forgotten by tourism and transportation studies (Haldrup, 2004; Urry, 2002). Only with growing pressures on destinations did the necessity to establish a joint tourism mobility perspective become apparent and lead to new partnerships, tools, and changing attitudes in favour of more sustainable modes of transport and travel alternatives (Gronau and Kagermeier, 2004; Scuttari, Lucia and Martini, 2013b).

However, prior to a joint discussion of tourism mobility, the individual components of the ‘system of systems’ need to be defined and understood.

2.3. Defining Mobility

When discussing ‘mobility’ one can refer to the Oxford dictionary and define ‘mobility’ as “The ability to move or be moved freely and easily” (OUP, 2023). This definition, in core reflects the generalisation necessary for a succinct, one-line definition of a polysemous, ambiguously abstract term. Thus, the discussion of the actual movement of something or someone, requires an a priori consideration of the prerequisites, such as physical abilities, psychological state of

a person and an outline of the numerous frameworks enabling movement (technical, social, economic, etc.) as well as the overall determination of type and mode of the notion under consideration. All these parameters influence the decision or elicitor of where, when and how to move (Hoppe and Michl, 2018).

Urry and Grieco (2016, p. 92) use a three-dimensional approach towards the definition of the term mobility and distinguish between spatial mobility as the “manoeuvrability of individuals and objects within a physical-geographical space the includes constraints in time and space”, socio-spatial mobility covering the availability of opportunities to fulfil needs (eat, sleep, work, etc.) and the socio-cultural mobility which refers to the changing social positioning.

For this study spatial movement is in the centre of discussion. However, due to the cross-sectoral character of innovating tourism mobility systems aspects of social mobility, economic mobility and virtual mobility are also reflected in the discussion (Urry and Grieco, 2016; Warschauer, 2003).

2.4. Defining Tourism

William and Shaw (1991, p. 8) observed that “the definition of tourism is a particularly arid pursuit” but important to understand the nature, scope, impact, and magnitude of tourism (Page and Connell, 2006). Whereas, Urry and Rojek argue that tourism “embraces so many different notions that it is hardly useful as a term” (1997, p. 1).

Ever since, tourism shows a very strong conceptual and practical connection to mobility. Definitions of tourism always incorporate spatial aspects. In 1811 tourism was succinctly defined as

> “the theory and practice of touring; travelling for pleasure” (Tribe, 2009, p. 44).

In the 1900s, tourism slowly emerged as an academic field in universities of economics in mainly German-speaking countries (Stradner, 1905).

> “Tourism describes all, but mainly economic, processes, bound to inflows, sojourns and outflows of foreigners to, in and from municipalities, counties and countries” (Schrattenhofen, 1911, p. 437).

With a growing academic interest, tourism gained also more prominence in other academic fields leading to conceptualisations and discussions from geographers, sociologists, psychologist as well as anthropologists (Hall, 2005). These influences resulted in an increasingly versatility of tourism definition. Temporal and social aspects were incorporated,

and the sheer economy-centric focus lost on importance. Resulting in more holistic definitions such as

> "tourism is a sum of relations and phenomena resulting from travel and stay of non-residents, in so far a stay does not lead to permanent residence and is not connected with any permanent or temporary earning activity" (Hunziker and Krapf, 1942, p. 13).

A current definition of the UNWTO defines tourism as

> a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes. These people are called visitors (which may be either tourists or excursionists; residents or non-residents) and tourism has to do with their activities, some of which involve tourism expenditure. (UNWTO, 2023)

However, Hall et al. (2005, p. 31) note that "there is one troubling paradox associated with the dogma of definition: tourism is fluid and dynamic as a research object, yet definitions and conceptualisations […] remain static."

2.5. Defining the Traveller

The key actor tourism mobility systems revolve around is the traveller. Thus, it is essential to understand the characteristics and distinction of traveller, visitor and tourists.

Cohen (1974) points out that "tourism is an imprecise concept with blurred boundaries between tourist and non-tourist roles, and with many intermediate categories." Ross (2011) identified seven characteristics of distinction between the tourist and other travellers:

1. temporary: to distinguish it from the permanent travel undertaken by the tramp and nomad;
2. voluntary: to distinguish it from the forces travel of the exile and refugee;
3. round trip: to distinguish it from the one-way journey of the migrant;
4. relatively long: to distinguish it from the trip of the excursionist or tripper;
5. non-recurrent: to distinguish it from the recurrent trips of the holiday house owners;
6. non-instrumental: to distinguish it from the travel as a means to another end of the business traveller, travelling sales representatives and pilgrims
7. for novelty and change: to distinguish it from travel for other purposes such as study.

The institutionalised conceptualisation of travellers is, however, far more complex. Chadwick (1994) draws a basic distinction between residents and visitors, in considering a person to be a 'resident' of a place when the person has lived in that place for at least twelve consecutive

months “prior to his/her arrival in another place for a period not exceeding one year.” (Chadwick, 1994, p. 66). Whereas, a ‘visitor’ is a person travelling to a place that is not the place of his/her usual residence, but outside of his/her usual environment, with the purpose other than to exercise an activity remunerated from within the visited country, for a period not exceeding one year (e.g. tourist) (Theobald, 2005).

This study focuses on the visitor and understands the visitor as traveller who is taking a trip to a main destination, for less than a day, with the main purpose of engaging in leisure activities.

2.6. Drawing the Connection Between Tourism and Mobility

William and Shaw (1991, p. 8) observed that, “the definition of tourism is a particularly arid pursuit” but essential to understand the nature, scope, impact, and magnitude of tourism (Page and Connell, 2006). Urry and Rojek argue that tourism “embraces so many different notions that it is hardly useful as a term” (1997, p. 1).

However, the obvious interdependency of tourism and mobility was only encouraged by the idea of the ‘mobility turn’ (Urry, 2000). The ‘mobility turn’ asserts that the world is progressively structured by mobile flows, and with the increasing calls for a post-disciplinary theorisation, tourism saw a progressive transformation into being understood as a temporary form of human mobility (Hall and Page, 2006; Theobald, 2005; Hall, 2005).

> Tourism is, in essence, presented as a temporary form of mobility, and as such is roughly and conceptually analogous in scope and meaning to other forms of movement. (Coles, Duval and Hall, 2004, p. 464)

In accordance with one of the fundamental concepts in geography, namely “everything is related to everything else, but near things are more related than distant things” (Tobler, 1970, p. 236), Hall (2004) based his model of temporary mobility on the idea of distance decay.

A wide range of research fields has taken interest in this new form of mobility (Morley, Rosselló and Santana-Gallego, 2014; Lumsdon and Page, 2004). With the breakthrough of new technologies and the increasing availability of spatio-temporal data on individual movement, the body of literature exploring the gravitational approach to tourism mobility has especially grown and diversified, with contributions from disciplines such as geography and urban planning (Morley, Rosselló and Santana-Gallego, 2014; Hall, Smith and Marciszewska, 2006; Silberman, 2012). However, tourism research has predominantly focused on the conceptual singularity of tourism as an economic pursuit and largely neglected to integrate any alternative viewpoints on tourism.

Based on the ground-breaking work on tourism mobilities by Sheller and Urry (2004) and Hall's (2004) gravitational approach towards tourism, this study understands tourism, not just as a form of mobility, but, as tourism informs and is informed by other mobilities, it involves a multimodal movement of people, tangible materials, and objects, as well as intangible thoughts and fantasies. Furthermore, tourism and touristic movement are increasingly penetrated by and already strongly rely on digital and mobile technologies, which add the layer of virtual movement into the conceptualisation (Hannam, Butler and Paris, 2014).

Given this new paradigmatic view and the reconceptualisation of tourism as a form of mobility, the ontology of tourism mobility is becoming blurred. Demarcating tourism mobility within the tourism system and, within the city system, is an essential aspect for eventually gaining a clear understanding of the scope and structure of tourism mobility, as well as of the relevant innovation processes of this socio-technical system.

2.7. Tourism Mobility Systems on Destination Level

Like the definition of 'tourism' the holistic concept of a 'destination' seems to be comparably difficult to compress into just a few lines. The concept of a destination is, however, a multi-disciplinary concern and can be found among other in humanities, social sciences and natural sciences. This study limits the focus only on tourist destinations, once defined by the UNWTO as an important place visited by tourists and outlined by geographical (geographic or administrative boundaries), economic (expenditures by tourist and relevance of tourist income for region) and psycho-graphical (to see the place is the main reason for the journey) attributes (Inskeep, 1994).

In 2002 the World Tourism Organisation conducted a forum including academic institutions and destination management organisations with the goal to reach a consensus on the framework of a tourism destination. The think tank came up with the following definition of a local tourism destination:

> a physical space that includes tourism products such as support services and attractions, and tourism resources. It has physical and administrative boundaries defining its management, and images and perceptions defining its market competitiveness. Local destinations incorporate various stakeholders, often including a host community, and can nest network to form larger destinations. They are the focal point in the delivery of tourism products and the implementation of tourism policies." (Lew and McKercher, 2006, p. 405)

However, this framework is a step towards a conceptualisation of destinations as a local entity including cities, towns and regional areas; it excludes, however, resort complexes as well as states, provinces, countries and multinational agglomerations.

When considering the structure of a destination from a mere anatomical view point Gunn's Destination Zone model comes to mind (Gunn and Var, 2002). For Gunn (2002, p. 202) "the greatest imperative for all tourism is place." Referring to Motloch's (2000, p. 242) definition of 'place' as "the mental construct of the temporal-spatial experience that occurs as the individual ascribes meaning to settings, through environmental perception and cognition." Gunn and Var (2002) point out that the qualities of a place are absolute for all components of supply, including services, facilities, transportation, information and promotion and take a community-centric approach to model a Destination Zone. Gunn (1988) was one of the first researchers to explore tourism as a functional system which highlights the role of micro-movement within the destination as well as the role of gateways of the destination.

The evolution of tourism as form of mobility has conditioned the destination as facilitating place, providing meaning, reason, and context for movement. While touristic macro-movement and inter-destination mobility are well examined study areas, in relation to management (Hall and Page, 2009; Hall, Ram and Shoval, 2017), sustainability (Tideswell and Faulkner, 1999; Hawelka et al., 2014), political and economic issues (Rickly, Hannam and Mostafanezhad, 2016; Hall, 1994; Williams and Hall, 2002), "the relationship [of tourism mobility] at the destination is less clear" (Prideaux, 2000, p. 54).

Initial work to better understand micro-movement patterns at the destination was dominated by studies in confined destinations, such as national parks, heritage sites, theme parks or museum areas (Orellana et al., 2011; Chrysanthi, 2012; Smallwood, Beckley and Moore, 2012; Solmaz, Akbaş and Turgut, 2012; Kanda et al., 2007). Lew and McKercher (2006) pioneered research on intra-destination movement within urban environment. They based their research on urban transportation modelling and highlighted that both, destination characteristics as well as visitor characteristics influence decision-making and mobility behaviour in space and time. Thus, for a better understanding of change processes of tourism mobility it is crucial, not only to discuss the act of touristic-motivated movement, but to comprehend the concept, composition and characteristics of the 'enabling, mobilised place' (Sheller and Urry, 2016), which is in this case the destination.

2.8. Public Transport in Destination Systems

Research on intra-destination movement also identified the availability and quality of transportation infrastructure as decisive factor for mobility mode choice (Lew and McKercher, 2006). In Europe the car is still considered one of the lead mobility modes for inter-destination movement (EC, 2023). A mode which is also considered a significant generator for CO2-emissions. However, in recent years the relevance of public transport for intra- but also inter-destination movement is gaining on importance (Cohen, Higham, Peeters & Gössling, 2014). Especially, policy agendas such as the European Green Deal and the 'Sustainable and Smart Mobility Strategy' by the European Commission are driving the development of sustainable, smart and affordable mobility infrastructures on national level (Le-Klähn, Hall, 2015; Gühnemann, Kurzweil and Mailer, 2021). Non-motorised transportation modes (e.g. e-mobility, bicycles) and public transport are perceived as the most promising alternative modes to reduce transport emissions of touristic mobility (Dickinson, Robbins, & Fletcher, 2009; Dubois et al., 2011; Filimonau, Dickinson, & Robbins, 2014).

However, research indicates a clear divide between the potential utilization of public transport in rural and urban areas (Tomej, & Janne, 2019). Tourism mobility in rural areas is still dominated by individual traffic, mainly the car. This mode choice can be explained on one side by a generally poor supply of public transport options in rural areas with infrequent services, and on the other side by the fact that attractions in rural areas are often scattered or located at remote places (Li, Tao, & Lu, 2023). With the increasing use of OMTs, also novel mobility approaches such as intelligent multimodal mobility services (e.g. Mobility as a Service (Maas) emerged and proved to provide a technical framework for public transport solutions also in rural areas (Mulley, Nelson, Ho, & Hensher, (2023). Intelligent multimodal mobility solutions for public transport are also considered as promising aid to ease the last/first mile issues which also concerns urban tourism (Zehetgruber, 2019; Ilieva and Pepa, 2018¸Yang, Li,D., & Li, X. 2019).

In contrast to rural areas, transportation systems in urban areas comprise a variety of public transportation modes, such as train, tram, metro, bus and shared mobility services. Thus, the mode choice of visitors in urban areas is less dependent on the availability of public transport but on other factors, such as availability, accessibility and user-friendliness of information on public transport services (Le-Klähn, Roosen, Gerike, & Hall, 2015), convenience and attractivity to drive and park a car in the destination (Le-Klaehn, Gerike, & Hall, 2014), purpose and length of the visit, physical and language barriers as well as personal preferences of the visitor (Le-Klähn, Roosen, Gerike, & Hall, 2015). With the increasing use of OMTs and MaaS solutions, digital skills and habits are also increasingly shaping the mobility mode choice of visitors (Martinčević, Brlek, & Domjan Kačarević, 2022; Porru, et al., 2020).

Encouraging behavioural change of visitors towards shifting to public transport use is considered the key to establish a more sustainable tourism mobility system in rural as well as urban areas. However, research also highlights the importance of concomitant policy frameworks that support and substantiate innovation activities of public transport systems to make them fit and attractive for enhanced touristic use (Le-Klähn, Hall, 2015). For the development of successful and sustainable policy frameworks several challenges must be overcome. These challenges include the establishment of trust among actors as well as partnership and suitable collaboration structures of multiple stakeholders from diverse sectors. In addition, significant institutional barriers, such as data ownership or rules for revenue sharing must be overcome (Gühnemann, Kurzweil and Mailer, 2021).

2.9. Tourism Mobility in Historic Cities

In the context of the historic city, tourism mobility systems are confronted with and additional challenge, the need to blend into historic fabric and at the same time allow a sustainable but attractive touristic exploration of the site (García-Hernández, De la Calle-Vaquero, & Yubero, 2017).

Tourism may offer a range of opportunities and the promise of economic growth. However, it is also an invasive force, volatile, unstable by nature, fashion driven, afflicted by political agendas and perceptions, conditioned on external environments, and exposed to unforeseeable social or natural events.

Orbasli (2000, p. 128) states that "[…] tourism is a consumer of natural environments, historic buildings, urban spaces and local culture, all of which they have once been spoilt by overcrowding and overdevelopment, face the danger of being abandoned in favour of fresh and unspoilt destinations."

The historic city is a contemporarily created phenomenon mainly shaped around urban forms and fabrics of the past and feed by intangible heritage creating a spirit of place (Mitsche et al. 2013). Nonetheless, historic cities, considered in this study, are modern cities with "both the past and the future [being] intrinsic characteristics in the modern city." (Ashworth and Tunbridge 2000, p. 2). While history has become heritage and heritage has become an urban resource, the 'past' has never been more accessible but also vulnerable than ever before (Lowenthal and Till, 1997). Tourism providers widely perceive historic sites and cities as sellable products. Nonetheless, the historic city continues to be a living entity; a modern city marrying the past and the future with all its functions, problems, opportunities and challenges for management and planning (Ashworth and Tunbridge 2000).

2.9.1. UNESCO World Heritage Sites

As an aiding tool for the management and planning of historic cities and with the focus on the protection and preservation of heritage sites the 'Convention Concerning the Protection of the World Cultural and Natural Heritage' (UNESCO, 1972) was adopted by the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972. Based on the Convention the UNESCO periodically releases updated operational guidelines (UNESCO, 2021) as well as management guidelines (Feilden & Jokilehto, 1998) for UNESCO Listed World Heritage Sites (WHS). As part of the management guidelines also urban planning and visitor management aspects are outlined, which highlight the need for a periodic assessment and strategic management of transport, traffic, and visitor movement on-site to warrant the conservation and protection of the historic fabric (Feilden & Jokilehto, 1998).

In literature, research relating to tourism mobility in WHS focuses on communication and interpretive aspects to convey information to visitors on-the-go (Ramires, et al. 2018; Shackley, 2001), more recently also on digital transformation aspects for heritage interpretation in WHS (Cantoni, 2020; Weng, Liang, & Bao, 2020), conservation issues (Staiff, & Bushell, 2013), as well as sustainability issues in WHS which predominately relate to visitor movement management, access control and emission levels of touristic visits (Streifeneder, & Omizzolo, 2017; Babri, et al., 2022; Mousazadeh, et al., 2023; Cavallaro, et al. 2017). In addition, research on pedestrian movement in WHS with focus on movement patterns and walkability (Rahman, Ismail, & Wai, 2011; Noraffendi, & Rahman, 2020) as well as facilities for 'walking visitors' (Ghani, Shimizu, & Mokhtar, 2015; Zainol, et al., 2014) outline the relevance of urban form and infrastructure for place consumption and purposive visitor movement management.

Overall, identified literature related to movement and mobility aspects in WHS highlights the intrinsic need to preserve and safeguard local heritage which are increasingly put under pressures from globalisation developments (e.g. significantly increasing numbers of visitors), safety issues (e.g. wars) or environmental challenges (e.g. increasing CO2-emissions, consequences of climate change). However, the guiding principles of the WHS program, in combination with the concomitant awareness and conveyance of the significant value of the heritage at the individual sites, seem to drive a more considerate and sustainable touristic development and utilization of sites. Strategic touristic mobility planning and management emerges as one of several factors warranting a balanced and healthy touristic utilization of sites.

2.10. Investigating the Innovation of Tourism Mobility Systems

To identify literature discussing the innovation processes of tourism mobility systems, a comprehensive literature review was conducted. Overall, 123 academic publications published were reviewed. The search was based on key terms and phrases, including ‘tourism mobility’, ‘tourism mobility systems’, ‘socio-technical tourism mobility system’, ‘innovation of tourism mobility’, ‘transformation processes of tourism mobility’, and ‘digital transformation of tourism mobility’. Relevant referenced papers from reviewed papers were also included in the literature review. However, no publication could be identified that explicitly investigated innovation processes of tourism mobility systems using a socio-technical system approach. Thus, related publications that support the argument for this study were reviewed. Overall, an additional 66 papers were identified using key search terms such as ‘socio-technical mobility systems’, ‘innovation of mobility systems’, ‘transformation processes of mobility systems’, and ‘relevance of tourism in mobility systems’.

The review revealed that, over time, the research focus on innovation processes changed. The reviewed literature can be sequentially classified into four main thematic periods:

1. a techno-centric approach in which the capabilities of new technologies for the management of touristic movement are explored (see 2.10.1)
2. a visitor-centric approach with a strong focus on the utilisation of online technologies and the effects on visitor behaviour, visitor experience, and place consumption (see 2.10.2)
3. a discussion on the sustainability implications of tourism mobility, in which the relevance of tourism mobility management in destinations and Smart City systems is explored (see 2.10.3)
4. the relevance and necessity to amend governance structures and also take an institutional approach towards tourism mobility (see 2.10.4)

The first three research foci constitute the largest body of relevant literature, whereas the discussion on the institutionalisation-related aspects of innovation processes of tourism mobility systems is the most recent and least investigated research area. In the following section, each individual research focus is outlined, and the implications for this study are highlighted.

2.10.1. Exploring the Capabilities of New Technologies for Tourism Mobility

A wide range of the literature indicates that exploring tourism mobility and investigating its evolution were initially triggered by growing touristic pressures on destinations (Glasson, Goodey and Godfrey, 1995; McKercher, 1993; Farrell and Marion, 2002) and the increasing need to understand better the relevance of touristic mobility in environments (Williams and Hall, 2002; Hall, 2003; Coles, Duval and Hall, 2004).

In the pre-online-technology age, pioneering work that established a basic understanding of the movement behaviour and patterns of visitors on the go laid the foundation for future tourism mobility research (Debbage, 1991; Keul, 1996; Tideswell and Faulkner, 1999). With the rapid diffusion of new technologies, tourism mobility research shifted towards a techno-centric debate on the feasibility and usability of novel technical solutions as methods to generate increasingly detailed data on visitors who travel (e.g. tracking, data-mining, geocoding) (Xu, et al., 2021; O'Connor, Zerger and Itami, 2005; Ratti et al., 2007; Girardin et al., 2010). Large numbers of sensing and tracking data on the whereabouts and movement behaviour of visitors were generated during this phase. These data also enabled highly accurate and detailed analysis of touristic mobility regarding destination (Raun, Ahas and Tiru, 2016; Ainhoa et al., 2017; Girardin et al., 2008; Ratti et al., 2006; Yoshimura et al., 2012). These novel digital insights confirmed already existing models of touristic mobility behaviour, which were elaborated by using analogue research methods (Lau and McKercher, 2006; McKercher et al., 2011) and which highlighted the significance of tourism mobility as a central aspect of destination and city management (Dye and Shaw, 2007; Kramer et al., 2007). However, at this stage, the concept of tourism mobility was considered predominantly an academic pursuit, and hardly any activities to innovate tourism mobility systems in destinations took place.

With the breakthrough of OMTs (mainly the smartphone), this situation changed. These OMTs opened a plethora of novel possibilities to communicate and convey information to the visitor on the go. These unprecedented possibilities to communicate with the visitor on the move were perceived as a 'game-changer' (Sheller and Urry, 2006; Dickinson et al., 2012) and led to a shift from a techno-centric research focus towards a user-centric one that prioritised the investigation of the effects and implications of ubiquitous, online mobility technologies on involved tourism mobility system actors (Dickinson et al., 2013).

2.10.2. The Digitalisation of Tourism Mobility

A core focus of the study of digitally induced innovation process in current socio-technical systems is on the user (Střelák, Škola and Liarokapis, 2016; Cheng and Xu, 2018; Collison, 2011). The user is perceived as the socio-technical regime actor most affected by OMTs (Verkasalo, 2010), which triggers substantial behavioural changes.

A wide range of studies has examined the effects of new mobile technologies on the touristic mobility and place consumption behaviour of individuals. Although business and marketing studies dominate this research focus (Wang, Park and Fesenmaier, 2012; Dickinson et al., 2012; Kim and Han, 2014), these rather specific findings have a multitude of implications for tourism mobility management and add to a better understanding of change dynamics and digitally induced impacts on a destination level.

Mackay and Vogt (2012) indicate that the digital skills of individuals are rapidly advancing and are obtained on a trial-and-error basis during the everyday use of OMTs. Continuous OMT penetration is fundamentally changing the routine behaviour of users. However, these behavioural changes are not just relevant for established, daily routine situations, habits, or skills of people, but have also been identified as 'spilling over' into non-routine situations, such as travelling or exploring new places. Behavioural changes, which have been identified as most relevant within the innovation processes of tourism mobility systems, cover, among others, a significantly increasing communication frequency and volume of 'connected' visitors, which implies the necessity for destination management to provide the 'connected' visitor with sufficient digital and analogue material while exploring the site (Wang, Xiang and Fesenmaier, 2016). Furthermore, the constant accessing of large amounts of information leads to a 'filling-up' of all downtime while visiting a place. In particular, research has found that breaks are mainly used to generate even more information about the destination, for ad-hoc decision-making, to solve problems occurring on the go, or to simply be entertained (Wang, Xiang and Fesenmaier, 2016). The combination of pervasiveness, large amounts of accessible information, and sophisticated recommendation functions – be they digital (e.g. recommender algorithms) or inter-human (sharing, rating platforms) – triggers unprecedented ad-hoc decision-making on the move (Paulson, 2017). Thus, 'connected' visitors demonstrate volatile, highly spontaneous, and fairly unpredictable behaviour, not only in cyberspace, but also in the corporeal environment (Dickinson et al., 2012). Although studies have highlighted these highly relevant behavioural changes of 'connected' visitors, discussions on the implications of these changes for tourism mobility management and innovation processes of tourism mobility systems are scarce.

Changes in movement and the place consumption behaviour of ‘connected’ visitors have been more comprehensively addressed in the heritage interpretation and information and communication technologies (ICT) field.

A rather large body of literature discusses innovation activities and the underlying processes for the digitalisation of analogue interpretation approaches at sites (Kidd, 2019; Falk and Dierking, 2016). Studies have revealed that digitally enhanced communication with visitors evolved from a linear model to a ‘transactional’ model, in which “information is devised, discussed and interpreted in a circular process, allowing the audience to move from a passive to an active role” (Hooper-Greenhill, 1994, p. 15). These changes created a new generation of heritage consumers, namely a ‘prosuming’ audience, which is both ‘producer’ and ‘consumer’ (Dusi, 2016). Although some studies have discussed the cause and effects of these behavioural changes on consumption and movement behaviour (Kidd, 2019; Jen, 2018), no studies could be identified that investigated the role of ‘prosuming’ visitors within the tourism mobility stakeholder structures (regime), nor the relevance and impact of these changes regarding the innovation and change dynamics of tourism mobility systems.

However, a large body of literature exists that addresses the digitalisation of heritage and place interpretation. Overall, the concept of interpretation has remained essentially the same and comprises essential processes and methods of communication to convey the significance of a place to a visiting audience, as well as to help them experience the place in a way they might not be able to without that interpretation (Hammitt, 1984; Wollrab, 2015). The breakthrough of OMTs has opened new interpretive possibilities.

Studies have revealed that early OMT-supported interpretation implementations tended to focus on demonstrating new technical gimmicks to communicate with visitors but often neglected the stories to be told and meaning to be conveyed (Champion, 2008; Huggett, 2003). However, with the growing diffusion of OMTs into everybody’s lives, the focus on the mere use of novel technologies faded and the stories gained centre stage again (Alexander, 2011).

There is a large body of studies dedicated to understanding better this synchronisation of novel, digitally enhanced communication tools and ‘old’ stories. Most studies originate from marketing and communication sciences, heritage interpretation, and business studies. These studies provide insights into the cognitive-communication potentials of interpretive OMTs, which significantly increase user experience, engagement, and learning processes (Williams, 2013; Falk and Dierking, 2016). However, analysis of the direct effects of digitally enhanced interpretative solutions on touristic mobility is relatively scarce. This neglect is mainly ascribed to the unavailability of micro-movement data for ‘connected’ visitors in built environments,

which are necessary to cross-reference interpretive measures, place-consumption patterns, and movement patterns (Al-Subhi, Bell and Lashmar, 2015).

With the growing diffusion of digitally enhanced interpretative tools and a concomitant growing adoption rate of these tools by 'connected' visitors, the availability of micro-movement data, which could also be related to qualitative aspects of place consumption (e.g. through data-mining of social media posts), has also grown. These newly available insights have proved highly valuable for strategic discussions regarding digitally enhanced tourism mobility and visitor-movement management at destinations (Scholochow, Fuchs and Höpken, 2010).

2.10.3. Sustainability as a Driver for the Strategic Innovation of Tourism Mobility

The discussion regarding the relevance of tourism mobility as an aid for enhancing the sustainability and efficiency of destination and urban management was not new (Glasson, Goodey and Godfrey, 1995; Russo and van der Borg, 2002). However, rapidly progressing digital innovation processes on a destination level made it imperative for research to understand the interrelations, potentials, and challenges of digitally enhanced touristic mobility within destination systems.

In the reviewed literature, the majority of research discusses digitally supported managerial possibilities to minimise tourist impacts on the destination, including visitor access and flow management to ease overcrowding and over-touristic destination usage (Ko, Albert and Bernadett, 2018; Namberger et al., 2019). In this context, the relevance of gateways was rediscovered as a management tool for tourism mobility management. The first conceptualisation of gateways dates to the 1970s (Burghardt, 1971) and dealt mainly with their implications regarding the internal functions of the destination (Warnaby, 2009; Lohmann, 2009). In particular, the role of gateways in the context of visitor-impact management was thematised, mainly considering gateways as a restraining bottleneck to control touristic streams (Clivaz, Hausser and Michelet, 2004; Straaten, Borg and Trumbic, 2001; Jovicic and Dragin, 2008). However, with the innovation of tourism mobility systems, the role of gateways for the provision of pre- and post-tour experiences (Lew and McKercher, 2002), as well as in the context of the last/first mile issue, was increasingly thematised (Zehetgruber, 2019; Ilieva and Pepa, 2018). The last/first mile problem refers to the limited availability of mobility options offered to complete or start a journey by public transport (EEA, 2020). With the digital innovation of tourism mobility systems but also with a growing focus on climate change issues (Guehnemann, Kurzweil and Mailer 2021), new mobility solutions, such as MaaS (Mobility as a Service), multimodal route planning, and mobility sharing services, came into the focus of

research (Signorile, 2018). These studies were mainly case-based and lacked conceptual discussions. Nevertheless, the findings of these case analyses revealed that digital tools had matured enough to be utilised at destinations and displayed great potential to enable novel approaches to address existing challenges of local mobility and destination systems. However, the findings repeatedly highlight the need to innovate management structures to accommodate novel digital solutions (Scuttari, 2019; Albrecht, 2017).

The growing awareness of digitally induced challenges for existing management approaches triggered a change of perspective regarding destination and tourism mobility systems. Atomistic discussions of isolated destination functions, such as visitor movement, were argued to be ineffective due to the increasing interconnectedness of actors, but also due to the changing motives and priorities regarding the use of destinations (Pearce and Schanzel, 2013; Sheehan et al., 2016; Ivars-Baidal et al., 2019). Thus, the management of digitally enhanced destinations and tourism mobility systems was largely embedded into the overarching discussion on Smart Cities and Smart Mobility systems. With this shifting research angle, the perspective on contemporary destination and tourism mobility systems also evolved further. Since the Smart City approach is based on the assumption that technology is part of the system and not an additional element in performing urban activities (Rosa Anna La, 2015), a system-centric discussion was introduced, which provided process-orientated insights into mechanisms of innovation dynamics.

‘Smartness’ debates led to overall reconsiderations of city systems, their functions, stakeholder structures, and innovation processes. However, for tourism mobility research, this new perspective provided the opportunity to progress with a systemic discussion of the role, function, and integration of tourism mobility management to enhance the ‘smartness’ of destinations.

‘Smart’ concepts allow a system-thinking approach (Freeman, Yearworth and Cherruault, 2014). This approach focuses on how constituent parts of a system interrelate and analyses their linkages, perspectives, and boundaries while maintaining a holistic view of the overall system dynamics. Under this perspective, tourism mobility and tourism mobility management are frequently mentioned issues in the study of Smart Destinations and Smart Mobility systems (Ivars-Baidal et al., 2019; Gretzel and Scarpino-Johns, 2018; Boes, Buhalis and Inversini, 2016; Hall and Williams, 2019). However, no in-depth analysis dedicated to a detailed understanding of tourism mobility systems within Smart Cities or Smart Destinations was identified during the literature review.

Nevertheless, a comparative review of literature on digital transformation processes in Smart Destinations identified innovation dynamics and challenges for tourism mobility management in the ‘Smart City’ context.

(1) Existing infrastructures, including physical and cyber-physical infrastructures, such as digital, transportation, and urban infrastructures, as well as soft infrastructures such as operating systems and human resources, are continuously under pressure to upgrade (OECD, 2020a; Lamsfus, 2013; Gretzel and Scarpino-Johns, 2018). The provision and upgrade of necessary infrastructures is a key challenge for management organisations and local authorities. The scope of necessary upgrades and installations of infrastructure systems (e.g. broadband, 5G) often goes far beyond the capabilities of management organisations and authorities at the destination and requires cooperative, multi-stakeholder solutions (Gretzel et al., 2015) and are closely linked to governance structures (see Section 2.10.4.). Furthermore, the speed of digital infrastructure upgrades is considered a challenge for financial resources and local expertise (OECD, 2020a; Ozseker, 2019; Guerreiro, 2019).

(2) All-encompassing, digitally induced change processes highlight the fragmentation of tourism and mobility management structures (Guerreiro, 2019) that is commonly embedded in long-established stakeholder structures of destinations. These entrenched stakeholder structures, which seem difficult to address, are a key challenge for achieving a balanced and attuned innovation of the joint tourism mobility systems (Sheehan et al., 2016; Moradi and Vagnoni, 2018; Abou-Shouk, 2018; Ivars-Baidal et al., 2019).

(3) However, not only established stakeholder structures seem increasingly inadequate to deal effectively with an innovative tourism mobility system, but also existing business models, practices, and cultures need to be amended to fit a digitally penetrated city system (Abou-Shouk, 2018; OECD, 2020a).

(4) Some studies have also highlighted that the perceived risks dominate the perceived benefits of applying and integrating new technologies into established management structures. This attitude towards new technologies is a key barrier that hinders a progressive and proactive pursuit to transform business and management structures digitally and, eventually, governance and regulatory structures (Guehnemann, Kurzweil and Mailer 2021; OECD, 2020a; Dredge et al., 2019). However, research on organisational and institutional technology acceptance (Abou-Shouk, 2018; Kim, Park and Morrison, 2008; Fuchs, Höpken and Rasinger, 2011) regarding the use and integration of OMTs into management and governance structures is very limited, and the underlying dynamics are not clearly understood.

Despite the investigation of transformational processes of destinations and tourism mobility systems being in its infancy, some studies agree that the next necessary, evolutionary step in

the innovation process concerns the inevitable transformation of governance and regulative structures (Dredge et al., 2019; Hall and Williams, 2019; Saarinen and Gill, 2018; OECD, 2020a).

2.10.4. Institutionalising Innovation

> Governments have an important role to play in creating the right framework conditions for the digital transformation […] of the wider tourism ecosystem. Integrated and coherent policy approaches are needed to leverage the opportunities of digitalisation while also addressing challenges and minimising any negative consequences that may emerge. (OECD, 2020a, p. 84)

Although dedicated governance implications of digitally transforming tourism mobility systems were not identified in the literature, publications on Smart Destination innovation processes provide an outlook on governance issues and suggest a 'set of trajectories' for future transformation processes. These trajectories include suggestions that governments should actively champion the digital transformation process and take the leading role in creating new business models, value chains, and ecosystems (Mayer and Acuto, 2015; Saarinen and Gill, 2018). Furthermore, a strategic and cooperative approach to enhance investments into new digital technologies is considered inevitable and emphasises the necessity to create a solid basis of know-how and skill sets and to develop a structured experience and knowledge-exchange platform (Saarinen and Gill, 2018; OECD, 2020a). Also Lundvall (1992) argues in the national system of innovation approach that not only technology but the flow of knowledge and information among actors and institutions is a fundamental resource driving innovation. Furthermore, clear governance structures reduce uncertainty and create trust which is argued to be beneficial for innovation. Another suggestion concerns the role of governance in innovating business models, which are considered "the lever to optimise the benefits of digital transformation" (OECD, 2020b, p. 8).

Despite the fact that the governance of innovation has been subject of some research, no relevant research on tourism and tourism mobility could be identified in the literature review.

2.11. Chapter Conclusion and Key Findings

The literature review on tourism mobility and movement research highlighted several gaps in the understanding of contemporary tourism mobility systems and their innovation process.

Overall, it became apparent that the transformation of tourism mobility systems is rapidly progressing, and both research and practice are challenged by the speed and complexity of

system innovation processes. This characteristic of socio-technical tourism mobility systems makes a system-thinking approach inevitable to be able to grasp the holistic extent and dynamics of innovating tourism mobility systems.

From this perspective, an overview of the key findings in the above discussion is provided below, in addition to a consideration of the key implications for the study.

2.11.1. Conceptual Implications

In recent years, case-based research on tourism mobility systems has increased considerably. However, the conceptual debate is limited. In particular, the failure to develop a joint understanding of tourism mobility can be considered a significant factor hindering the advancement of tourism mobility as a key objective in terms of research, management and governance.

Although the call for a unified conceptualisation of tourism mobility is growing louder, key research has considered tourism a form of mobility (Hall and Page, 2006; Coles and Hall, 2006), transportation and movement as enabling factors for a tourist utilisation of spaces (Rosa Anna La, 2015; Scuttari, 2019), or tourism as a motivation to move (Larsen, Axhausen and Urry, 2006; Dickinson et al., 2013). These approaches have discussed interrelations and interdependencies of tourism and mobility; however, the discrete, complex socio-technical system of tourism mobility is yet to be analysed.

An essential challenge for the conceptualisation of contemporary tourism mobility systems is the lack of underlying frameworks incorporating digitally induced effects into system elements. As the review of literature outlined, research on tourism mobility has widely applied pre-OMT concepts. Although these concepts provide insights into the evolution process of tourism mobility, an adequate discussion of contemporary tourism mobility systems urgently requires a ‘conceptual digital transformation’ that addresses the interplay of the digital dimensions of tourism, mobility, the visitor, stakeholders, the destination, and innovation processes in the digital age**.**

2.11.2. Implications for the Innovation of Tourism Mobility

Investigating a transforming stakeholder structure

The literature review highlighted that research rapidly advanced the understanding of movement patterns, the underlying aspects that purposively influence mobility behaviour, the effects of tourism mobility on environments and social structures, and the role of tourism mobility in Smart Cities. Research has sought to introduce new technologies in destination or mobility systems to alter touristic movement and urban consumption. However, a comprehensive discussion of the underlying processes of digitalisation effects on the overall socio-technical tourism mobility system remains absent

Although stakeholder structures have been the subject of a considerable amount of research (Getz, 2008; Timur and Getz, 2009), studies focusing on tourism mobility system-relevant stakeholder structures are very limited. In particular, the articulation of a holistic stakeholder structure subject to digitally induced transformation processes has yet to be conducted.

Due to the ongoing character of the digital transformation of tourism mobility systems, only a snapshot of the system and its underlying elements can be created. However, insights into stakeholder structures in a time of transition (from analogue to digital systems) enable a view of the former setup and facilitate the capture of the co-evolutionary transformation of the stakeholder structure into the new configuration.

Pressures and drivers of tourism mobility systems

The literature review also highlighted that contemporary destinations and tourism mobility systems are subject to growing and changing pressures. These pressures are caused by globalisation developments, which mainly result in a growing volume of tourism mobility in European destinations. Furthermore, the increasing digitalisation of societies, environments, economies, and individuals pressures tourism mobility systems to keep up with digital innovations to remain competitive and attractive to the increasing number of ‘connected’ visitors.

These pressures have mainly been discussed in relation to the sustainability issues of destinations. Effects on local environments and communities, as well as the implications for management when addressing these pressures, have been a key focus. However, the potential of pressures as drivers for change has been less investigated.

Progressing the management and governance of tourism mobility

The literature review highlighted the limited academic focus on relating insights into movement patterns to destination management and the governance of tourist sites. Several studies have identified key factors shaping tourist movements, which are subject to planning, management, and governance activities (e.g. infrastructure, interpretive strategies, and planning and place-making approaches; (Chancellor, 2012).

A shifting focus toward Smart Cities, Smart Mobility, and Smart Destination has also opened up a more holistic perspective on underlying management and governance structures. However, this 'zooming out' to the holistic city system blurs the details of tourism mobility systems. Thus, the 'smartness' approach might entail a system-thinking perspective to understand holistic, complex, interrelated systems. However, it is the challenge of this study to find the right lens to focus on the tourism mobility system within the complex set of many interconnected systems at a destination and to discuss its innovation in the context of the overall structure.

To be able to unravel and analyse the complexity of the tourism mobility system-of-systems it is essential to use a structured analytical framework, which provides a theoretical basis to understand the system-thinking perspective but also provides analytical tools to discuss innovation processes of contemporary tourism mobility systems.

3. Analytical Framework

The tourism mobility system is a highly complex socio-technical system in which actors employ technologies to alter and shape movement in the built environment. From a system-thinking perspective, tourism mobility constitutes, in this study, one of many linked systems comprising a destination system. Furthermore, the tourism mobility system itself is composed of a set of interconnected and interdependent sub-systems. It is the challenge of this study to unravel this highly complex network of systems to understand not only the structure, but also the innovation processes that shape the complex socio-technical system of tourism mobility.

This chapter outlines the principles of system thinking, complex system theory, and the socio-technical system concept, all of which provide the foundations for the discussion of digitally penetrated, complex, socio-technical tourism mobility systems. The MLP is introduced as an analytical tool to identify innovation stages of tourism mobility systems in digitalising historic cities.

3.1. System Thinking and Complex Systems

> The whole is more than the sum of its parts. (Aristotle)

Arguably, system thinking has been studied by humans for thousands of years, although the modern scientific study of complex systems is comparatively young. Isaac Newton's *Calculus* (1666) and Henri Poincarè's *Algebraic Topology* (1895) provided, among others, the foundation for the development of modern system theories.

The early 20th century witnessed an unprecedented rise in the development of complexity science and system thinking across academic disciplines. Sociological system thinking constitutes an essential part of the evolution of system theory and complex system thinking. *Social network analysis,* with its roots in the works of Georg Simmel and Émile Durkheim (Prell, 2011), *game theory* (Neumann, 1928), *action theory* (Parsons, 1937), and Luhmann's (1984) *social systems* are only a few of the most influential early works shaping a complex system approach within social science. The Austrian biologist Ludwig Bertalanffy, who is widely considered the founder of system theory, published his seminal work, *The General System Theory,* in 1968, further inspiring system theory ideas within academia beyond the boundaries of natural sciences.

The emergence of *System Science* (Flood and Carson, 1988) and *Cybernetics* (Wiener, 1948) in the 1950s triggered the development of complexity theory and the subsequent investigation of complex systems. Thus, in essence, the study of complex systems is an endeavour

involving the theorising and modelling of system dynamics. However, the complex systems approach had its breakthrough with the advent of advanced computation capabilities in the 1990s. New mathematical computer modelling techniques, including neural networks, cellular automata, and genetic algorithms (Geels, 2005b), were developed and used to understand the complexities of natural dynamics.

3.1.1. Understanding Complex Systems

The moment a system starts to consist of parts interacting with each other in a non-linear fashion, it starts to exhibit complex behaviour (Pavard and Dugdale, 2006). As such, a complex system has a hierarchical structure and is characterised by non-deterministic, emergence, and self-organised behaviour resulting from the interconnections among its parts, but also by a limited functional decomposability producing non-obvious consequences. Thus, it is difficult, if not impossible, to reduce the number of parameters or characterising variables without losing a system's essential functional properties (Pavard and Dugdale, 2006).

The complex system approach helps to establish how relationships between components drive collective behaviour within a system and how the system interacts and creates relationships within its environment. However, critical voices have highlighted the limits to understanding complex systems. For example, Mikulecky (2007, p. 2483) argues that complexity is "the property of a real-world system that is manifest in the inability of any one formalism being adequate to capture all its properties". As Ferreira (2001, p. 16) notes, even with major leaps in computational capabilities, "the models developed would be so intricate that they would elude human understanding".

Despite these limitations, complex system thinking has enabled the comprehension of interconnected system structures, most notably the understanding of socio-technical and socio-cognitive systems (Pavard and Dugdale, 2006).

3.1.2. Complex System Thinking and Tourism Mobility Systems

Complexity theory exhibits a wide range of applicability, with the most prominent fields of research being mathematics, physics, biology, computer science, and the social sciences. In recent years, more applied approaches utilising complexity thinking have fostered advances in evolutionary and networked dynamics, as well as economic and social systems (McDonald, 2009; Tadeja Jere, 2017; Adelt et al., 2018).

Transportation research has embraced complex system theory, making it integral for understanding internal and external system dynamics (Jönson and Tengström, 2005). Sussman et al. (2016) consider *complex transportation networks* to be stochastic, influenced mainly by policymakers who introduce 'non-linear' strategies that affect the overall behaviour of the systems. Hillier (2012) employs *urban complexity theory* and used *levels problem* and *parallel problem* concepts to redefine cities as cognitive formations functioning as socio-technical systems. With the advancement of Smart City and Smart Mobility discussions, reductionistic approaches are in rapid decline, largely replaced by complex system thinking (Macmillen, 2013; Hefnawy, Bouras and Cherifi, 2016; Lombardi et al., 2012).

Similar developments can be observed in tourism research, which increasingly employs complex system theory to understand the structure and functioning of tourism systems (Baggio and Sainaghi, 2011; Tadeja Jere, 2017) and to model change and innovation processes (McDonald, 2009; Baggio and Sainaghi, 2011; Baggio, 2014). The concept has also been used as the underlying framework to understand the destination system (Baggio, Scott and Cooper, 2010; Schianetz and Kavanagh, 2008) and the role of the destination within the tourism system (Baggio, 2007; Baggio, 2014).

Tourism mobility research has also integrated complex system thinking. However, to date, research approaches have predominantly used the concept to create analytic tools to assess network structures (Asero, Gozzo and Tomaselli, 2016) or to inform discussions on the use of new technologies in tourism mobility (Smirnov et al., 2013).

No approach that employs complex system theory to investigate the socio-technical tourism mobility system holistically was identified in the literature.

3.2. The Socio-Technical Approach

> […] all organizations are socio-technical systems; that is no more than a definition, a tautology (Cherns, 1976)

Tourism mobility is a socio-technical system. At the most simplistic level, this system involves a basic socio-technical interaction – visitors walking in a built environment – through to complex system configurations (e.g. multimodal transport solutions for visitors or complex cyber-physical communication systems that inform visitors but are also informed by visitors and act as gateways to the 'digital-layer' of the destination).

For this study, a socio-technical system approach is used as an analytical approach. Creswell (2014, p. 4) highlights that this approach provides a foundation to understand and sketch the complex system of tourism mobility in contemporary tourist-historic cities in Europe.

3.2.1. Illustrating Changing Worlds

The notion of socio-technical systems emerged in the early 1950s as part of action research by members of the Tavistock Institute in London, who were investigating the existing process and organisational design (Trist and Bamforth, 1951) of deterministic manufacturing processes in times of socioeconomic change.

Prior to socio-technical thinking, the social and the technical were perceived as parallel and separate systems. However, with the increasing complexity of the modern world, a new perspective focusing on the interwoven mechanisms, functions, and the dynamics of change was established (Trist, 1981). Initially, socio-technical thinking was mainly applied in organisation studies and increasingly identified nascent conflicts between social needs and values and the prevailing reductive *Taylorism*, which focused on improving economic efficiency mainly via increasing labour productivity. As a result, socio-technical design was formulated, describing a set of principles to improve the widely unsatisfactory work situations of the 1950s (Trist, 1981). Based on these insights, the necessity for a joint-optimisation of social and technical systems was realised (Bertalanffy, 1968).

However, the socio-technical design method was widely neglected, and only a few applications and case studies were identified in the literature. Baxter and Sommerville (2011) attribute this lack to a certain disconnect between the proposed theoretical design methods, applied technical engineering, and the interaction of individuals with technical systems.

Only with the growing discussion regarding sustainability issues (Smith, Stirling and Berkhout, 2005; Nykvist and Whitmarsh, 2008) and ‘Smart’ systems (Carvalho, 2015; Chaeyoung, Noha and Jaehyun, 2017) has a socio-technical perspective on city and destination development, management, and governance gained importance.

In tourism mobility research specifically, the socio-technical approach has been similarly used primarily in relation to sustainability discussions (Scuttari, Volgger and Pechlaner, 2016; Verbeek and Mommaas, 2008) and, more recently, been linked to the discussion of digitalisation (Carayannis et al., 2018). Investigations into visitor mobility and movement have only rarely been considered under a socio-technical lens (Smirnova and Vinck, 2019).

The majority of studies highlight the interwoven and interconnected nature of tourism and mobilities, emphasising the necessity for a holistic perspective of the social and technical side of the tourism mobility system to be able to understand its structures (Hall, 2015; Cohen et al., 2014; Sheller and Urry, 2004). Although recent studies have commonly only focused on one part of the system, they acknowledge that each part only functions as part of the whole, and change can only succeed when holistic systems adapt (Baxter and Sommerville, 2011). Thus, for an effective analysis of socio-technical system changes, a comprehensive perspective on the overall system structures must be applied, which makes a complex system-thinking approach the most suitable choice.

3.3. The Multi-Level Perspective

One analytical tool for discussing innovation processes within complex socio-technical systems is the MLP, which was developed to understand change processes in large socio-technical systems (Kemp, 1994; Kemp, Schot and Hoogma, 1998). Based on the socioeconomic concepts of *co-evolution* and *actor-network theory,* Rip and Kemp (1998) formulated the basic concept of the MLP, which consists of insights from evolutionary theory, the sociology of technology, and the history of technology.

Frank Geels (2002) is one of the major contributors, further developing and applying the MLP as a heuristic research framework. Geels investigated the role of technological change within modern society to understand why some innovations emerged and were successfully integrated into existing systems, whereas others did not prevail and vanished. Geels mainly discusses infrastructure-related systems: for example, the development of highway systems (Geels, 2007), changes in aviation systems (Geels, 2006), the change from horse-drawn carriages to automobiles (Geels, 2005c), low-carbon transitions (Geels, 2012), and a range of energy-related studies (Verbong and Geels, 2007; Geels and Verhees, 2011; Förster, 2020). An increasing number of publications employ the MLP in sustainable transportation and mobility research (Nykvist and Whitmarsh, 2008; Marx et al., 2015), city systems (Hodson and Marvin, 2010), and transforming urban mobility systems (Moradi and Vagnoni, 2018).

In tourism research, the MLP is increasingly used to understand the destination system (Haugland et al., 2011; Amore, Prayag and Hall, 2018) and transformation processes within the tourism industry (Romero and Tejada, 2011).

The MLP is especially useful for the study of innovation processes in complex technical systems. Whitmarsh (2012, p. 458) argues that

> MLP research, with its multidisciplinary, long-term and systemic approach, appears better able than much traditional innovation and transport analysis to identify […] unintended consequences and feedbacks, and to highlight the diversity of processes and actors involved in social change.

For this study, the MLP provides a suitable framework to comprehend the tourism mobility system and understand where change is coming from, which tools enable change, and how local actors deal with change. The emerging transition pathways also offer insights into underlying change dynamics and provide, to a certain extent, an outlook on innovation trajectories.

3.3.1. Analytical Elements of the Multi-Level Perspective

The fundamental idea of the MLP originates from the sociology of technology. The concept comprises three analytical elements that interrelate, interact, and co-construct each other (see Figure 1). The first element is the socio-technical system, which is the tangible part to support societal functions consisting of resources and material aspects. The second element covers the social groups and actors maintaining, changing, or refining the system. The final element is the rules and institutions that guide and orientate the behaviour and perception of social groups.

For a detailed analysis, the individual elements of the system need to be identified, internal dynamics and composition understood, and their role within the system outlined.

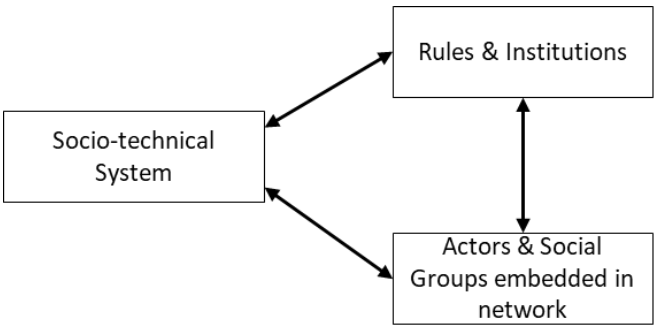

Figure 1 The analytical elements of the MLP (adapted from Geels, 2004, p. 903)

Socio-technical system

Socio-technical systems are the linkage between elements to fulfil societal functions, such as communication or transportation. These systems do not focus on the technological component from the production side, but distinguish between sub-functions, namely production, distribution, and use of technology (see Figure 2).

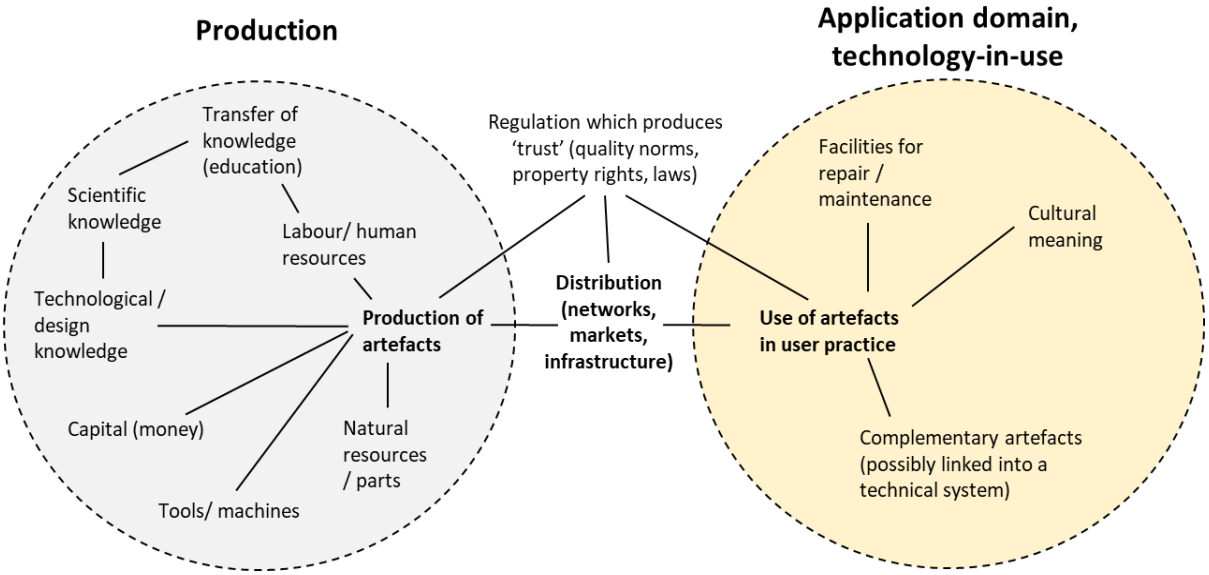

Figure 2 Sub-functions and resources of socio-technical systems (Geels, 2004, p. 900)

The socio-technical system of personal transport (Figure 3) exemplifies this approach and demonstrates how this method seeks to unclutter the complexity of systems to enable a structured analysis of innovation dynamics.

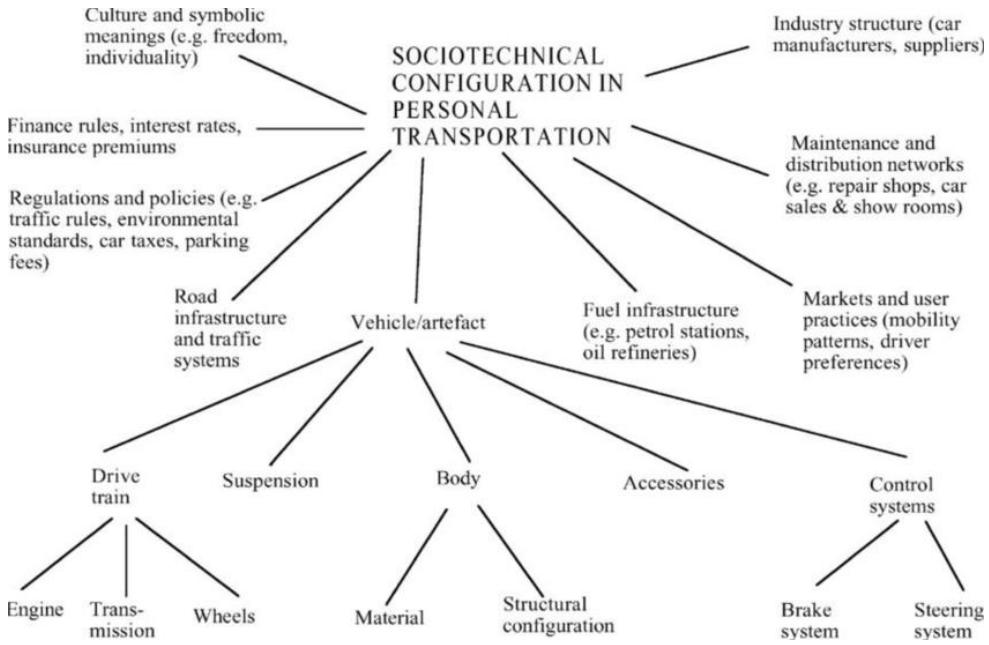

Figure 3 Socio-technical system of personal transport (Geels, 2002)

Actors and social groups

Social groups comprise human actors who share certain characteristics (e.g. norms, perception, roles, responsibilities) and are formed based on historical differentiation processes that commonly lead to the optimisation of the functioning of the group. Such groups have relative autonomy and display an increasingly specialised nature, which is not only reflected in shared interests and attitudes, but also common 'jargon' (language), similar problem agendas, information channels, and a closer connection to certain resources and sub-functions in the systems. Although they are autonomous entities, inter-group activities (interlinkage, networks, alignments, overlapping, etc.) are very common and trigger a certain 'interpenetration' (Geels, 2004) among the groups, which leads to the formation of social networks.

As discussed in the literature review, stakeholder structures in tourism mobility systems are particularly atomistic. Thus, it is not only necessary to understand clearly the configuration and roles of involved stakeholders, it is even more important to gain insights into the interrelation, interpenetration, and interdependencies among actors within a transforming joint tourism mobility system.

Rules and institutions

Although human actors and social groups are highly dynamic, their activities are coordinated and guided by rules and institutions, which constrain their freedom and autonomy. Overall, there are three dimensions of rules (Scott, 1995): regulative, normative, and cognitive.

(1) Regulative rules refer to formal rules that regulate interactions and constrain and sanction behaviour (e.g. government rules). (2) Normative rules are created through socialisation processes and confer values, norms, duties, rights, or responsibilities. (3) Cognitive rules "constitute the nature of reality and the frames through which meaning or sense is made" (Geels, 2005b, p. 13). Cognitive frameworks, belief systems, or symbols (words, concepts, signs, gestures, etc.) are used to process information and shape the meanings of objects and activities.

Rules are not autonomous entities but are linked in rule systems, which structure and regulate social transactions and are supported by social sanctions and networks of control. Rules within a system can hardly be changed without altering the others.

3.3.2. Interactions Between the Elements

Six types of interaction can be identified between the three analytical elements. These interactions form the basis of a socio-technical analysis and are founded on the principles that social actions influence technological change, as well as technology influencing society (see Figure 4):

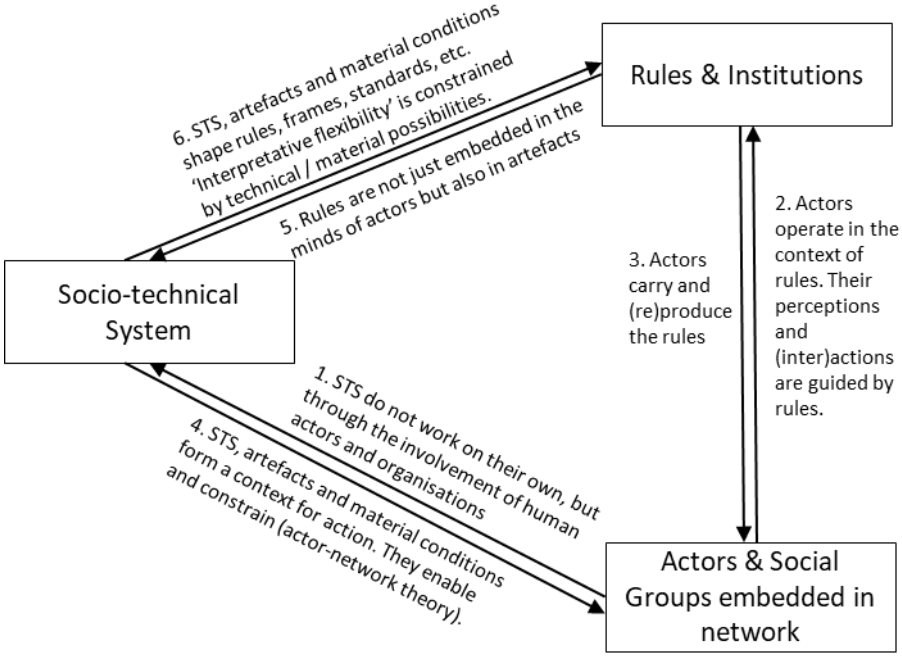

Figure 4 Three interrelated analytical dimensions (adapted from Geels, 2004, p. 903)

Socio-technical systems need human actors to function; they cannot work on their own. Human actors, on the other hand, reproduce the elements and linkages of socio-technical systems in their activities. Existing rules, regimes, and institutions provide guidance through 'structuration', which shapes the perception and (inter)actions of actors and social groups through a constraining and enabling context. Conversely, actors and social groups carry and reproduce, but also produce, (new) rules and even institutions (e.g. government institutions for digitalisation) through their activities.

However, it is not only rules and institutions that form and structure human behaviour patterns, perception, and activities, but also the material nature of socio-technical systems. Modern societies live in 'technotopes' surrounded by technology and material artefacts that provide the context for human behaviour. These artefacts and practices are also subject to rules and regulations, shaping, directing, and limiting these material objects and their ambit.

Conversely, the socio-technical system, its material artefacts, and conditions shape rules, policies, regulations, and standards, affecting institutions and political decision-making. However, material artefacts are not only subject to socio-political and socioeconomic ('soft') rules, but also 'hard' rules, such as technical and material possibilities and limitations, creating a greater barrier to change than 'soft' rules.

3.3.3. The Multiple Levels

The MLP theorises that socio-technical and co-evolutionary dynamics unfold on three levels: technological niches, technological regimes, and socio-technical landscapes. Rip and Kemp (1998) build on hierarchy and complex systems theory and understand the relationship between the three levels as a nested hierarchy (Figure 5).

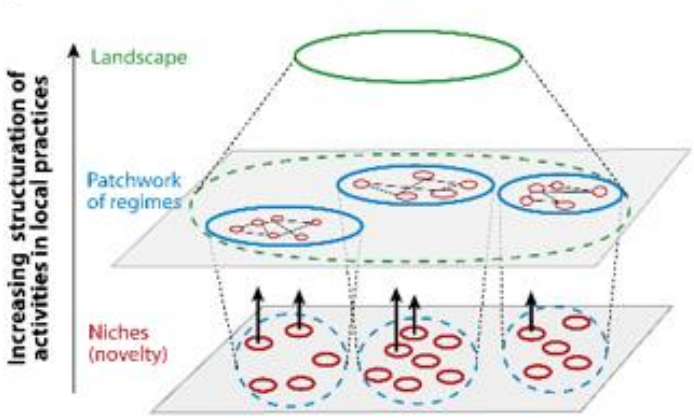

Figure 5 Multiple levels as a nested hierarchy (adapted from Loorbach, Frantzeskaki and Avelino, 2017b, p. 23)

Niche level

The starting point for potential innovations in the model is niches. Niches are protected spaces within which experimental innovations can develop. Initially confined application domains shield experimental, immature, unstable, and low-performing innovations from superior and dominating market forces (see Figure 6).

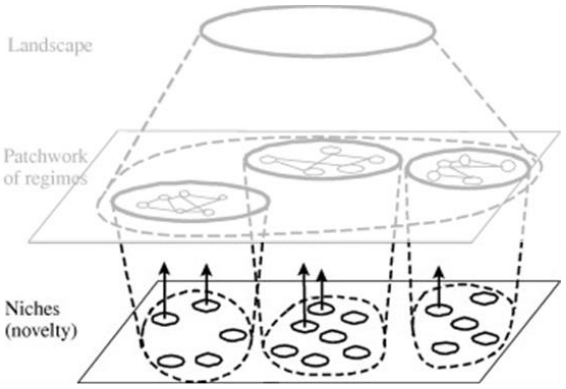

Figure 6 The Niche Level in the nested hierarchy (adapted from Geels, 2002, p.1261)

Technological niche development is shaped by learning articulation processes in various dimensions to adjust immature novelties to expectations and demand. In practice, these

learnings, articulations, and adjustment processes are informed, for example, by technical design, market demand, user preferences, infrastructure requirements, organisational issues, business models, policy instruments, or symbolic meanings. These processes are cost- and effort-intensive, requiring a high level of motivation and faith in the innovation from sponsors to sustain support until the breakthrough or breakdown of the novelty.

Innovations can be incremental or radical within the niches. Incremental innovations act as correcting factors for flaws or induce soft changes at the regime level, giving the regime stability. Radical innovations emerge as 'hopeful monsters' (Goldschmidt, 1940) very much in need of the protecting environment of the niche. "Most inventions are initially relatively crude, have low technical performance, and are cumbersome and expensive" (Geels, 2005b, p. 79); as such, they are considered 'hopeful' due to the great hopes in phenotypic changes with the potential to succeed as a new technology because of their ability to perform certain new or enhanced tasks, appropriate 'unchartered land', or augur innovation. However, the 'monster' is, by analogy, error-prone, and has low-performance characteristics (Mokyr, 1990).

Hence, niches act as 'incubation rooms', protecting novelties against mainstream market selection (Nykvist and Whitmarsh, 2008). Niche innovations are carried and developed by "small networks of dedicated actors, often outsiders or fringe actors" (Geels and Schot, 2007, p. 400). Niches also provide space and time for research and learning through experience, they foster the establishment of supporting networks (e.g. supply chains), and they attract investment and, active or passive, affirmative measures from innovators, prospecting actors, 'incubators', or 'product champions' (Loorbach, Frantzeskaki and Avelino, 2017a). These actors pioneer innovations and promote possible functionalities, applications, and market impact, raise interest among other relevant actors (e.g. policymakers, users, suppliers), and can mobilise resources for further innovation development, establishment, and market integration (Van Lente, 1993), creating a support network of actors.

Niches can also be created in response to landscape developments but are outside the regime selection environment; they are micro-phenomena interacting with the established regimes on the meso-level.

Socio-technical regimes

The concept of technological regimes stems from Nelson and Winter (1982) and considers innovation as a problem-solving activity that draws on knowledge bases stored in routines and practices, such as engineering practices, corporate governance structures, or manufacturing processes (Winter, 1984; Breschi, Malerba and Orsenigo, 2000).

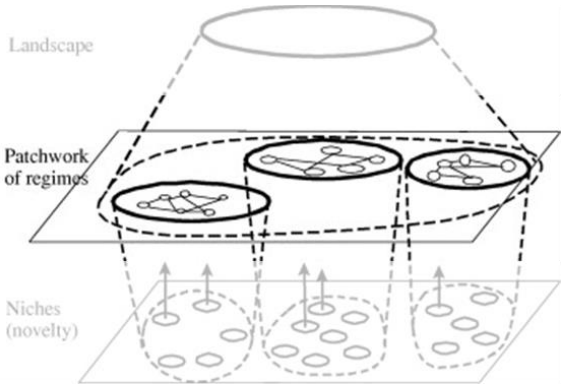

Figure 7 The Regime Level in the nested hierarchy (adapted from Geels, 2002, p.1261)

Rip and Kemp (1998) widened the spectrum and recognised the influence of financial networks, suppliers, user groups, societal groups, producer networks, public authorities, and research networks at a regime level.

Geels (2002) focused on the mechanism and dynamics within and around the regime. He defines the socio-technical regime as a 'semi-coherent set of rules' carried by different social groups. By providing orientation and coordination to the activities of relevant actor groups, socio-technical regimes account for the stability of socio-technical systems. This stability is dynamic, meaning that innovation still occurs but is incremental. In evolutionary terms, a socio-technical regime "function[s] as [a] selection and retention mechanism" (Geels, 2002, p. 1260).

The socio-technical regime comprises sector-specific sub-regimes (e.g. policy regime, science regime) that bring the individual social groups together (see Figure 8). When embedded into a sub-regime, social groups interlink and interpenetrate each other, which inevitably results in an alignment of activities to stabilise the overall system.

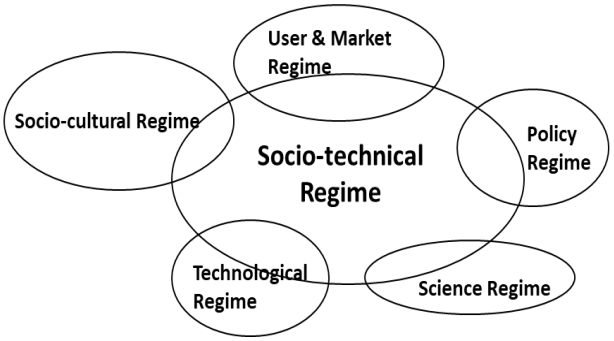

Figure 8 Meta-coordination through socio-technical regimes (Geels, 2005b, p. 17)

Existing socio-technical systems generally display high stability. This stability is achieved mainly due to a constant alignment of the trajectories of processes at a regime level, and thus enables a co-evolution of actors and sub-regimes (see Figure 9).

The stability is mainly supported, on one side, by highly interdependent relationships or mutual dependencies between buyer, seller, supplier, financier, etc., as well as by established norms, ideologies, and structures. On the other side, strong interest in the continuation of the existing systems dominates, which is based on organisation commitments and vested interests. The focus, to continue the prevalent trajectory, may even manifest in the suppression of innovations (e.g. through lobbying, 'buying-up' of possibly radical innovations), which may eventually cause instabilities.

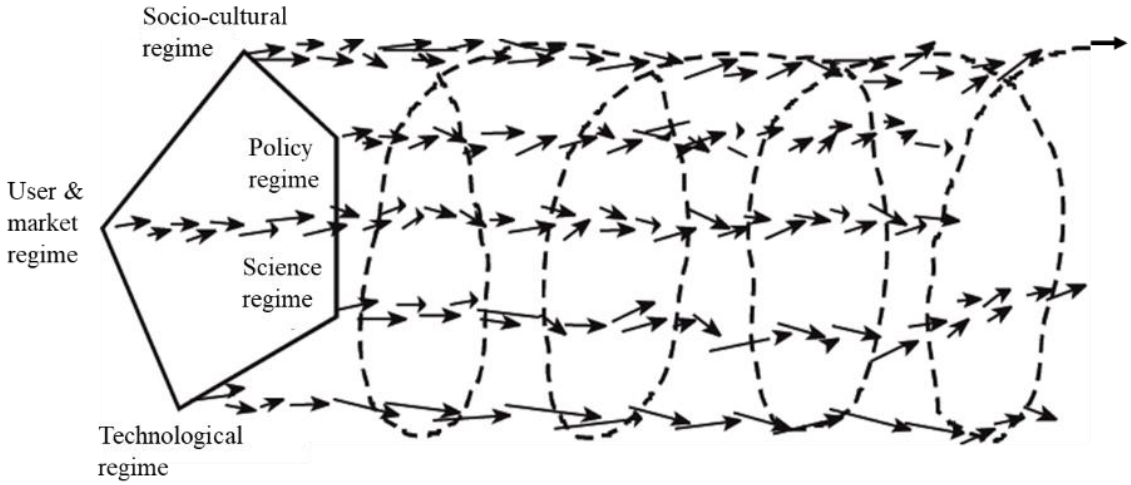

Figure 9 Alignment of ongoing processes in a socio-technical regime (Geels, 2005c, p.23)

Socio-technical landscape

While regimes refer to rules that support or constrain activities, the socio-technical landscape refers to a wide, external technological context that imbeds technology trajectories and provides a 'gradient' or backdrop for development (see Figure 10).

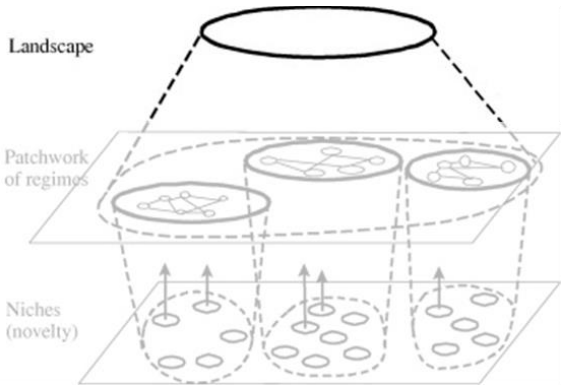

Figure 10 The Landscape Level in the nested hierarchy (adapted from Geels, 2002, p.1261)

The landscape is an exogenous environment that is considered to lie beyond the active influence of niche actors and is only influenced by regimes to a very limited extent (Smith, Voß and Grin, 2010). However, emerging trajectories at the landscape level hold the potential to influence lower levels. While the niche level partly uses landscape developments as guiding factors to develop and adjust innovations, regimes are directly affected by landscape developments. Changes at landscape level commonly manifest as pressures on the regime level and often lead to further transformation processes of the system.

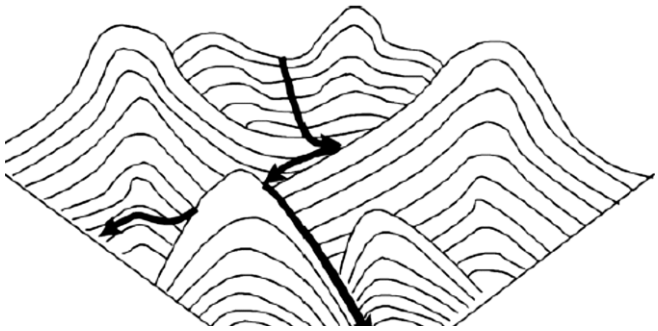

Figure 11 Topography of development trajectories (Sahal, 1985, p. 79)

Landscape developments, cover issues such as environmental problems (e.g. climate change), resource scarcity, wars, commodity processes, political arrangements, social norms, economic developments (e.g. industrialisation, globalisation), and the large material context of society (e.g. material and spatial arrangements of cities, infrastructure; (Sahal, 1993). Landscape dynamics are important for a better understanding of how and why broader societal developments affect the evolution or breakdown of regimes.

3.3.4. The Multi-Level Perspective on System Innovation

A core argument of the MLP is there is no single cause or driver; simultaneous processes at multiple levels and dimensions link up and create circular causalities that reinforce one another.

The MLP argues that change occurs through interactions of elements, agents, and processes on three levels bound to a relational time scale. However, the complexity of socio-technical system developments exceeds causal and predictive theories (Cagnin and Keenan, 2008). A multitude of dynamics connects the heterogeneous and ever-changing composition of actors, agents, elements, fragments, and external factors on each level. Each level is again a set of causal and situation-specific heterogeneous factors with a different relation to time and space. As a result of this highly complex and interconnected system structure, system outcomes are

commonly stochastic, and thus are difficult to predict and to conceptualise (Keating et al., 2001).

Where change is triggered, a highly complex, interconnected, and multi-variant set of change processes is started.

The key feature of the MLP is its structure, which enables a systemic approach to understand the dynamic interactions between the different levels. The MLP highlights that not only processes at a niche level are essential for the successful breakthrough of novelties, but also developments in existing regimes and the landscape. The alignment of all components and processes determines whether change occurs and a regime shift happens. Figure 12 illustrates the dynamic interplay between processes at the three levels, fostering the potential evolution of novelties from niches, to regimes, and up to landscapes (Wigboldus et al., 2016).

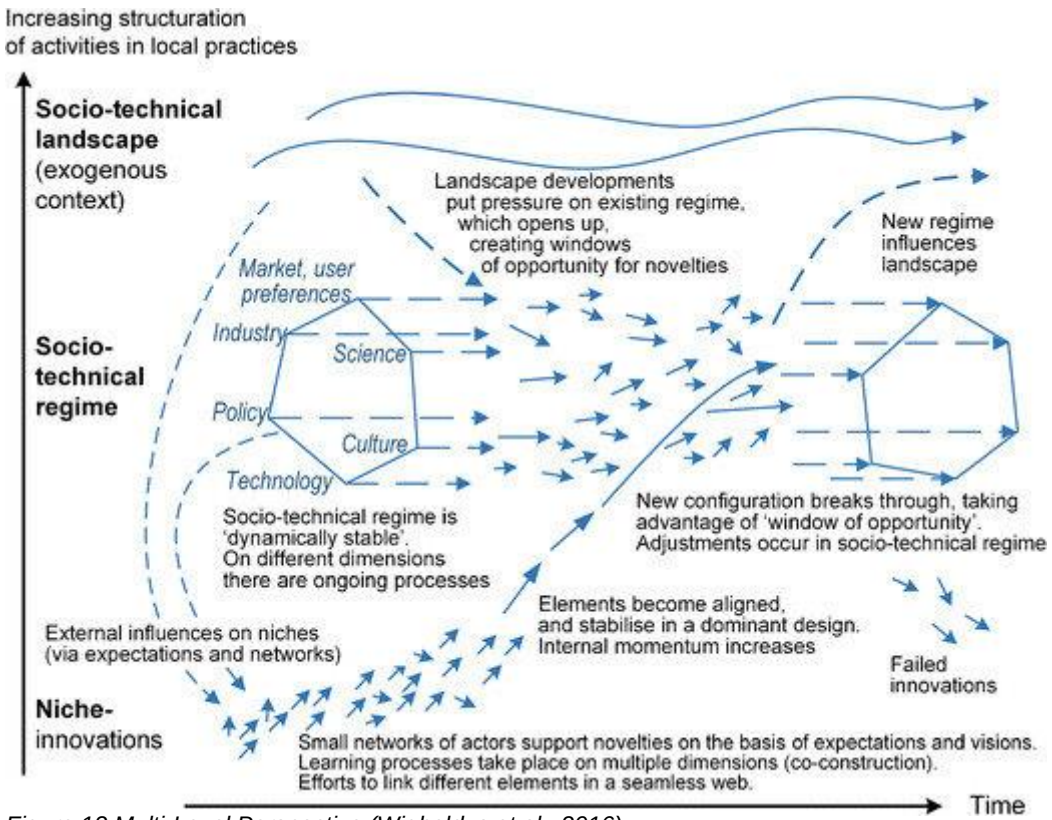

Figure 12 Multi-Level Perspective (Wigboldus et al., 2016)

In the first phase, radical innovations emerge in niches, often beyond the fringe of existing regimes or the dominate design. Actors improvise and experiment with and around the novelty (design, user preferences, market demand, etc.). The networks carrying the innovation are

small and precarious. The innovation does not (yet) threaten existing regimes. (In Figure 12, these processes are represented by small arrows.)

In the second phase, small market niches capture novelties and provide resources for (technical) development and specialisation. The novelty starts to align its processes within the niche, develops a technical trajectory (the arrow is getting longer), and rules begin to stabilise. However, the novelty still does not present a threat to existing regimes because it has a highly specialised character. The novelty may be stuck in this phase for some time if no match with the existing regime or window of opportunity appears.

Phase 3 is characterised by the wider breakthrough of the novelty. External regime and landscape developments are important for this phase; they might create a window of opportunity for the novelty to establish itself in the existing regime structure.

Phase 4 is a gradual replacement of the established regime, with the potential for the new regime to influence the landscape level, having a wider impact on society.

3.3.5. Transition Pathways

The above-outlined system innovation process is an example to understand better the functioning of the MLP. Transition pathways and change dynamics of socio-technical system innovation processes are manifold and highly situational and configuration specific. Although a range of reoccurring transition pathways and dynamics can be identified, each system innovation is unique in form, scope, duration, and outcome.

To illustrate the multi-variant character of possible innovation processes, an overview of the most common translation pathways is provided in Table 1.

Transition pathways analyse how technological innovations mature. The pathways are defined by the interactions between activities and structures of internal regime dynamics, wider landscape dynamics, and promising niches, as well as by the level and intensity with which the incumbent regimes are destabilised and the outcome of the change process.

Differences in the pathways depend on the timing and nature of interactions, the main actors who led the change, and the supported niches.

Pathway	Description	Literature
Re-production of trajectories	This path depicts the baseline at the regime level. The regime is stable and reproducing the existing configuration in the absence of landscape pressures.	(cf. Berkhout, Smith and Stirling, 2004; Grin, Rotmans and Schot, 2010)
Transformation	Incumbent actors change regime elements and setup to accommodate external pressures.	(cf. Weber and Rohracher, 2012; Geels and Schot, 2007)
Endogenous Renewal	A coordinated response to slight, internal, or external pressures, which can be dealt with by internal adaptations of the regimes. Change is dynamic but regimes remain stable.	(cf. Berkhout, Smith and Stirling, 2004; Brent, 2016)
De-alignment and Re-alignment	This pathway refers to a regimen shift due to strong landscape pressure opening a window of opportunity for niche innovations, but no niche innovation is sufficiently developed for substitution.	(cf. Siyanbola, 2012; Geels and Schot, 2007; Grin, Rotmans and Schot, 2010)
Re-orientation of trajectories	Uncoordinated, outside pressures on the system trigger a 'shock' of incumbent actors and lead to internal adjustments of the regime, which are disparate and but within existing capacities.	(cf. Berkhout, Smith and Stirling, 2004; Kompella, 2017)
Technological Substitution	Strong landscape pressures are destabilising the regime and radical niche innovations are ready to substitute the obsolete technology, resulting in broader changes in the socio-technical regime. New actors emerge and need to be integrated into the system.	(cf. El Bilali, 2019; Kemp, Schot and Hoogma, 1998; Geels and Schot, 2007)
Emergent transformation	The pathway is an unintended consequence of uncoordinated pressures from outside which results in adjustments going beyond existing regime structures	(cf. Berkhout, Smith and Stirling, 2004; Genus and Coles, 2008)
Re-configuration	A new regime 'grows' out of an old regime, substantially changing the regime architecture	(cf. Foxon, Hammond and Pearson, 2010; Geels and Schot, 2007; Grin, Rotmans and Schot, 2010)
Positive transition	A growing set of expectations of the socio-technical systems which stem from outside of the regime is emerging. The regime is responding in a coordinated way, by adapting external elements and uses external resources.	(cf. Berkhout, Smith and Stirling, 2004)
Selection of relevant specialised variance of pathways		
Sequence of Transition pathways	Under 'disruptive change' pressures from the landscape level the regime is likely to start with transformation, leading to re-configuration and possibly followed by substitutions or de-alignment and realignment.	(cf. Kompella, 2017)
Market rules	The regime is dominated by the market side of the socio-technical system. Emerging pressures and adaptations are dealt with in favour of market interests.	(cf. Foxon, Hammond and Pearson, 2010)
Central control	On regime actor started to control regime setup and adjustments. Commonly, government regimes are taking this central control and management position.	(cf. Trutnevyte et al., 2015; Foxon, Hammond and Pearson, 2010)
Thousand flowers	A structured, collective and social approach to deal with emerging expectations or pressures on the system is taken. A bottom-up and participative process supports the regime to identify diverse solutions for adjustment or shifts.	(cf. Seyfang, Park and Smith, 2013; Foxon, Hammond and Pearson, 2010)
Eco-City	A coalition of actors develop new visions for the desired system setup and developed (proactive) scenarios for transition	(cf. Marletto, 2014)

Table 1 Overview of transition pathways (Source: own illustration)

3.3.6. Critique of the Multi-Level Perspective

The MLP offers an approach for a heuristic and holistic analysis of change. The increasing multidisciplinary application of the MLP for the analysis of a wide range of distinct cases demonstrates the high usability of the tool to investigate highly complex system innovation processes, but the multidisciplinary application also identified several limitations of the original conceptualisation.

One strength of the MLP is the 'structure-agent duality' that addresses long-term, evolutionary trajectories that shape our current understanding of socio-technical system changes. However, this historical analysis of quasi-co-evolutionary processes has led to a neglect of the spatial dimension, which is the most prominent and widely cited critique point of the MLP (Coenen, Benneworth and Truffer, 2012).

Truffer and Coenen (2012) highlight that a spatial scale is crucial for the analysis of all levels of the MLP (landscape, regime and niche level). The researchers argue that regimes are erroneously considered homogeneous structures, disregarding that local variations and interpretations and niche developments depend substantially on endowments and access to innovative resources and environments, which indicates a highly spatio-specific aspect: "The MLP has difficulty explaining why niches emerge in one place and not in others" (Raven, Schot and Berkhout, 2012, p. 67).

Berkhout (2004) generally questions how the analytical levels can be applied empirically, highlighting that the perspective and starting point of observation shape the results. A radical regime shift from a close perspective might look like an incremental change from a more distanced viewpoint (e.g. does one study a regime at the level of an artefact [technology, fuel, etc.] or an entire system [production, distribution, consumption, etc.]?).

Fünfschilling and Binz (2018) theorise a *global socio-technical regime*. The researchers apply new institutionalism and globalisation theory and argue in support for institutional homogenisation and the resulting world polity, which is enforcing isomorphism through institutional pressures.

Hodson and Marvin (2009; 2010) discuss how the (re-)emerging influence of the 'city' should be reflected and conceptualised in the MLP. De-centralisation leads to the transfer of key policies and governance from the national to the city and regional levels. The ambiguous conceptualisation of the 'city' or 'region' in the MLP leaves room for questions such as the following: Do cities represent their own regime? Are cities actively appropriating landscape pressures to their local context? Are cities only a site where niches are developed under the national context? Raven et al. (2012) add the consideration of transnational interactions of global cities and their interplay in regime shifts to Hodson and Marvin (2009; 2010) discussion.

To investigate the innovation of the tourism mobility system in the digitalising destination, ‘space’ appears in many forms and shapes. On the one hand, the ‘destination space’ is not only the context for tourism mobility, but also an essential influencing factor shaping mobility (e.g. morphology, gateways), and depicts a ‘capital’ for innovation (touristic consumption of historic built environments). On the other hand, cyberspace, which enables the ubiquitous use of OMTs, is of crucial importance. The role of cyberspace, the delimitation of cyberspace, physical space, and placeless experience spaces (e.g. Virtual Realities) is unclear but is an essential factor for a detailed understanding of the digitally induced innovation process of tourism mobility systems. Thus, the use of the MLP for the analysis of digitally supported tourism mobility systems adds to the debate on the ‘spatiality’ of the MLP.

Further critiques have argued that regime transformation is treated as a single process, is overly functionalistic, and neglects differences in context (Geels and Schot, 2007). Furthermore, an arbitrary emphasis on niches as the “principal locus for change” was identified by Berkhut et al. (2004, p. 62), resulting in a focal point on niche innovations as a trigger for change. However, this point only considers landscape pressures as supporting factors for change and neglects actors or processes that bypass the niche level and directly address the socio-technical regime. Although in theory this bypassing of certain levels or evolutionary steps is considered, in practice the incorporation of these processes individually would lead to an overload of information that would make the MLP ponderous and ineffective. However, a phase-wise discussion of the individual innovation stages would allow the consideration of internal and external processes and still maintain a certain clarity and overview of the tourism mobility system.

3.3.7. Chapter Conclusion

The endeavour to understand the status quo and innovation processes in tourism mobility systems requires the use of a comprehensive and well-structured analytical framework.

The socio-technical discussion of the tourism mobility system and the application of the MLP are considered the most suitable analytical tools for this thesis. In particular, the co-evolutionary perspective on technology and society, which focuses on complex dynamics and not on linear cause-and-effect relations or simple drivers, is a key advantage of the MLP. Furthermore, the MLP’s analytical scope covers a wide array of transformation dynamics, from stability to radical change. The multidimensional approach, which integrates technology, industry, markets, consumer behaviour, policy, infrastructure, and cultural values into the discussion, helps access all relevant industry areas and dimensions, enabling insights into sector-specific configurations, developments, and issues. When focusing on the regime level,

the MLP uses an actor-based approach to discuss interactions and dynamics among different groups of stakeholders.

These specific characteristics allow the MLP to capture the highly complex system of systems, but, at the same time, provide detailed insights into all levels of system dynamics and transformation processes.

For a comprehensive discussion of digitally diffused tourism mobility systems of contemporary historic cities, it is essential to pursue a structured investigation. The point of departure is the formulation of the socio-technical system of tourism mobility. As highlighted in Chapter 2 of the thesis, tourism mobility is yet to be conceptually established as a unified system. Thus, it is necessary to capture the configuration of tourism mobility systems at the destination. This initial draft of the system configuration is developed in the first empirical phase.

This system configuration offers only a snapshot of prevailing tourism mobility systems and is a somewhat static setup of relevant elements and actors. However, the developed system configuration is used as a baseline for further, in-depth investigations of the evolution, transformation, and change dynamics of the system over time and with increasing digital diffusion.

The following in-depth discussions of past innovation trajectories and processes provide detailed insights into how the contemporary tourism mobility system has evolved (‘Where have we come from?’), as well as complementing the drafted, static system configuration of the contemporary tourism mobility system, with innovation trajectories and underlying system dynamics.

Due to the actor-based and multidimensional approach of the MLP, co-evolutionary processes, change dynamics, and the resulting innovation trajectories can be traced not only over time, but also within the hierarchical system, from system level down to intra-actor processes. This high-resolution but still holistic investigation method helps to determine pressures, drivers, challenges, potential, and change dynamics on all levels. However, the far-reaching character of the method, which produces large numbers of insights and data, requires a structured and focused analysis approach. Thus, the case-based discussion, which is meant to outline the innovation processes, change dynamics, pathways, and trajectories, applies a chronological discussion of the innovation of tourism mobility systems. Thematic core areas, including key touristic developments, destination, and city developments (including local mobility structures), as well as evolving visitor structures, are used to structure the discussion and to identify sectors, actors, or configurations that are driving, hindering, or struggling with innovation. In addition, the process-centric discussion offers an outlook on the innovation processes of tourism mobility systems.

4. Methodological Design

The methodological approach is informed by the analytical framework and is designed to enable a comprehensive analysis of the status quo and innovation processes within tourism mobility systems. A clear understanding of the tourism mobility system configuration constitutes the basis for an in-depth investigation of the factors affecting the systems and the internal processes shaping the innovation of tourism mobility.

This chapter introduces the approach to the investigation. Pragmatism was adopted because the study of changing socio-technical systems from the MLP requires a wide range of multidisciplinary considerations. This chapter describes the rationale for using this approach and explains the methods used to generate not only a conceptual baseline of tourism mobility, but also be able to follow and trace the innovation path of tourism mobility systems in historic cities in Austria.

4.1. Philosophical Approach

This study applies mixed-methods research, which is commonly argued to have its philosophical and methodological foundations in *Pragmatism* (Creswell, 2010; Teddlie and Tashakkori, 2008). The purpose of this study is to understand the innovation processes of tourism mobility systems in historic cities, which are argued in this thesis to have significantly accelerated with the breakthrough of OMTs. Hence, multiple complex socio-technical systems need to be understood and their (inter-)relationships, dynamics, and linkages dismantled, understood, scrutinised, and re-constructed.

The constructive, empirical data collection illustrates the high relevance of practical implications but also copes with the sum of subjective perspectives. This subjectivity is approached via the *constructivist paradigm*, which claims that the truth is relative and dependent on perspective (Baxter and Jack, 2008), recognising “the importance of the subjective human creation of meaning, but doesn’t reject outright some notion of objectivity […]” (Crabtree, Miller and Swenson, 1995, p. 10).

Thus, a constructive approach, of the researcher and the ‘researched’, enables a consciously subjective discussion regarding the sum of perspectives shaping the innovation processes of tourism mobility and provides the foundation to highlight pragmatically, substantiate, and adapt the conceptual approach so as to understand socio-technical systems and their dynamics in a world undergoing rapid digital transformation.

4.2. Methodological Design

As stated in previous chapters, this study investigates the innovation processes of tourism mobility systems in Austrian tourist-historic cities. Since no relevant research could be identified in the literature, no existing data on innovating tourism mobility systems in tourist-historic sites were available as reference or as a foundation for the methodological approach of this study. Thus, this study was designed in two empirical stages. The first stage involved a scoping study to generate evidence on the current state of tourism mobility systems in Europe and to gain an overview of innovation dynamics, such as pressures, niche innovations, and change dynamics in European historic cities. The scoping study constituted the foundation for the subsequent in-depth case analyses of Austrian cities in the second empirical phase.

In accordance with this two-stage data generation approach, a sequential mixed-methods approach was chosen. This approach was deemed most suitable for examining a complex, real-life contextual research problem based on multi-level and multidimensional perspectives. This analytical combination enables quantitative and qualitative data generation to build on each other, allowing a more comprehensive and rigorous discussion of the study context (Creswell and Creswell, 2017). Tashakkori and Creswell (2007) argue that the mixed-methods approach is not simply a combination of quantitative and qualitative methods, but is also a complementing, epistemological paradigm that occupies the conceptual space between *positivism* and *interpretivism*.

The advantages of mixed methods for this research are as follows:

- A complex and broader research problem can be investigated due to the possible combination of multiple methods.
- The strength of one method can counteract or compensate for the weaknesses of the other (e.g. qualitative explanation for quantitative data by using case findings).
- Findings based upon the quantitative data (in this study via an online survey) can be supported, substantiated, refined, and expanded by qualitative data generated in the case study work.
- Research subjects can be investigated in greater depth, more precisely, and more flexibly when combining multiple methods, which may generate new knowledge and reveal new insights (patterns, relationships, etc.), and the generalisability of findings for theory and practice is increased.
- The data generated and evidence collected can be more robust and rigorous to help support the conclusions.

The challenges and limitations of this methodological approach are as follows:

- The methodological design, data generation, and analysis required an extensive amount of time and more resources due to the multiple methods applied.
- The researcher needed profound knowledge and understanding of the diverse methods applied, as well as proficiency in designing a mixed-methods approach to combine the applied methods coherently.
- When merging quantitative and qualitative methods, the methods for evaluating and analysing generated data need to be synchronised.
- Conflicting results are more likely due to the different methods and different angles of investigation, which might limit the rigour and representativity of the results and conclusion.

In addition, a secondary research approach was pursued throughout the study. This secondary research was used for the literature review, in which academic publications, conference proceedings, and NGO (e.g. UNESCO) and government publications, such as policy papers, strategic papers, management and development plans, and regulative documents, as well as statistical data were examined. Secondary research was also conducted throughout the second empirical phase (interviews) to complement and extend the findings of the interviews with secondary material, such as masterplans, government papers, development and innovation plans, and development reports or strategic papers on tourism and mobility management in the case cities. The material was obtained through the literature research online or in library catalogues, or interviewees and local contacts in the case cities were contacted to provide more detailed information. The material was categorised, and relevant information was coded and inserted in NVivo (see Section 4.4.7).

One challenge for conducting secondary research on innovating tourism mobility is the fast speed of development of digital innovation in socio-technical systems. Thus, the literature reviewed often provided more of a historic perspective and was less able to reflect recent developments in rapidly changing (tourism) mobility systems. As mentioned earlier, another constraint was the fact that literature on tourism mobility was rather limited. Thus, related material on touristic mobility and movement was also reviewed. However, this material tends to have either a strong tourism or mobility focus and largely does not consider tourism mobility as a combined topic. Furthermore, it should be noted that this thesis does not include material on research which deals with the effects of Covid19 on tourism mobility, due to the fact, that the empirical work was carried out between 2017 and the beginning of 2019.

4.2.1. Methodological Framework

The methodological framework was designed around the MLP using secondary desk research and a mixed-methods approach. The application of multiple methods and sources (see Figure 13) enables 'evidence triangulation', increasing the validity of the theoretical framework, proposed innovation model (see Section 10), and conclusion (see Section 11).

The empirical two-stage approach of this study was also chosen based on arguments outlined in the critique points of the MLP (see Section 3.3.6). One key consideration was based on Berkhout's (2004) argument, which highlights that the perspective and starting point of observation shape the results. Thus, this study zooms in from a broader European level on the overall innovation status of tourism mobility systems to a detailed discussion on innovation processes and dynamics of local tourism mobility systems in case cities.

Furthermore, the empirical approach of this study also enables us to consider a spatial scale within the MLP analysis. Especially, the detailed case discussions of innovation processes of three tourism mobility systems in cities within the same national context enable us to highlight spatio-specific aspects (Truffer, Coenen 2012) within a national framework, as well as enhancing our understanding of the influence and relevance of the 'city' through the MLP analysis (Hodson, Marvin 2010).

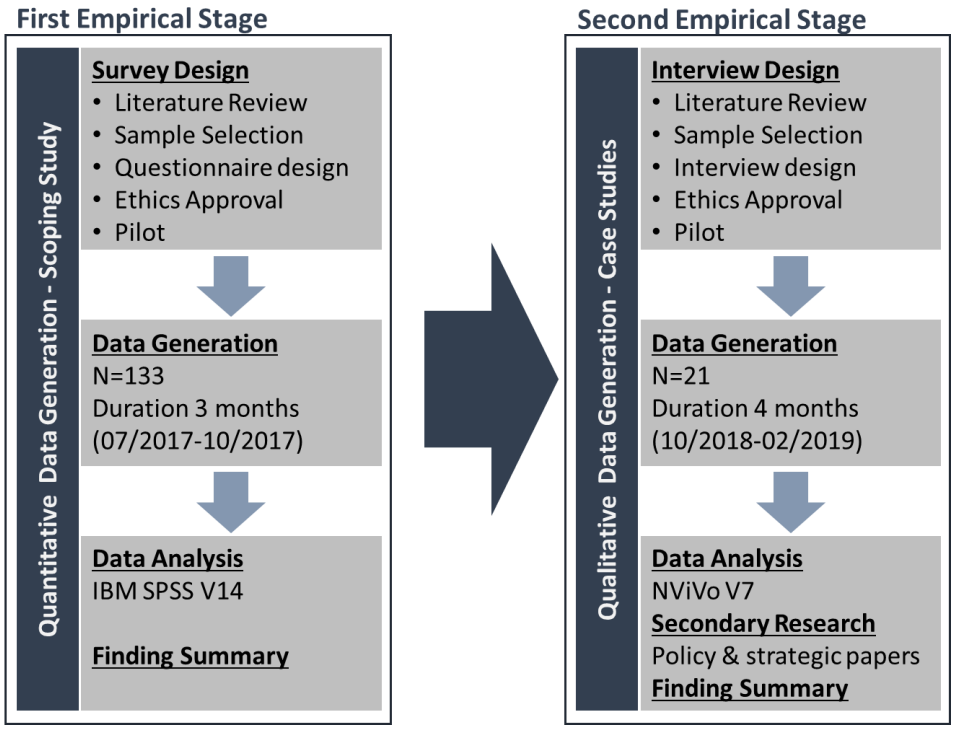

Figure 13 Empirical stages for data generation (Source: own illustration)

4.3. Quantitative Research Design

The quantitative phase of the methodology employed a scoping study by using an online questionnaire. This scoping study was designed to provide an initial overview of the setup and state of contemporary socio-technical tourism mobility systems in historic cities in Europe. Since the literature contained no existing research on socio-technical tourism mobility systems, nor on the innovation state and processes of tourism mobility systems in historic cities, the scoping study acted as a baseline for the subsequent in-depth investigation of the Austrian case cities.

The three Austrian case cities of Vienna, Graz, and Salzburg were included in the scoping study to set them in direct comparison with the other investigated European historic cities and to generate an overall understanding of the setup of the local tourism mobility systems and the level of innovation of the systems.

This first empirical phase was designed to generate data for the discussion of RO1: To establish an overview of the current state of tourism mobility systems in contemporary, digitalising historic cities in Europe.

The findings of the scoping study acted as a foundation for the design of the in-depth interviews in the second empirical phase.

The structure of the questionnaire was based on the MLP (see in detail in Section 3.3), with a focus on generating initial evidence on pressures, change dynamics, and digital innovations (e.g. tour guide apps on smartphones, GPS tracking) penetrating and triggering change within tourism mobility systems in UNESCO-listed historic cities.

Input from technology acceptance concepts was also incorporated into the questionnaire design. These concepts were considered mainly under the premise that the

> findings of user acceptance as a psychological construct […] shed light on the forces that determine behaviour and […] predict with some accuracy how users will respond to given applications (Dillon and Morris, 1996, p. 22).

Socio-technical systems illustrate

> that a technology on its own has little meaning for purposes of organisational analysis, being truly comprehensive only in terms of the context in which it is embedded and […] the organisational goals or transformation that it serves or enables (Pasmore and Sherwood, 1978; Dillon and Morris, 1996, p. 23).

An increasing number of discussions on the interdependency and interrelation of technology acceptance and socio-technical systems are also emerging (Lee, Kozar and Larsen, 2003; Shipps, 2013; Domènech and Saurí, 2010; Schaper and Pervan, 2007). Dillon (2000)

identified, for example, a conceptual gap and argues that socio-technical models tend to emphasise the organisational context for shaping technology use, whereas usability research focuses on the individual disposition and reaction. These aspects, by accumulation, form the foundation of organisational dynamics and the understanding of factors that potentially minimise the resistance and rejection by users and user groups regarding the integration and utilisation of new technologies.

Technology acceptance concept

For this survey, a technology acceptance model construct was applied to provide guidelines for question design and survey structure to optimise the identification of socio-technical system dynamics influenced and triggered by the technological use behaviour of actors and actor networks.

The *unified theory of acceptance and use* (UTAUT) was identified as the most suitable technology acceptance model mainly due to (1) its recent update and optimisation, which merges key aspects of earlier models (Venkatesh, Thong and Xu, 2016; Venkatesh et al., 2003; Williams, Rana and Dwivedi, 2015; Dwivedi et al., 2017); (2) it is one of the most frequently used models for the analysis of new, interactive, and social technology systems that also covers tourism and mobilities research (Chen and Chang, 2013; Schaupp, Carter and McBride, 2010; Curtis et al., 2010; Rasinger, Fuchs and Höpken, 2007); and (3) a large body of literature demonstrates that also only using the UTAUT produces representative results (van Dijk, Peters and Ebbers, 2008; Lin and Anol, 2008; Huser, Narus and Rocha, 2010; Nov and Ye, 2009).

Technology awareness

When discussing acceptance and adoption theories, the factor of awareness or better unawareness is a crucial moderator (Abubakar and Ahmad, 2013). Heifetz et al. (2006, p. 15) argue that unawareness is a natural state of mind and “conceptually distinct from ignorance, incomplete information or faulty analysis: It has to do with the lack of conception, not the lack of knowledge”.

The acceptance and potential use of technologies is the precondition for a functioning socio-technical system; however, without a certain consciousness of a technology’s existence, acceptance and its utilisation are baseless concepts. Thus, technology acceptance models presuppose the user’s awareness of the technology under investigation (Dillon and Morris, 1996). With the advancements and rapid uptake of OMTs and the increasing possibilities

offered by mobile services (e.g. e-governance, e-commerce), the interplay and influence of technology awareness regarding technology acceptance and the actual-use behaviour of (new) technologies have been more frequently investigated (Rehman, Esichaikul and Kamal, 2012; Mofleh, 2008; Charbaji and Mikdashi, 2003; Wan, Cheung and Qiping Shen, 2012). However, studies have always highlighted that awareness of technologies is a determining factor for the subsequent adoption and diffusion processes. While adoption and diffusion of novel technologies strongly shape the breakthrough and overall success of technological novelties (Yaqub et al., 2013; Bamberg and Möser, 2007; Abubakar and Ahmad, 2013).

"Modelling unawareness proves to be a tricky task" (Heifetz, Meier and Schipper, 2006, p. 2), especially with 'interactive unawareness' on multiple levels being conditioned by time and space. No conceptualisation model exists that synergises technology awareness factors and technology adoption and diffusion processes. Nonetheless, technology awareness parameters have been adopted for this research and were used in one part of the questionnaire survey (signpost to the details) to filter the respondents' self-assessed level of conception of current OMTs and future trends.

4.3.1. Questionnaire Design

A literature survey was conducted to identify the structure, wording, and sequence of questions formulated for technology acceptance surveys (Tan, 2013; Emmanuel et al., 2015; Lai, 2017; Scholochow, Fuchs and Höpken, 2010; Fuchs, Höpken and Rasinger, 2011). Based on the findings of the review, questions were developed in accordance with some semantic principles in survey design (Raatz and Lienert, 1998), namely the following:

- Avoid equivocal phrases and terms.
- Address only one investigative topic per question.
- Use words the respondents are most likely familiar with.
- Avoid double negatives and broad generalisations.
- Avoid circumlocutory, long, or very short formulations.

The majority of the questions were closed-ended Likert (values between 1 and 5), dichotomous, and matrix questions with unipolar and bipolar rating scales (neglecting a neutral middle value) but incorporating a non-disclosure option for the respondents. Open-ended questions were also used for questions requiring individual input (e.g. number of employees) or to qualify a prior answer in more detail.

The majority of the questions applied verbalised qualifiers for the rating scale (e.g. 'I disagree', 'I agree'). This practice is widely used because it provides practical advantages, such as ease

of explanation, familiarity, and facilitating normative judgement (Rohrmann, 2007). However, the disadvantages of this approach are inferior measurements that result in deviations of equidistance and being prone to cultural bias (Auer et al., 2000; Weinfurt and Moghaddam, 2001). These questions enabled the generation of ordinal data, whereas the generation of data through dichotomous questions provided nominal data (Stevens, 1946).

Based on the structure of the MLP, the questionnaire was divided into thematic core areas to identify the following:

(1) The overall tourism mobility situation within the destination (e.g. use level, modality mix).
(2) Involved actors and components of the socio-technical tourism mobility system (regime setup).
(3) Perceived pressures and challenges related to tourism mobility.
(4) First indications regarding digital tools used for tourism mobility.
(5) Insight into change dynamics at regime level.

In addition, socio-demographic information, education level, and insights into organisational structures were also requested from the respondents.

The questions were formulated in English and distributed to 133 respondents in 120 destinations (see questionnaire in Appendix I).

4.3.2. Survey Sample Selection Criteria

For the online survey, only destinations listed as a UNESCO World Heritage Historic City in Europe were selected. This selection was made based on the following set of considerations.

First, historic built environments act as pull factors that attract visitors to a place. Heritage tourism is one of the dominating tourism forms in Europe. In particular, UNESCO-listed historic sites have strong pull factors for tourists and are often subjected to high volumes of visitors. This point is beneficial for this study because more dynamics and interrelations can be observed when a destination has a higher touristic utilisation.

Second, purposive utilisation of a built environment requires planning and management. The touristic utilisation of historic sites is commonly enabled, guided, and controlled by active visitor management. Historic cities require dedicated management for the conservation and protection of the built environment. Structured management is also necessary to create and shape the visitor experience, which is mainly designed by purposively guiding visitors through the built environment and providing them with relevant information. For this study, the expected high engagement of local actors in visitor-movement management activities and the active

utilisation of guidance and interpretation techniques are highly beneficial due to these activities reflecting regime dynamics and indicating the tendencies of innovation directions.

Third, UNESCO-listed historic cities have a clearly defined delimitation of the historic city centre distinct from the rest of the city. This demarcation of destination areas (see Section 2.6) adds to the spatial implications of tourism mobility (e.g. gateways, adjacent areas), but also has implications for the planning, management, and governance of the city and destination system.

A peripheral aspect when discussing a 'grown' urban environment with a long history is the opportunity to consider past developments of urban, mobility, and touristic structures that reflect the continuous evolution process of the city. The past and the future are intrinsic characteristics of the modern city, which do not exist in isolation but in a series of functional or spatial associations, co-evolving and dynamically stabilising the city system.

The consideration to use UNESCO-affiliated WHSs included the availability of the following:

- A pre-selection and categorisation of sites based on the UNESCO criteria for a WHS (UNESCO, 2019c; UNESCO, 1972).
- Guidelines, manuals, and procedures provided by UNESCO as a foundation to understand the regimes and rules (see MLP Section 3.3), organisational structures, hierarchies, responsibilities, etc.
- New technology concepts, research, and suggestions for sites provided by UNESCO (UNESCO, 2015; UNESCO, 2019b).
- Documentation and information available online (nomination application, site inventory description, meeting minutes, annual reports, etc.), with UNESCO considered a reliable source.
- Predefined spatial delimitation of the sites available online as published maps.
- An expected higher comparability of sites due to the same guidelines provided by UNESCO (dependent on the local implementation).
- An expected higher knowledge of the site by people in charge of the management of the site.
- An expected higher and active willingness to participate in this study by the people in charge of the management of the site.

The geographical selection process of a UNESCO global region was mainly determined by the following:

- Language skills of the researcher.

- Feasibility and cost awareness of site visits.
- Density and number of WHS within a UNSECO region, with the focus on the number of historic cities.
- Available statistics of tourism key figures, new technology use, and provision of apps (focus on tourism apps).

4.3.3. The Survey Sample Selection Process

Based on the above-outlined criteria, the final selection was made and the study area was conducted among UNESCO classified ‘Historic Cities’ identified via the search tool on the UNESCO website (UNESCO, 2016b). Based on geographical considerations, the UNESCO Region ‘Europe & North America’ was selected, comprising 113 cities in 39 countries (see Table 2).

List of UNESCO World Heritage Cities in Europe & North America				
#	Country	Cities	# WHS	WHS in Danger
1	Albania	1	1	
2	Austria	3	4	1
3	Azerbaijan	1	1	
4	Belgium	1	1	
5	Bosnia-Herzegovina	1	1	
6	Bulgaria	1	1	
7	Canada	2	2	
8	Croatia	3	3	
9	Cyprus	1	1	
10	Czech Republic	4	6	
11	Estonia	1	1	
12	Finland	1	1	
13	France	8	9	
14	Germany	7	8	
15	Greece	3	3	
16	Holy See	2	2	
17	Hungary	1	1	
18	Israel	2	2	
19	Italy	18	18	
20	Latvia	1	1	
21	Lithuania	1	1	
22	Luxembourg	1	1	
23	Malta	1	1	
24	Montenegro	1	1	
25	The Netherlands	1	2	
26	Norway	2	2	
27	Poland	4	4	
28	Portugal	4	4	
29	Romania	1	1	
30	Russian Federation	2	3	
31	San Marino	1	1	
32	Slovakia	3	3	
33	Spain	14	14	
34	Sweden	3	3	
35	Switzerland	2	2	
36	the Former Yugoslav Republic of Macedonia	1	1	
37	Turkey	2	2	
38	Ukraine	1	1	
39	United Kingdom	6	6	1
Total	**39**	**113**	**120**	**2**

Table 2 UNESCO 'Historic Cities' Europe & North America 2016 (UNESCO, 2016)

Furthermore, cities within the UNESCO region not themselves classified as a ‘Historic City’ but with multiple WHS within the city boundaries were also included in the sample (see Table 3). Overall, eight cities with a total of 20 World Heritage Sites met this criterion and were selected.

List of cities in Europe & North America containing min. 2 UNESCO WHS				
#	country	city	#WHS	danger
1	Belgium	Brussels	2	
2	Germany	Berlin	3	
3	Italy	Rome	2	
4	Italy	Tivoli	2	
5	Netherlands	Amsterdam	2	
6	Russian Federation	Moscow	3	
7	Spain	Barcelona	2	
8	United Kingdom	London	4	
Sub-Total	**7**	**8**	**20**	**0**

Table 3 UNESCO WHS in selected European Cities (UNESCO, 2016)

The complete online survey sample contained 113 UNESCO-listed World Heritage 'Historic Cities' and eight cities for a total of 121 cities and 140 WHS in 39 countries under investigation (see destinations list in Appendix II Section 1.1).

4.3.4. Sampling

The sample for the online survey involved persons involved in the touristic management of the city or the WHS management of a destination within the selected study area. Potential respondents were identified, and contact details generated via online research of tourism-related websites, city- or government-related websites, and thorough research of online UNESCO documents (reports, applications, or meeting minutes).

If the relevant responsibilities for tourism mobility management rested with two or more persons from different actor groups at one destination, all relevant persons were contacted. Thus, multiple responses from one destination were possible. Within the study, this situation emerged mainly when one person was in charge of tourism management and another was responsible for mobility aspects.

4.3.5. Pre-Test

A pilot of the online survey was conducted to check the wording of the questions, the structure, and the setup of the survey, and to double-check the online form, contact process (via e-mail), and the submission of the finished survey.

For the test, five volunteers were asked to take the survey. The volunteers were two active tourism managers from destinations not included in the survey, two postdoc researchers working in tourism research, and one postdoc researcher from the field of transportation studies. The volunteers were provided with a dedicated e-mail account set up to test the e-mail containing the survey cover letter and link. In accordance with the feedback of the test

respondents, the length of the survey was shortened, and some questions were rephrased to enhance their clarity.

4.3.6. Survey Execution and Response

The questionnaire was distributed via SurveyMonkey, which is a cloud-based, online survey platform. The 133 potential respondents were sent invites via encrypted e-mails. The e-mails contained information about the research background and purpose, the researcher, and contact details. In addition, the link to the online survey was included and an information sheet outlining confidentiality and anonymity was attached.

In case no response was received within two weeks after the initial e-mail, the respondent was contacted with a follow-up e-mail. This process also applied to respondents who started but did not complete the online survey on SurveyMonkey within two weeks. A second and third follow-up e-mail were sent out after four and six weeks of the initial invitation e-mail. The online survey was conducted from 1st July 2017 until 30th September 2017.

An average response rate between 20% and 60% was identified during a literature review of similar online surveys (Scholochow, Fuchs and Höpken, 2010; Kim, Connolly and Blum, 2014; Lu et al., 2015; Deutskens et al., 2004). A response rate of around 60% was expected.

Based on this previous research and consideration of other factors, such as the following:

- Thematic relevance (e.g. digital transformation trend, mobility issues in touristic cities) of the research.
- Research activities in and with the cooperation of UNESCO WHS management (UNESCO, 2018c).
- The proactivity and willingness of the government and management to go through the nomination and application process to become a UNESCO WHS and comply with regulations and monitoring.
- The potentially more frequent training offered by or communicated via UNESCO to keep the participants up to date regarding technologies and trends.
- The potentially greater interest regarding enhanced yielding at the destination by utilising the added value of the UNESCO status.

Eighty-one surveys were returned. Thus, a response rate of 61% was achieved. The responses were from 29 countries. The high response rate and personal feedback from respondents indicated that the topic of the online survey was of great interest to the respondents.

The survey was designed in accordance with the research ethics regulations of the university (UREC Registration No: 171115), and approval was granted on 12th June 2017.

4.3.7. Data Analysis

The questionnaires were sorted, data coded, and analysed using the Statistical Program for Social Sciences (SPSS Version14).

Descriptive techniques such as frequency, correlation (Pearson correlation coefficient calculations), and crosstab analysis were used to analyse nominal variables, including socioeconomic factors, morphological and interpretive indicators, and the practical utilisation of online mobile media devices and apps. Levels of awareness, acceptance, and policy integration of online mobile media devices and apps were evaluated by frequency and mean analyses. Correlation analysis was applied to identify and substantiate statistically significant relationships between relevant variables. The detailed discussion of results and findings is in Chapter 5.

4.4. Qualitative Research Design

A qualitative approach was used for the in-depth analysis of the tourism mobility systems and the innovation processes of the Austrian case cities of Vienna, Salzburg, and Graz. Chapter 6 contains an overview of the tourism mobility situation in Austria while in Chapter 7 to 9, the case cities are analysed in detail.

In accordance with the constructivist approach of the study and the applied sequential mixed-methods research design, the design of the semi-structured interviews was based on the findings of the literature review and from the first empirical phase (online survey).

Overall, the second empirical phase set out to generate data for the discussion of research objectives RO 2A, RO 2B, and RO 3.

RO 2A Gain an in-depth understanding of landscape **pressure**s as well as niche innovations that affect the innovation of the tourism mobility systems

RO 2B Gain an in-depth understanding of the **regime configuration and dynamics and processes at regime level**, which shape the innovation of tourism mobility systems

RO 3 To conduct a multi-level perspective analysis to **understand holistically the innovation processes and phases** of tourism mobility systems

RO 2A and RO 2B provide input for a case-specific MLP analysis of each case city, whereas RO 3 seeks to merge findings of the three case cities and develop an overall and generalisable understanding of reoccurring innovation processes and phases of tourism mobility systems in European tourist-historic towns.

4.4.1. Case selection criteria

The three Austrian case cities were selected for the in-depth analysis of the innovation of processes of local tourism mobility systems, due to the fact that all three case cities are subjected to the same national farmwork in terms of transport policies and laws, national mobility management and development plans, tourism development plans (e.g. Plan T) and digitalisation initiatives and plans. (see in detail Appendix III). However, on local level the three case cities show different levels in their:

- touristic utilisation of the site,
- prioritisation of tourism mobility,
- strategic approach to use tourism mobility for destination and city management,
- (digital) innovation levels as well as approaches to (digitally) innovate the destination and tourism mobility systems.

Thus, the three Austrian case cities constitute a homogeneous sample in terms of the national policy framework but, are heterogeneous in terms of virtual and physical mobility at city level. This constellation provides site-specific context to innovation developments and thus, allows a detailed and contextual MLP analysis of different local tourism mobility systems.

The heterotic case city sample adds to the elaboration of the Innovation Phase Model (see section 10.4) which builds on the identification of similar innovation phases of different contextual and spatial tourism mobility systems.

4.4.2. Semi-Structured Interviews

Semi-structured interviews were employed for the second empirical data collection. The interviews were designed to investigate further the findings of the literature review and of the first empirical phase (scoping study) and follow the structure of the MLP framework (see in detail Section 3.3). The interviews discussed the heterogenic set of case cities in a unified and structured manner, with the key focal areas being landscape pressures and niche innovations that influence local tourism mobility systems and trigger change at regime level. Furthermore, dynamics at regime level are investigated in detail, with special focus on how actors and actor

groups at regime level deal with novel digital tools and how they react to emerging change mechanisms that are triggered by internal and external changes.

Although the overall aim of this study (namely, to investigate the innovation of tourism mobility systems) is an ongoing process, a historic perspective on tourism mobility systems and transformation processes is necessary to understand the origins and structural evolution of contemporary tourism mobility systems.

4.4.3. Interview Guidelines

The semi-structured interview process was chosen due to its structured yet flexible nature.

> The real purpose of qualitative research is not counting opinions or people but rather exploring the range of opinions, the different representations of the issue. (Bauer and Gaskell, 2000, p. 41)

The semi-structured interview guidelines provided a thematic focus on pre-identified topics and were a time-management tool to optimise the use of the limited interview time. However, the partly open structure also provided some leeway to investigate emerging topics in greater depth (Berger, 2016). The interviews were designed to fit the university's research ethics guidelines and principles. Full ethics approval (UREC Ref Number 181237) was received on the 18th of October 2018.

The interviews were designed to last one hour, starting with a warm-up question and concluding with a feedback question (see Appendix I). The structure of the interviews was divided into five focal areas:

- Basic understanding of the scope, role, and importance of tourism mobility.
- Retrospective and current state of the local tourism mobility system (emergence and status quo).
- Driving factors for change of the tourism mobility system (pressures, innovations, intrinsic or externally driven).
- Change dynamics and handling mechanism at regime level.
- Stakeholder structure, collaboration, and changing stakeholder configuration.

4.4.4. Interviewees

The sample included local and thematic experts on destination and visitor management, mobility management, ICT, digitalisation and online mobile technology infrastructures, and representatives from governmental and NGOs with expertise in the above-mentioned fields (see in detail Table 4).

The analysis of stakeholders involved in the first empirical stage (see Section 5.2.1 and in detail Figure 51) showed that the stakeholder configuration comprises a wide range of actors. Due to feasibility and time issues interviewees were chosen who are in higher positions within an actor group (e.g. CEOs, Head of Department at government) and thus, are more likely to oversee or have a more holistic picture of activities and developments within an actor group (e.g. tourism, mobility / traffic management in the city) and provide comprehensive information on the subject area. Therefore, only six interviewees were interviewed per case city. These interviewees covered the actor groups tourism, mobility, city government with focus on planning, digitalisation, interpretation (tour guides) to cover the perspective of visitors and 'unconnected' visitors and science / academia.

In cases where detailed questions emerged during the interview, interviewees were asked to refer to the expert in the relevant field, who were then contacted. This was mainly relevant for obtaining secondary material such as government papers, masterplans or development plans.

Interviewees were identified via internet research and contacted via e-mail to enquire about their willingness to participate in the interview.

	Interviewee reference in the study	Organisation	Role	Relevance within the tourism mobility system
International	Professor Political Sciences at Ludwig Maximilian University Munich	Ludwig Maximilian University Munich	Professor Political Sciences: Research focus on digital transformation	Input on overarching digital transformation processes of socio-technical systems in cities. High relevance for the discussion on landscape pressures and coping mechanism at regime level.
National	CEO of Austria Tourism	Austria Tourism Organisation	CEO	National perspective on tourism mobility developments, especially under the context of digitalisation. Tourism-centric perspective on pressures on tourism mobility systems. Insights into and comparisons of how tourism organisations in the case cities cope with change dynamics. Insights on tools and niche innovations that shape(d) tourism mobility.
	Professor Information Technologies at Technical University Vienna	Technical University Vienna – Faculty of Computer Sciences	Professor with focus on Information Technologies for Tourism	Insights into technical aspects of digital solutions for tourism mobility. Also strong focus on effects of digital tools on end-user behaviour while consuming touristic places.
Vienna	Head of Mobility Management of City of Vienna	Vienna Holding	Head of Mobility Management Vienna	Insights into the role and relevance of tourism for the traffic management of Vienna. Insights into visitor mobility management considerations and the relevance of novel digital tools for the optimisation of touristic mobility in Vienna.
	Head of PACE	City-Owned Start-Up PACE	Head of PACE (City of Vienna start-up in charge of the digital innovation of Vienna)	Insights into the city's strategic approach on how to integrate novel (digital) tools and on how to manage digital transformation processes. Insights into past digital transformation activities and examples of best practice cases for digital innovation from other city management departments.
	Head of Urban Planning of City of Vienna	City Government	Head of Urban Planning Department	Insights into the role and relevance of tourism and tourism mobility for urban planning. Focus on the historic development of tourism mobility in Vienna. Implications of tourism mobility and digital transformation for city management and development plans. Insights into the collaboration of relevant actors of the tourism mobility system in Vienna.
	Head of Department of Digital Vienna	Digitalisation Department of the City Government	Head of Department	Mainly insights into the strategic plans to transform Vienna digitally. Strong focus on digitalisation of end-user tools to

				enhance urban mobility solutions and consumption of Vienna for residents and visitors.
	Chairlady of Vienna Tour Guides	Association of Tour Guides – Vienna	Chairlady of Tour Guides Austria	Insights into effects of digitalisation of tourism mobility and of increasing availability of interpretive solutions for visitors.
	CEO of Vienna Tourism	Vienna Tourism Organisation	CEO	Insights into the role and relevance of tourism mobility. Insights into the innovation process of the tourism mobility system in Vienna and relevance of stakeholders within this process.
Salzburg	Head of Urban Planning of City of Salzburg	City of Salzburg Holding	Head of Urban Planning	Insights into the role and relevance of tourism mobility for urban planning of Salzburg. Insights into the past development of tourism mobility, discussion of current tourism mobility-related issues within the city, and plans for the future innovation of the urban mobility/tourism mobility system.
	Councilman City Council Salzburg	City Council	Council Man (Green Party)	Insights into tourism mobility relevant issues and the 'over-tourism' debate at city council level. Discussion of historical developments of tourism mobility and perspective on strategic approaches on how to innovate tourism mobility in Salzburg.
	Salzburg Tour Guides	Association of Tour Guides – Salzburg	Head of the Association	Insights into effects of digitalisation of tourism mobility and of increasing availability of interpretive solutions for visitors. Insights into the 'over-tourism' situation of the destination.
	CEO of Salzburg Tourism	Salzburg Tourism Organisation	CEO	Insights into the role and relevance of tourism mobility. Insights into the innovation process of the tourism mobility system in Salzburg and relevance of stakeholders within this process.
	Professor & Head of Transcultural Communication at Salzburg University	Salzburg University – Communication Sciences	Professor & Head of Transcultural Communication	Insights into the 'over-tourism' situation of Salzburg from an academic viewpoint. Focus on digital communication tools to enhance visitor mobility management.
	Chairperson of Mobility Forum Salzburg	Forum Mobility	Chairperson	Insights into the tourism mobility situation from a sustainability viewpoint. Focus beyond urban mobility and on last/first mile, sub-urban, and regional mobility concepts.
Graz	CEO of City Forum Graz	International City Forum Graz (ISG)	CEO	Insights into the actor group and stakeholder configuration relevant for tourism mobility and into regime dynamics relevant for the past and future innovation of tourism mobility in Salzburg.
	Head of Urban Planning of City of Graz	City of Graz Holding	Head of Urban Planning	Insights into the role and relevance of tourism mobility for urban planning of Graz. Insights into the past development of urban and tourism mobility and plans for the future innovation of the urban mobility/tourism mobility system.

	CEO of Graz Tourism	Graz Tourism Organisation	CEO	Insights into the role and relevance of tourism mobility. Insights into the innovation process of the tourism mobility system in Graz and the relevance of stakeholders within this process.
	CEO of Mobility Research Graz	Forschungsgesellschaft (Research Association) Mobilität FGM-AMOR GmbH	CEO	Insights into the role and relevance of tourism mobility for the mobility system of Graz. Insights into the past development of tourism mobility and future innovation tendencies, as well as discussion of involved actor groups and stakeholders.
	CEO of Smart City Graz	City-Owned Start-Up	CEO	Discussion on the relevance of tourism mobility in a smart city. Insights into innovation processes of smart mobility systems in Graz. Identification of relevant actors for smart mobility in Graz.
	CEO of Urban Mobility Lab Graz	City-Owned Start-Up	CEO	Insights into the role and relevance of tourism mobility for the UML.

Table 4 List of Interviewees for case studies (Source: own illustration)

4.4.5. Pilot Interview

The first interview was also used as a pilot interview to check the wording, sequence, and understandability of the questions, and to estimate the maximum interview duration. The pilot interview was conducted with the Head of Department of Digital Vienna. The pilot interviewee was informed of his role prior to the interview and was asked to give feedback after the interview. Overall, the pilot did not reveal major shortcomings of the interview design; thus, no changes were made.

4.4.6. Interview Execution

The interviews were conducted between October 2018 and February 2019. Thirteen interviews were conducted face-to-face at the destinations, and eight interviews took place via Skype (7) or telephone calls (1). Twenty interviews were audio-recorded; only the interview via telephone could not be recorded. The interviews lasted, on average, 58 minutes: the shortest took 36 minutes and the longest 1h 32 minutes.

All the interviews were transcribed, and copies were sent to all the interviewees to double-check and validate their statements. No comments or corrections were sent back to the researcher.

To validate the interpretation of the interviewee's statements, the completed case analyses were sent to the relevant interviewees for feedback. Only positive feedback but not requests for amendments were sent back.

4.4.7. Data Analysis

The transcribed interviews were transferred to NVivo Version 8 for text analysis. A codebook (see Table 5) was designed based on the findings of the scoping study and in line with the used analytical tool (MLP).

The key areas of the interviews were as follows:

- Discussion on the role and relevance of tourism mobility within the case cities.
- Elaboration of a more detailed stakeholder structure and actor groups.
- Identification of pressures, niche innovations, and regime dynamics within tourism mobility systems of the case cities (MLP analysis).

- Generating a clearer understanding of the innovation phases of tourism mobility identified in the scoping study.

Code	Description	Example
Tourism Mobility (TM)	Identifies statements of interviewees on the role, scope, and relevance of tourism mobility within the local city/destination system	"Without the tour buses we would have never reached the high amount of day visitors in the city" (CEO - Salzburg Tourism, 2018) (TM)
Stakeholder (ST) Sub-code: • ST-TourismMobility • ST-Tourism • ST-Mobility • ST-Authority • ST-Digitalisation • ST-Other	Identifies stakeholders within the socio-technical tourism mobility system. Sub-codes highlight the key area of their responsibilities. Input for the development of the stakeholder structure and of the socio-technical system map.	"The tourism management organisation is only taking care of touristic marketing." (CEO - Vienna Tourism, 2018) (ST-Tourism)
Landscape Pressures (PR) Sub-code: P-cause P-trigger	Identifies indications regarding perceived pressures on landscape level, which are either caused by tourism mobility or are triggering change dynamics of existing tourism mobility system.	"The increasing number of tourists puts enormous pressure on the city's infrastructures." (Councilman City Council Salzburg, 2018) (P-cause)
Niche Innovation (NI) Sub-code: NI-Tool NI-BusinessModel	Identifies statements that refer to niche innovations, such as novel digital tools or business practices relevant for the overall innovation process.	"With the smartphone, a whole new area of urban consumption on-the-go was triggered." (CEO - Vienna Tourism, 2018) (NI-Tool)
Regime Dynamics (RD) Sub-code: RD-ProActive RD-ReActive RD-Path-dependent	Identifies dynamics at regime level that show how the actor groups/stakeholders coped with pressures or niche innovations penetrating the existing regime setup. Sub-codes mark strategic approaches to deal with change.	"The city government is the clear driver but also coordinator of the digital innovation of the mobility system. And only because of this proactive approach, the innovation was very smooth so far." (Head of Urban Planning of City of Vienna, 2018) (RD-ProActive)
Innovation Phase (IP) Sub-code: IP-Emergence IP-Utilisation IP-StrategicApproach IP-Integration IP-Institutionalisation	Identifies individual innovation phases within each case city and enables a cross-reference to change dynamics, pressures, and emerging niche innovations.	"In this period, the focus was on the mere utilisation of these new tools, so we could gain experience and better understand what can really be done with these mobile devices." (CEO Austria Tourism, 2018) (IP-Utilisation)

Table 5 Codebook of data analysis of interviews (Source: own illustration)

Based on these codes, the text was analysed. For each case city, an MLP model was drafted (e.g. see Vienna, Section 7.9), and findings from the interviews were incorporated into these models. These models illustrate pressures and key niche innovations relevant for the innovation of the systems and provide an overview of innovation processes at a regime level over time.

During the interviews, a range of references to historical documents (e.g. historical guide books, historic urban development plans), policy papers (e.g. urban planning regulations), strategic documents for city management or the development and management plans (e.g. Mobility Masterplan, Urban Innovation Plans) were made, so secondary research on the indicated literature was conducted after the interviews. Relevant material was incorporated into the case analysis.

4.5. Chapter Conclusion

This chapter explained the methodological design of the study. Due to the complexity and substantial number of data necessary to understand the innovation processes of tourism mobility systems, a stepwise investigation of the research objectives was pursued.

In the first empirical stage, a scoping study provided an initial quantitative overview of the current state of tourism mobility systems and generated evidence on existing innovation processes in tourist-historic cities across Europe. Based on the findings of the scoping study and the literature review, an in-depth study on Austrian case cities was designed as the second empirical stage. The interviews provided input for a detailed elaboration of innovation processes of tourism mobility systems in each case city.

The MLP functioned as the basic concept for data generation and data analysis throughout the study.

Based on the methodological design the scoping study of the first empirical stage was conducted in UNESCO World Heritage Cities in Europe. The following chapter discusses the findings of this scoping study and thus, builds also the basis for the second empirical stage, the case studies.

5. The Current State of Tourism Mobility in European UNESCO World Heritage Cities

In the literature review, a lack of research and significant gaps in the fundamental understanding of the concept and the setup and current state of tourism mobility systems were identified. Although, in literature tourism mobility is considered an increasingly relevant aspect for sustainability of touristic places and mobility structures, no detailed facts and figures nor a basic understanding regarding the functioning of the socio-technical tourism mobility system and the effects of touristic mobility on related systems and environments have been established to date.

Therefore, a scoping study was conducted to generate a basic understanding of the overall setup and current state of tourism mobility in historic cities in Europe. The findings of this scoping study provided the basis for the subsequent in-depth study on the three Austrian case cities. The case cities of Vienna, Salzburg, and Graz were included in the scoping study to generate more details on the existing local tourism mobility systems and to establish a certain comparative perspective on the three cities in the context of the other selected 78 UNESCO WHSs in Europe.

As outlined in the methodology (see Section 4.3), an online survey was devised and sent to 133 respondents in 120 destinations. The online survey was designed to investigate the prevailing situation of touristic mobility onsite and set these findings in the context of the overall touristic utilisation and key spatial characteristics of the sites. In addition, insights into existing management and governance aspects relevant for the manage and control of visitor movement and for guiding the innovation of the local tourism mobility systems structures were also generated. To complete this first exposition of contemporary tourism mobility systems of the selected European historic cities, an overview of the current utilisation of digital tools for tourism mobility management was included.

The generated data were analysed using the MLP. To set the background for the MLP analysis, an overview of the sample is given that provides information on respondents as well as on relevant characteristics of the sample sites, such as touristic facts and spatial characteristics. These findings are also incorporated into the subsequent MLP analysis of survey results. The MLP analysis allows first insights into a generalised system actor configuration that reflects the actor group setup at regime level. Furthermore, initial insights into prevailing pressures that trigger change in local tourism mobility systems are given as well as key digital innovations that penetrate destinations are outlined. These findings allow

an initial analysis of hindering and driving factors for an innovation of tourism mobility systems within the sample and exemplify change dynamics and processes on regime level.

5.1. Sample Overview

Before a detailed discussion on the current state of the tourism mobility systems of the sample sites (see Section 5.2), an overview of relevant key parameters, such as destination characteristics (see Section 5.1.2) and a brief respondents' profile (see Section 5.1.1), is presented.

5.1.1. Respondents' Profile

The sample for the online survey was identified using a selection process, as described in detail in Section 4.3.3. Overall, 133 potential respondents in 120 destinations and 39 countries were identified and invited via e-mail to participate in the online survey from July until September 2017. One hundred and two people responded to the invitation e-mail and returned the survey (see Table 6). Of the 102 responses, 20 did not consent to participate in the survey and thus were excluded from the final analysis. A total of 81 qualified responses were used for the following analysis of the current state of the tourism mobility system in European historic cities listed as UNESCO WHSs. The response rate reached an expected 60.9%. The responses originated from 29 countries located in the UNESCO predefined area 'Europe and North America' (UNESCO, 2016b).

Survey Overview	Responsents	
	in numbers	in %
Sent out	133	100.0%
Returned	102	76.7%
Not returned	31	23.3%
No Consent	20	15.0%
Qualified	81	60.9%

Table 6 Online survey completion overview (Source: own illustration)

The majority of respondents were between 25 and 55 years of age and had graduated from college. Although the majority were in charge of the destination management of a historic city and played an active role in decision-making processes for the innovation of the local tourism mobility system, a notable difference in their key responsibilities was identified. Most respondents focused either on destination marketing, tourism management, city or destination management activities (N=81; see Figure 14). These data were generated via an open-ended

question that asked the respondents to describe briefly their key tasks. This method was used to avoid distortion of data due to unclear or disparate job titles.

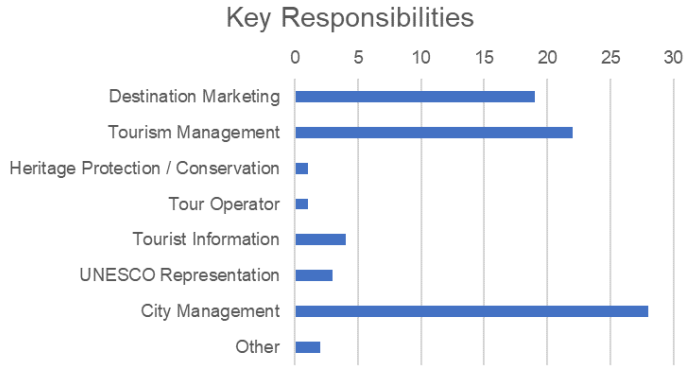

Figure 14 Respondents' key responsibilities (Source: own illustration)

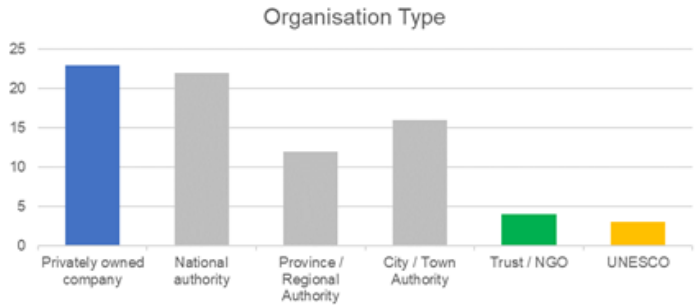

Figure 15 Organisation type participating respondents work in (Source: own illustration)

However, a cross-reference of key responsibilities and employer types (N=80; see Figure 16) highlighted that respondents working for government-related organisations were not only strongly involved in city management, but also in destination marketing and tourism management activities. This finding indicates that, at many sites, government-related organisations strongly influenced not only the infrastructural and mobility part of tourism mobility systems, but also the tourism part. More insights are necessary to understand whether governmental organisations act as ‘connectors’ between tourism and the mobility regime, and it is also unclear how much power governmental organisations (GOs) possess to influence and steer tourism mobility operation and innovation activities.

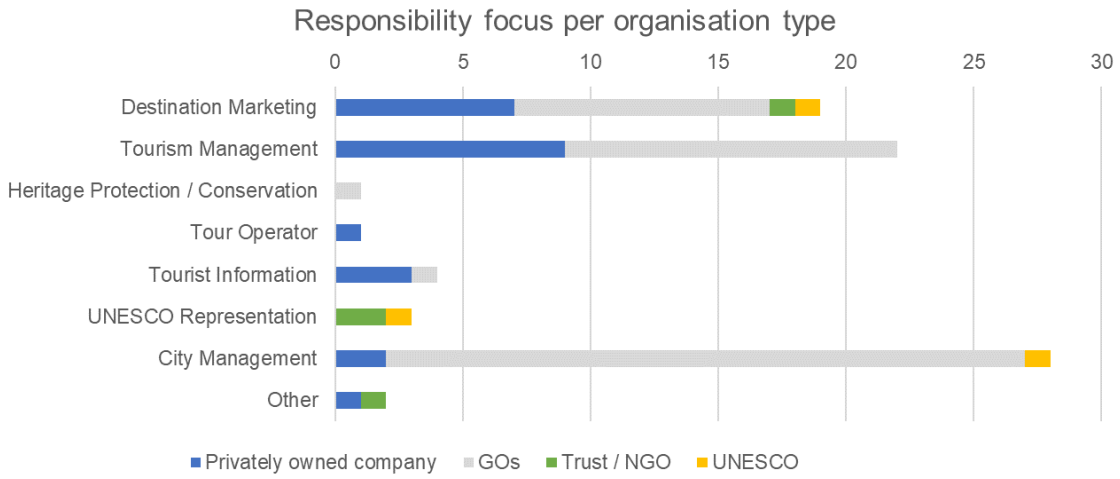

Figure 16 Responsibility focus per organisation type (Source: own illustration)

Technology awareness, acceptance, and innovativeness

The integration and utilisation of new technologies not only depend on the availability and suitability of digital solutions, but primarily on the willingness of decision-makers to use newly available technologies to innovate existing structures. The awareness of decision-makers of new technological possibilities and their capabilities is a key factor to enable and start innovation processes. Acceptance, attitude, and use behaviour of stakeholders towards new technologies strongly affect the depth of diffusion, speed of integration, and the long-term resilience of innovated systems.

The overview of the respondents' general technology awareness provides a baseline of the respondents' self-perceived experience with and knowledge of OMTs. The majority of respondents perceived their awareness of current OMT trends as high (21% as very high and 67% as high), and they indicated actively trying to stay up to date regarding new trends and novel devices and apps.

This positive approach to staying informed regarding OMT novelties was also reflected in the respondents' attitude towards the use of OMTs, with the majority (48.1%) not minding, and even enjoying working with OMTs for business purposes (25.9%; see Figure 17).

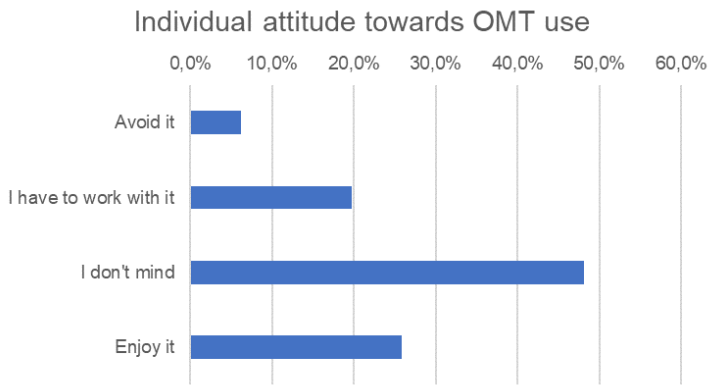

Figure 17 Individual attitude to use of OMTs for business (Source: own illustration)

Furthermore, the majority (49.4%) of respondents agreed that up-to-date knowledge of OMTs is important for their job performance (N=81; see Figure 18).

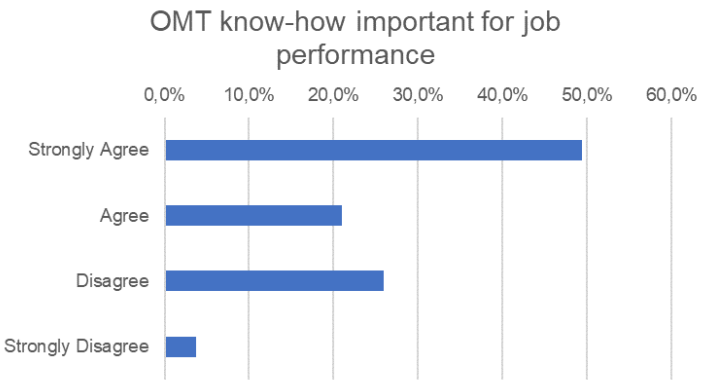

Figure 18 Professional OMT knowledge importance (Source: own illustration)

However, only a small share of organisations seemed to offer OMT-related training for employees. Nevertheless, the respondents indicated that a larger share of organisations was supporting a professional exchange on OMT topics and providing budgets for participation at conferences, trade fairs, or workshops (e.g. IT training, e-commerce; see detailed findings in Appendix II Section 2).

Throughout the analysis of the online survey, an active professional exchange with experts and colleagues was repeatedly identified as benefiting the overall innovation of the destinations. In particular, a critical discussion of the current innovation level and the quality of existing OMT solutions onsite was fostered, as well as a higher level of innovativeness of

destination management being triggered through an elevated level of professional exchange and networking.

Overall, the attitude of the respondents' employers towards integrating OMTs for tourism mobility management onsite was predominantly perceived as reserved (53.1%) or negative (23.5%), with only one respondent considering the attitude of the organisation as positive (N=81; see Figure 19).

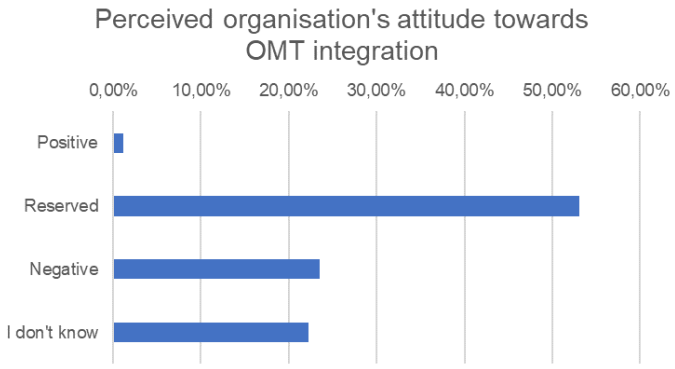

Figure 19 Organizational attitude towards OMT use (Source: own illustration)

This finding corresponds with the perceived innovation level of the respondents' destinations, which was considered low (N=81; Figure 20).

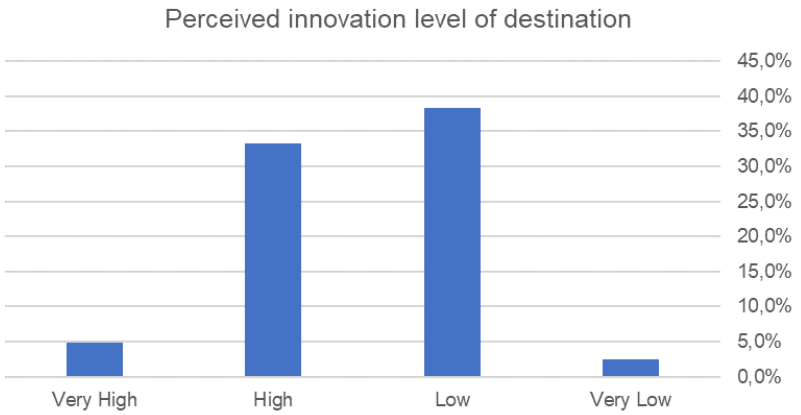

Figure 20 Perceived innovation level of destination (Source: own illustration)

However, by calculating the Pearson correlation coefficient, a statistically significant, positive correlation ($r(78) = .53$, $p = .000$) revealed that the innovation level was perceived as higher in destinations that were also capital cities.

Nevertheless, the respondents clearly considered start-ups (48%) as lead innovators for an OMT upgrade of the destinations, whereas destination management organisations (DMO) and city governments were only perceived as 26% and 21% as lead innovators, or (N=19; see Figure 21). These findings were generated via an open-ended question to identify the respondents' opinions on the most relevant actor to trigger and pursue innovation onsite.

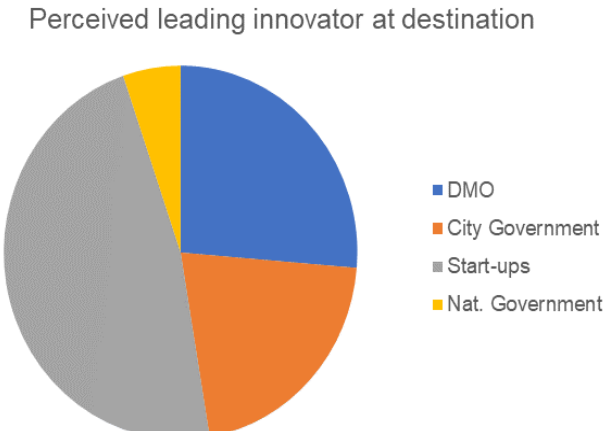

Figure 21 Perceived lead innovator (Source: own illustration)

The above findings provide a highly relevant context for the establishment of an understanding of the current state and innovation drivers, triggers for change, and transformation dynamics of tourism mobility systems in the sample. Within the MLP, change and innovation are guided and addressed by (regime) actors of the socio-technical system(s); thus, it is crucial to capture the background, motivation, and capabilities of the actor groups first before a detailed MLP on innovation processes and dynamics can be conducted.

5.1.2. Key Characteristics of Visitor Destinations

In the same way, the actors (respondents of the survey) constitute a crucial context for an informed MLP analysis of the survey data, it is also necessary to discuss the touristic-utilised spaces – in this case, the UNESCO-listed World Heritage cities.

Before elaborating on the MLP, secondary research (mainly via statistical websites of cities) was conducted to obtain a clearer understanding of the touristic and spatial situation in the sample cities. An overview of tourism indicators (e.g. visitor numbers per year or length of stay of visitors), some demographic data of the cities (e.g. number of inhabitants), and spatial characteristics (e.g. city size, morphological characteristic) was generated. In addition,

relevant UNESCO-related parameters, such as the size of the UNESCO-listed area or membership status (e.g. listed as 'World Heritage in Danger'), were summarised.

These data provide a context for the current setup and, to a certain extent, for the evolution of tourism mobility systems within the sample.

5.1.2.1. World Heritage Site characteristics

The 81 responses originated from 71 destinations in the UNESCO World Heritage program with one or multiple WHSs onsite.

The inscription years of the participating destinations ranged from 1980 to 2009, with most inscriptions in 1980, 1997, and 1999 (N=81; see Figure 22).

Among the Austrian case cities, Salzburg was the first city to inscribe as a WHS, in 1996, followed by Graz in 1999 and Vienna in 2001.

Several of the sample sites were extended over the years, among them Graz.

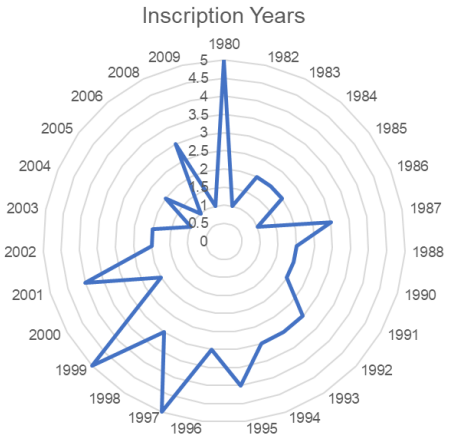

Figure 22 Inscription years of WHSs (Source: own illustration)

One open-ended question concerned the motivation of the sites to become a UNESCO WHS. The most common motivation was to enhance the global visibility of the destination (27%), followed by attracting more tourists (21%). Both options were mainly provided by smaller sites not located within or close to larger cities. Further answers referred to the historic and cultural value of the site, with 7% of the respondents considering the nomination as WHS to highlight the historic value (see Figure 23). Few destinations had very specific reasons to become a WHS, such as Graz (AUT), which indicated that the inscription was part of the city's development plans to diversify the city's utilization.

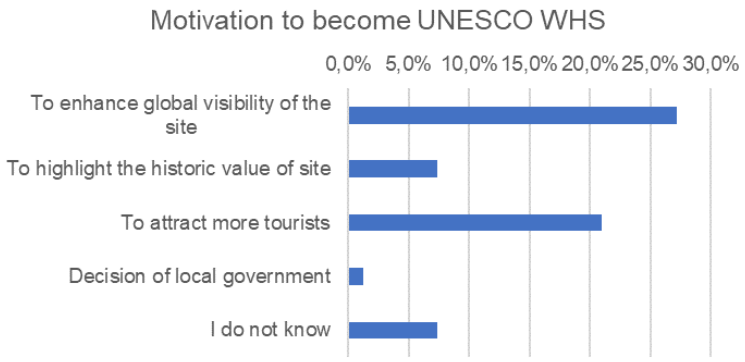

Figure 23 Motivation to become UNESCO WHS (Source: own illustration)

Two WHSs, Liverpool (UK) and Vienna (AUT), were listed as 'World Heritage in Danger'. In June 2012, the World Heritage Committee placed the Maritime Mercantile City in Liverpool on the 'endangered list' due to the proposed construction of Liverpool Waters, a redevelopment of the historic docklands north of the city center. In July 2017, Vienna was added to the 'endangered list' by the WH Committee due to concerns about redevelopments in the inner city, such as the rapidly increasing number of loft conversions, which alter the roofscape, and the redevelopment project of the Vienna Ice-Skating Club. These redevelopments were identified as adversely impacting the cityscape, and thus would endanger the outstanding WHS value of Vienna (UNESCO, 2017). Worldwide, 53 WHSs are listed as endangered, with four sites in the UNESCO region of 'Europe and North America'.

On a national level, the countries with the highest number of UNESCO WHSs in the sample were Italy (54), Spain (47), France (44), and Germany (44; (UNESCO, 2016a), which were also the countries with the most participating historic cities in the online survey: Italy (18), Spain (14), Germany (7), and France (6).

An analysis was conducted to determine whether WHSs within a country have the potential to impact the country's tourist performance. A statistically significant, positive correlation ($r(27) = .90$, $p = .000$) was identified between the number of WHSs in the country and the number of international tourist arrivals in the participating countries in 2017. Thus, UNESCO WHS-listed historic cities can be considered a strong touristic pull factor for visitors.

		Number of WHS sites in country	Internat Arrivals in 2017
Number of WHS sites in country	Pearson Correlation	1	.903**
	Sig. (2-tailed)		.000
	N	29	29
Internat Arrivals in 2017	Pearson Correlation	.903**	1
	Sig. (2-tailed)	.000	
	N	29	29

** Correlation is significant at the 0.01 level (2-tailed).

Table 7 Correlation - Number of WHS and international arrivals 2017 (Source: own illustration)

The findings stress the high relevance of the nomination as a WHS for national, regional, and local tourism and tourism mobility systems. Although WHSs provide valorisation and bring added value to regions and cities, higher touristic pressures on the destination and the tourism mobility system can also be expected and must be considered for development and management plans.

5.1.2.2. Spatial Characteristics

The perceived touristic pressures on destinations depend also on the spatial characteristics of a site. A spatial analysis of the participating destinations provides an overview of the destinations' size and the share of the WHS area (for complete findings, see Appendix II Section 1.1). Regarding tourism mobility, the destination size and its layout are considered highly relevant because size and structure influence the destination system configurations (Gunn, 1988), and thus also the tourism mobility infrastructure.

The destinations' size refers to predefined city boundaries. In the sample, 32 destinations covered an area of less than 100 square kilometres, and eight destinations occupied an area over 1,000 square kilometres, with Valletta (MLT) having the smallest area (0.80 km^2) and Baku (AZE) being the largest city, covering 2,130 square kilometres (see Table 8).

Destination Size in km^2 (N=71)	**<100 km2**	**<200 km2**	**<500 km2**	**<1,000 km2**	**>1,000 km2**
	32	13	14	6	8

Table 8 Destination size of participating WHS (Source: own illustration)

Focusing on the WHSs, they commonly occupied a small area of the destination, with the majority of WHSs being under 1% to 3% of the spatial share of the overall destination (see Table 9). Only in four destinations did the WHS area cover the entire destination area, such as Costiera Amalfitana, or go beyond city limits (Historic Town of Banská Štiavnica and the technical monuments in its vicinity, Droogmakerij de Beemster, Portovenere, Cinque Terre

and the Islands). The WHS areas covering 100% or more were either a conglomerate of connected historic towns combined into one WHS-listed cultural landscape or small historic towns listed together as a WHS Historic City and beyond the registered city boundaries (see Appendix II Section 1.1).

WHS Area/Destination Area (N=73)	<1%	<3%	<5%	<10%	<50%	<80%	100%	100%+
	36	15	6	8	2	1	1	3

Table 9 Site ratio – WHS area within destination area (Source: own illustration)

The N is 73 because three WHSs were in Berlin.

5.1.2.3. Tourism Characteristics

The three key touristic indicators used in this study were the number of tourist arrivals, number of overnight stays, and number of day-visitors (for complete findings, see Appendix II Section 1.2).

Numbers regarding tourist arrivals are commonly generated by authorities at destination gateways such as airports or cruise ship terminals, whereas numbers of visitors staying overnight are provided by registered, local accommodation providers. These two indicators use collected data. However, day-visitor numbers are commonly estimations from statistical institutions and only provide a rough idea of visitor volumes at the destination. Although the number of arrivals depends highly on the existence of controlled gateways, the number of overnight stays shows the nights spent at the destination but omits the number of tourists visiting the destination without staying overnight.

To study tourism mobility systems, distinguishing between arrivals, overnight stays, and day-visitors is crucial since each indicator refers to different underlying tourism mobility activities. A high number of day-visitors requires a mobility management focus on visitor routing, visiting velocity, succinct heritage interpretation methods, and gateway management. However, destinations with extended overnight stays are more likely to focus on (long-term) parking facilities and suitable onsite transportation facilities (taxis, short-term rentals, tourism-friendly public transport, etc.), more diverse heritage interpretation modulation, and a larger choice of different touristic routes, and adequate touristic infrastructure.

Within the limits of the data on the sample destinations, Paris (FRA), Vienna (AUT), Rome (ITA), Florence (ITA), and Warsaw (POL) had the highest estimations of day-visitor numbers (N=36; see Figure 24). Paris (FRA), Rome (ITA), Berlin (GER), Vienna (AUT), and Budapest (HUN) ranked highest for tourist arrivals (N=26; see Figure 25). Paris (FRA), Berlin (GER),

Rome (ITA), Tel-Aviv (ISR), and Vienna (AUT) reported the highest number of tourist-overnight stays in 2017 (N=24; see Figure 26).

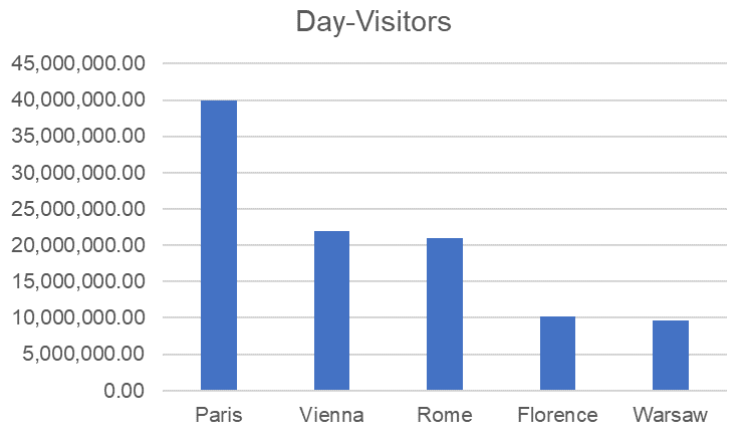

Figure 24 Top 5 destinations by day-visitor numbers in 2017 (Source: own illustration)

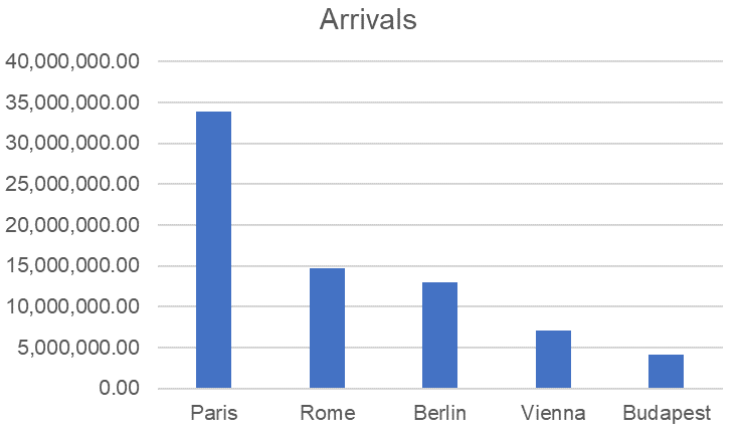

Figure 25 Top 5 destinations by arrival numbers in 2017 (Source: own illustration)

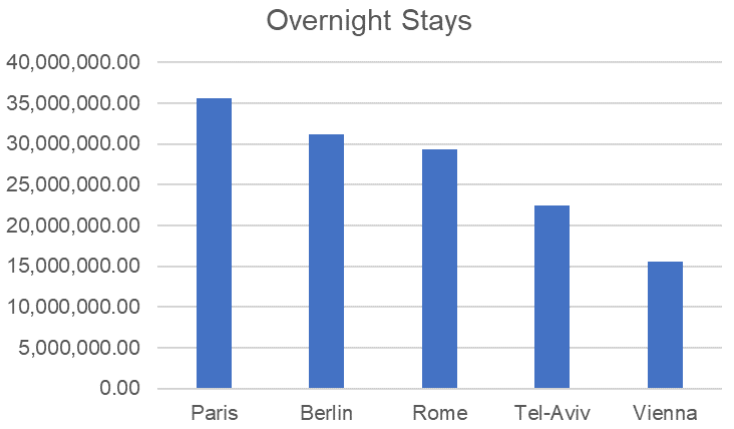

Figure 26 Top 5 destinations by overnight stays (Source: own illustration)

This analysis illustrates the significance of Vienna as a leading touristic destination in Europe. Although Salzburg is no match for the European metropolises, such as Paris and Rome, it had an estimated 6.5 million day-visitors, around 1.7 million arrivals, and 3 million overnight stays in 2017. No estimations of Graz's day tourism are available; however, the city had around 624k arrivals and 1.1 million overnight stays in 2017.

More significant for establishing an understating of potential touristic pressures on a living environment is the ratio of day-visitors per inhabitant (UNWTO, 2019b; Milano, Novelli and Cheer, 2019; Namberger et al., 2019). In the survey sample, Beemster (NDL) and San Gimignano (ITA) were the destinations with the highest ratios beyond 500 tourists per inhabitant in 2017. Brugge (BEL), Salzburg (AUT), and Carcassonne (FRA) followed in ranks 3 to 5. However, these destinations had far lower tourist ratios per inhabitant in 2017. Due to the unavailability of data, only 35 destinations could be included in the comparison (N=35; see Table 10).

	Destination	Country	Day-Visitors / Inhabitant
1	Beemster (Amsterdam)	Netherlands	564.7
2	San Gimignano	Italy	514.1
3	Brugge	Belgium	44.9
4	Salzburg	Austria	44.3
5	Carcassonne	France	37.0

Table 10 Top 5 destinations by day visitor per inhabitant ratio in 2017 (Source: own illustration)

The majority of destinations ranged between a day-visitor/inhabitant ratio of 11 to 30 (N=35; see Table 11), which can be considered a strong touristic impact (Almeida R. et al., 2020). Vienna is part of this majority, with a ratio of 11.6. For Graz, no ratio is available due to no estimation of day-visitor numbers being identified.

Day-Visitors per Inhabitant 2017	**<5**	**<10**	**<20**	**<30**	**<50**	**<80**	**<100**	**>100**
(N=35)	7	8	12	3	5	0	0	2

Table 11 Day visitors per inhabitant overview of participating sites (Source: own illustration)

The relevance of the day-visitor per inhabitant ratio also corresponds with the respondents' predominant agreement that tourisitic pressure on their destinations was increasing (N=81; see Figure 27). The literature supports the findings by drawing close connections between perceived pressures on a destination and the number of day-visitors at the destination (UNWTO, 2019b; Milano, Novelli and Cheer, 2019; Namberger et al., 2019). The spatial

characteristics of destinations are an additional factor impacting the perceived intensity of touristic pressures at a site. This correlation is highly relevant for this sample because the majority of the investigated WHSs occupy small areas and are commonly characterised by densely built-up spaces.

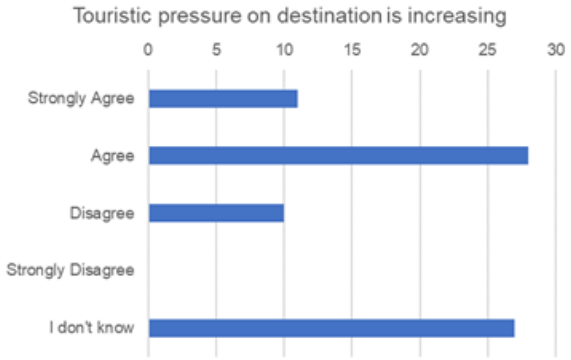

Figure 27 Perceived increase of touristic pressure on destination (Source: own illustration)

5.1.2.4. Touristic Movement at the Destinations

The focus of this study is touristic movement at destinations. However, the arrival mode of tourists and visitors to the destinations is also vital. Arrival mode is strongly linked with the setup and management of the destinations' gateways and shapes the touristic movement at sites.

In the sample, the arrival mode was dominated by tour bus transport (69%), followed by private cars (25%), planes (4%), and trains (1%; see Figure 28). Walking was the most prominent mode for tourists and visitors to explore the sites. Walking visitors were also identified by 88% of respondents as the main producers of tourism-related overcrowding and congestion in the participating historic cities, followed by tour buses (12%).

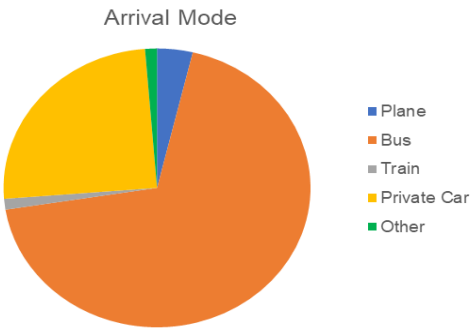

Figure 28 Overview of arrival mode of tourists to destinations (Source: own illustration)

In the three case cities, and with 89% of the respondents, the survey indicated that tourism-induced overcrowding was increasing in their WHSs. Touristic movement at the destination and the gateways of the sites are key challenges for the participating WHSs. Nevertheless, the respondents agreed that digitally (OMT) supported visitor management can influence how visitors reach the destination and move within the destination. Thus, one key motivator for the digital innovation of tourism mobility systems is the perceived aid of OMTs to ease touristic pressures at sites. However, the findings also indicate that the digital innovation of local tourism mobility systems is perceived as highly difficult. To identify the current state, key hindering factors and challenges, and potentials, the findings of the online survey were analysed through the lens of the MLP.

5.2. Status Quo of the Tourism Mobility System in the Participating World Heritage Sites

The MLP was used to elaborate a generalised overview of the stakeholders involved and the current configuration, and to identify the innovation dynamics of tourism mobility systems in Europe. These findings function as a baseline but also as a starting point for the subsequent in-depth discussions on innovation processes within the Austrian case cities.

The respondents were asked to provide insights into touristic mobility indicators, local digitalisation efforts for tourism mobility, perceived movement and site-consumption behaviour of their visitors, and existing management and governance frameworks relevant for the daily operation and innovation of touristic mobility.

In the below discussion key findings of the survey are summarised and illustrated in schematised MLPs. The illustrations show the identified pressures that trigger system innovation (see Section 5.2.2) and outline the key niche innovations penetrating current tourism mobility systems (see Section 5.2.3) and set them in the context to the innovation processes among actors on the regime level (see Section 5.2.4). Thus, insights into motivations to innovate, innovation tendencies and directions, and the hindering and driving factors for change were produced.

Figure 48 summarises the key findings of the surveys in a schematised MLP. The illustration shows the identified pressures that trigger system innovation (see Section 5.2.2) and outlines the key niche innovations penetrating current tourism mobility systems (see Section 5.2.3) and sets them in the context of the innovation processes among actors on the regime level (see

Section 5.2.4). Thus, insights into motivations to innovate, innovation tendencies and directions, and the hindering and driving factors for change were produced.

5.2.1. System Actor Configuration

Prior to a discussion on pressures, niche innovations, and developments at regime level, it is crucial to draft an initial stakeholder structure. The stakeholder structure outlines the configuration of actor groups at regime level that shape and steer the overall change processes, and thus also the innovation of tourism mobility systems.

As a starting point for the establishment of the stakeholder structure at regime level, the regime structure of the multi-level analysis was used (see Section 3.3). The findings of the survey enabled an initial adaptation of the tourism mobility system actor group setup (see Figure 29).

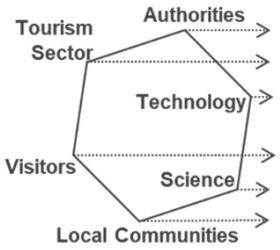

Figure 29 Actor groups at regime level (Source: own illustration)

Most insights into the roles and responsibilities of actors within the tourism mobility system were generated regarding the tourism sector, authorities, and visitors. Little information on stakeholders from science, technology, and local communities was generated. These actor groups need to be further investigated in subsequent case studies to understand better the relevance and role of these actors within the regime structure.

In the sample, the tourism sector and local authorities held key roles in the operation and innovation of local tourism mobility systems. However, due to the cross-sectoral character of tourism mobility, no clear delimitation of individual responsibilities, tasks, and activities could be identified. As outlined in Section 5.1.1, an overall tendency was identified, in which the tourism sector strongly focused on destination marketing and interpreting the site. Although local authorities controlled city management, and thus were more strongly involved in mobility aspects of the system than touristic stakeholders (see Figure 16), the findings also revealed that local authorities engaged in destination management, marketing, and site interpretation.

Thus, local authorities were strongly involved in both parts of the tourism mobility systems, and therefore was the actor who seemed to link the tourism and the mobility part and enabled a joint tourism mobility approach.

Another key role within the stakeholder setup was that of visitors. The visitor is currently evolving from a passive actor, predominantly consuming provided information on the destinations, into an active actor, 'shaping' local tourism mobility structures (see Section 2.10.2). The findings support these statements and highlight a rapid increase of 'prosuming' visitors who are not only using OMT devices for exploring the destination, but also increasingly co-create content.

Based on the literature review, tourism mobility is commonly considered a visitor-centric system (see Section 2.10). Therefore, this study also takes a visitor-centric approach for drafting the stakeholder structure of tourism mobility systems. However, the findings of the scoping study also identified changes in the role and behaviour of diverse actors, with the most significant shifts being among visitors. The findings indicate that different visitor types emerge, including 'connected' and 'unconnected' visitors. Furthermore, the changing behaviour of mainly 'connected' visitors, such as increasing 'prosuming' activities and ad-hoc decision-making, is increasingly impacting existing tourism mobility structures and requires other actor groups to amend their roles accordingly. More insights from the in-depth case studies are necessary to understand the relevance and effects of the shifting behaviour and role of visitors for the visitor-centric stakeholder structure of tourism mobility systems.

Although the scoping study did not provide enough insights to draft the role of visitors within the stakeholder structure, the survey findings revealed the respondents largely agreed that OMT-supported visitor management holds great potential to increase the control of visitors in the urban environment (N=78; see Figure 30).

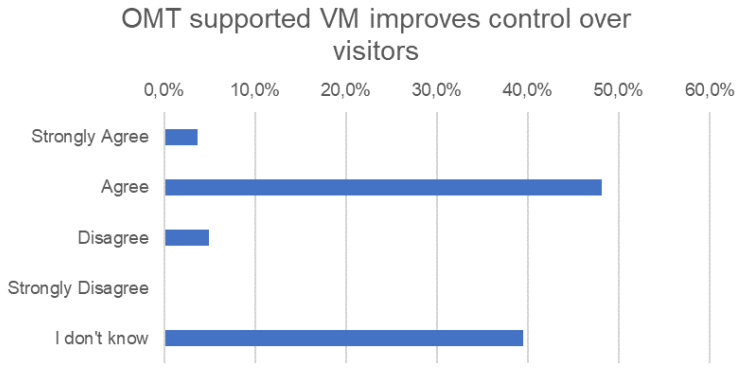

Figure 30 Perceived impact of OMT-supported visitor management to improve control over visitor movement at site (Source: own illustration)

The literature review outlined that the diffusion of OMTs into everyday lives has already progressed and led to noticeable and fundamental changes in human behaviour (see Section 2.10.2). Although a purposive utilisation of OMTs to influence visitor-movement behaviour is in its infancy within the sample, the respondents provided initial insights into OMT-induced changes in visitor behaviour at their destinations (N=78; see Figure 31). The respondents mainly indicated that 'connected' visitors were accessing far more information on the destinations (μ = 2.37) and relevant destinations in the vicinity (μ = 2.15). Furthermore, visitors were increasingly observed exploring formerly less-visited parts (μ = 1.64), which is a highly relevant management implication for strategic regeneration activities. However, OMT-diffused visitor behaviour was also perceived to have increasing volatility of movement, which was mainly ascribed to the growing ad-hoc decision-making habit of 'connected' visitors based on the ubiquitous availability of large amounts of information (μ = 1.62). The ability of OMT-supported visitor management to engage visitors to spend more money on site (μ = 1.24) or to extend the length of their stays (μ = 0.83) was considered least.

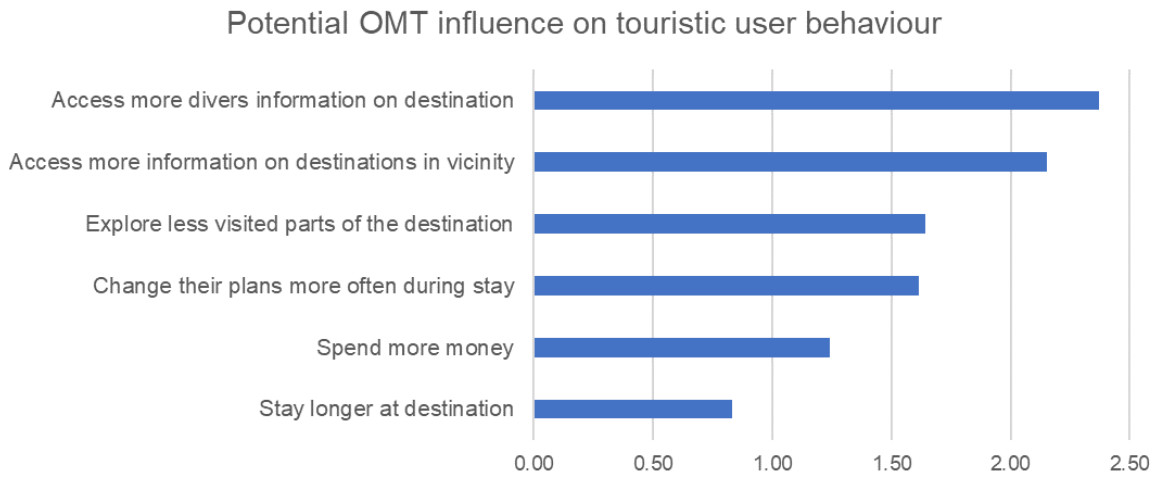

Figure 31 Perceived most relevant influence of OMT on visitor behaviour onsite (Source: own illustration)

Despite these perceived advantages of OMTs as a supporting management tool, the respondents also indicated that 'connected' visitors were more prone to ad-hoc decision-making, and thus changed their plans more often while exploring the destination (N=78; see Figure 32). This finding suggests that 'connected' visitors display more volatile and unpredictable movement behaviour, which has great challenges for systematic, OMT-supported visitor management.

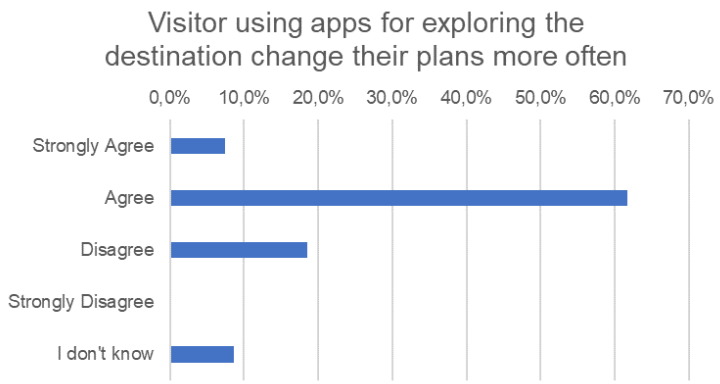

Figure 32 Level of increasing volatility of visitor behaviour of visitors using apps (Source: own illustration)

The above key findings indicate that OMTs are a key aid for enhancing the efficiency of visitor-movement management, but the movement of OMT-penetrated visitors is becoming more volatile and difficult to manage. These findings constitute a substantial controversy, which required more in-depth investigation in the case studies.

One initial explanation for this issue might be related to 65.4% of the respondents not focusing on the provision of digital information (N=81; see Figure 33). However, OMT-induced changes in visitor behaviour were already noticeable at the destinations at the time of the survey. This point suggests that other, mainly external actors were engaging in the provision of digital destination information, and thus played a noticeable role in shaping the 'connected' visitors' behaviour at the destination. This assumption is reflected in the respondents' statements that start-ups were considered key drivers for the innovations of the local tourism mobility system.

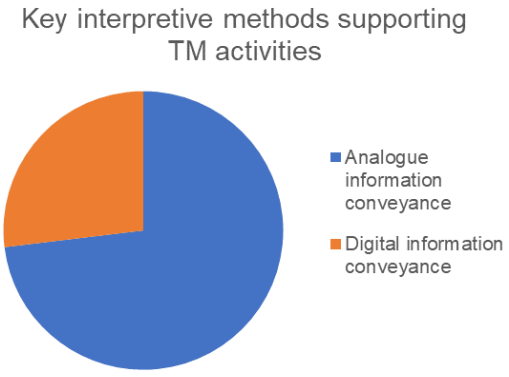

Figure 33 Key interpretive methods used at sites (Source: own illustration)

In addition, these findings again highlight it is crucial to establish a comprehensive understanding of the holistic stakeholder structure and the role and responsibilities of each stakeholder within the actor groups at regime level to understand system processes and transformation dynamics. Furthermore, the relevance of the linkages and penetration of external systems and actors on the local tourism mobility system is also highlighted.

5.2.2. Pressures on the Tourism Mobility System

The stakeholder structure provides a foundation for understanding the internal innovation processes of tourism mobility systems. However, external factors, such as pressures or niche innovations, penetrate existing tourism mobility systems to foster or even trigger change, and thus innovation processes within existing tourism mobility systems.

As outlined in the analytical framework (see Section 3.3), pressures on socio-technical systems commonly emerge at the landscape level. The findings of the survey identified two key developments at the landscape level that were increasingly pressuring tourism mobility systems in historic cities (see Figure 34). In particular, increasing touristic utilisation, which is mainly a result of globalisation, and digitalisation developments, which are mainly reflected in significant changes in visitor behaviour and a rapidly increasing demand for digitally enhanced information at destinations, were increasingly pressuring tourism mobility systems to change.

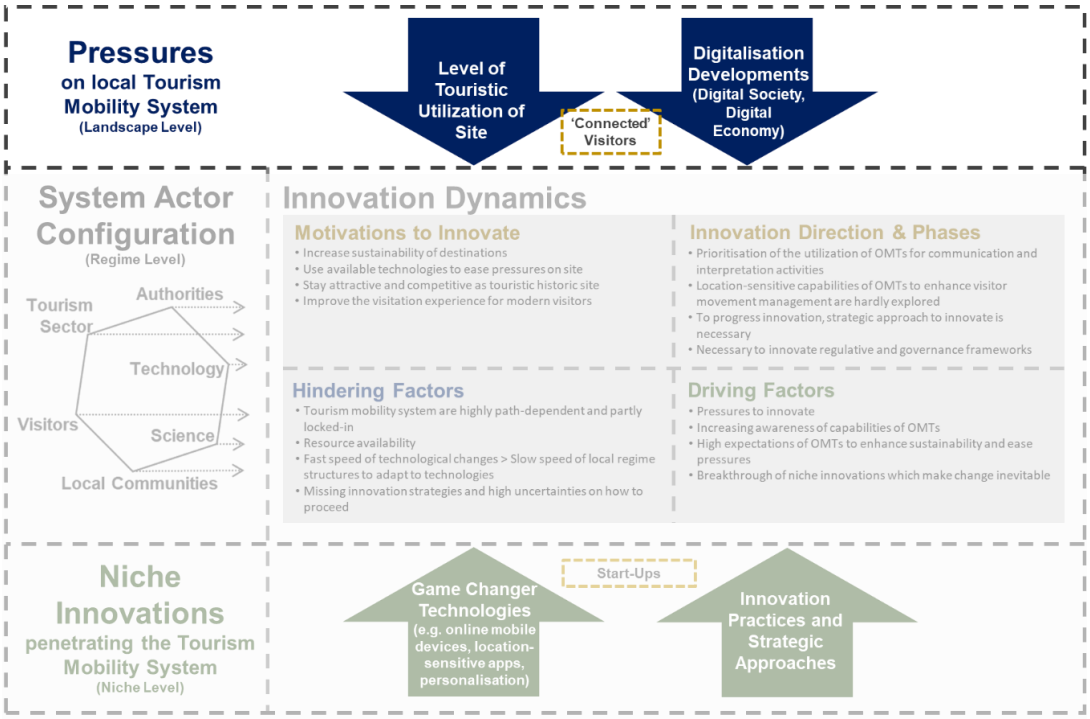

Figure 34 Amended multi-level perspective on current state of tourism mobility systems – focus on pressures (Source: own illustration)

Touristic utilisation

Throughout the sample, increasing touristic utilisation of the participating WHSs was identified, which mainly resulted in growing numbers of visitors and tourists moving within sites. Combined with the spatial characteristics of historic cities, most sites indicated that increasing touristic movement results in growing pressures on the living and built environments of the 81 WHSs (see Figure 35).

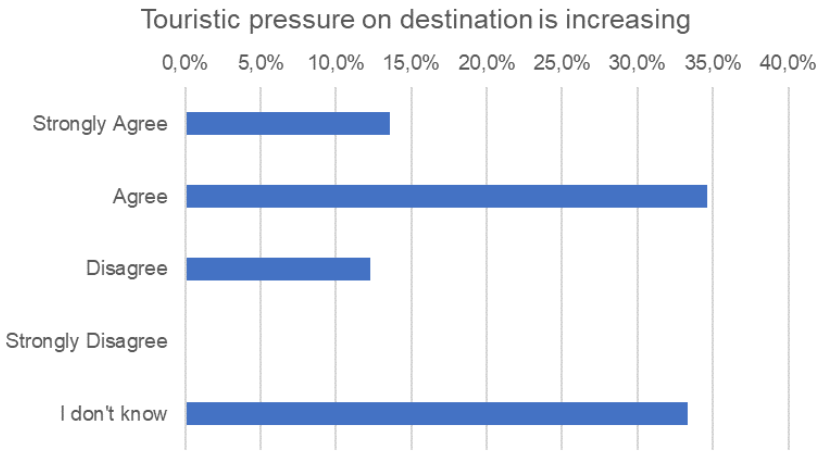

Figure 35 Growing touristic pressure on destinations (Source: own illustration)

The survey also revealed that existing visitor-management practices were largely perceived to be of decreasing efficiency regarding the growing number of 'connected' visitors at sites. As outlined above, many respondents were convinced that OMTs would enhance visitor management and the resulting control over visitors and tourists, and thus ease the pressure on sites (N=81; see Figure 30). However, only a few implementations of digitally enhanced visitor-management practices were indicated at the sample sites.

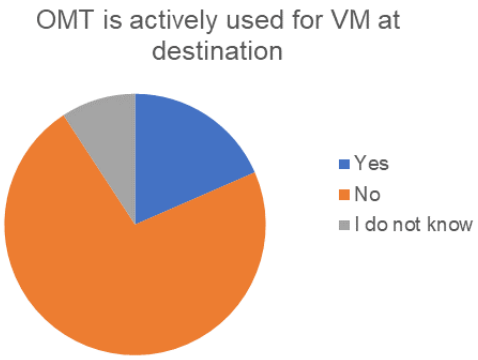

Figure 36 OMT policies in active use (Source: own illustration)

Most respondents indicated a plan to upgrade digitally the existing tourism mobility systems in the near future. However, following a more detailed enquiry regarding the strategies and plans to upgrade, the respondents indicated mainly focusing on upgrading the technical capabilities of their systems (N=40; see Figure 37) and less on upgrading interpretive services for visitors.

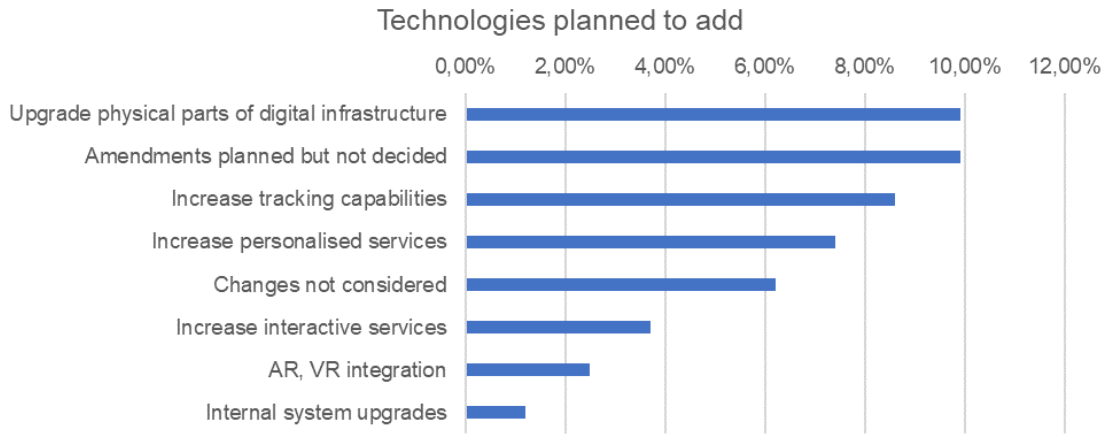

Figure 37 Planned technologies to add to infrastructure (Source: own illustration)

A clear correlation between the perceived intensity of touristic pressure and more concrete plans to innovate the destinations digitally is evident (see Table 12). However, detailed plans for the digital upgrades of the individual sites (see Figure 37) differ. Respondents indicated that they intend to put most effort into enhancing the digital infrastructure and visitor-tracking capabilities, while upgrading interpretive solutions (including interactive services, personalisation, and augmented reality [AR], VR solutions) was only ranked with a lower priority. However, a large number of respondents also indicated they have no concrete or no plans at all for a digital innovation of the visitor management of the site.

		Planning to use OMT for VM	Touristic pressure on destination is increasing
Planning to use OMT for VM	Pearson Correlation	1	.647**
	Sig. (2-tailed)		.000
	N	75	75
Touristic pressure on destination is increasing	Pearson Correlation	.647**	1
	Sig. (2-tailed)	.000	
	N	75	76

** Correlation is significant at the 0.01 level (2-tailed).

Table 12 Plans to innovate digitally related to touristic pressures (Source: own illustration)

Development of digital tools to manage tourism mobility systems

The second identified key pressure on tourism mobility systems concerns digitalisation developments. Digitalisation developments on the landscape level cover the growing user demand for digitally enhanced tools to explore destinations. This development is also closely connected with the 'spill-over' effect (see Section 2.10.2) of increasingly digitalised societies and economies. In particular, the need to enhance communication capabilities digitally to convey information to the 'connected' visitor while they explore the destination was considered inevitable by the respondents (see Figure 38).

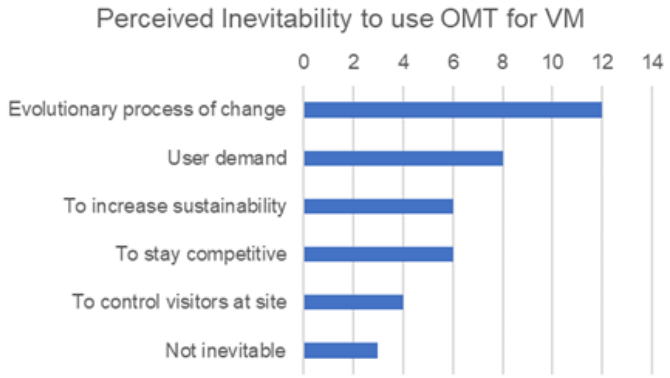

Figure 38 Inevitability to use OMT to convey information to visitors (Source: own illustration)

This perception was largely based on the respondents' focus to stay competitive in rapidly changing tourism markets by digitally enhancing the visitation experience of the growing number of 'connected' visitors.

However, the largely market-driven approach to enhance touristic movement digitally prioritised the utilisation of OMTs to convey more information but largely neglected to explore the visitor-movement management and control capabilities of OMTs. This finding was, for example, substantiated by the respondents' indication regarding the current utilisation of OMTs (N=78; see Figure 39).

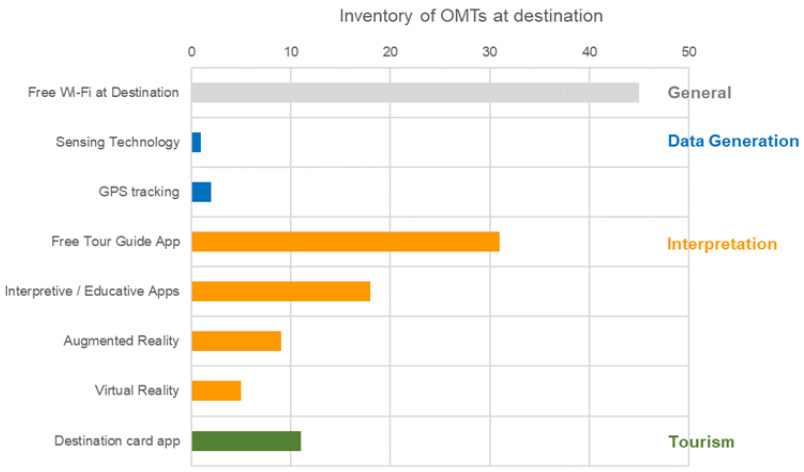

Figure 39 OMT inventory currently used at participating destinations (Source: own illustration)

Despite the obvious dominance of interpretative tools to satisfy the growing demand of visitors for a digitally enhanced exploration of the site, the need to use OMTs to enhance the control and management of visitors on site earlier highlighted has not been prioritised in the digitalisation and innovation efforts of the cities in the sample.

This neglect was mainly ascribed a lack of resources for innovation. Although most respondents indicated financial resources were available at their sites, a clear lack of know-how regarding how to integrate and use OMTs within the tourism mobility systems was identified (see Figure 40).

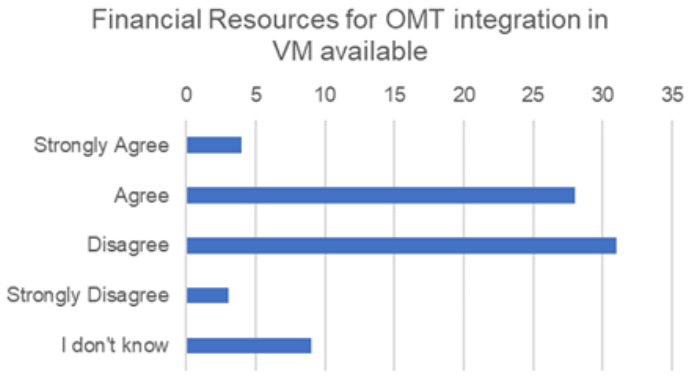

Figure 40 Financial resources for OMT integration are available at site (Source: own illustration)

The majority of respondents agreed (4% ‘strongly agreed’ and 78% ‘agreed’) it was necessary to hire digitalisation experts who possess the theoretical and practical know-how to integrate OMTs and innovate existing systems (N=72; see Figure 41).

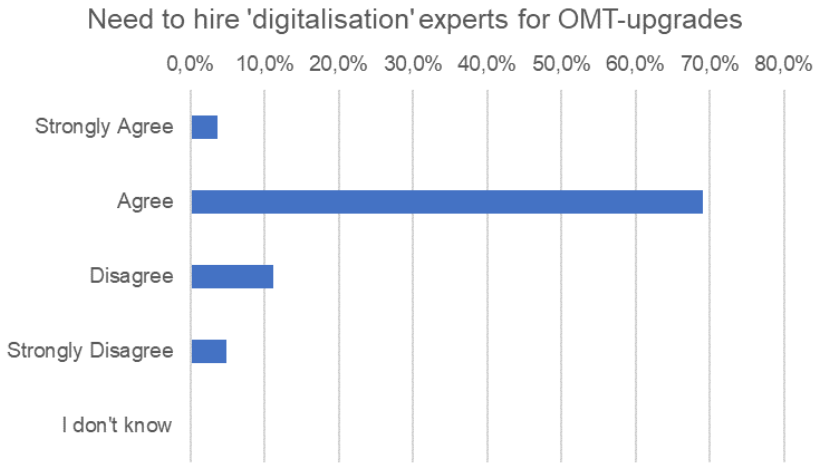

Figure 41 Need to hire 'Digitalisation' experts for innovation (Source: own illustration)

Both identified pressures (touristic utilisation and digitalisation developments) were perceived to grow and increasingly challenge existing tourism mobility systems. These pressures clearly triggered destabilisation of the existing tourism mobility systems and led to increasing uncertainty among the actors involved regarding how to proceed with the innovation of the systems.

However, some respondents perceived this pressure as motivation to act and to change the prevailing situation by innovating their systems. Therefore, pressure could also be perceived as a certain motivator and a trigger for change, as well as acting as a guiding factor for the development processes on a niche level.

The survey only provided an initial overview of the pressures affecting current tourism mobility systems. Comprehensive insights are necessary to understand fully the ‘power’ of pressure to shape innovation and change dynamics, as well as the effects of these pressures on the tourism mobility systems and their role as a driver or obstacle of the innovation of tourism mobility systems.

5.2.3. Niche Innovations Within the Tourism Mobility System

This study also provides insights into developments on a niche level. The findings enabled the identification of the most relevant technical innovations already integrated into tourism mobility systems. Except for the discussion on the role and relevance of individual niche innovations, two key findings were made in the scoping study. First, not only did technical innovations emerge on a niche level, but also the practices and strategies necessary to integrate novel technical solutions in existing tourism mobility systems were emerging and evolving on a niche level (see Figure 42). Second, the integration and utilisation of niche innovation on the regime level were strongly interlinked and driven by pressures from the landscape level.

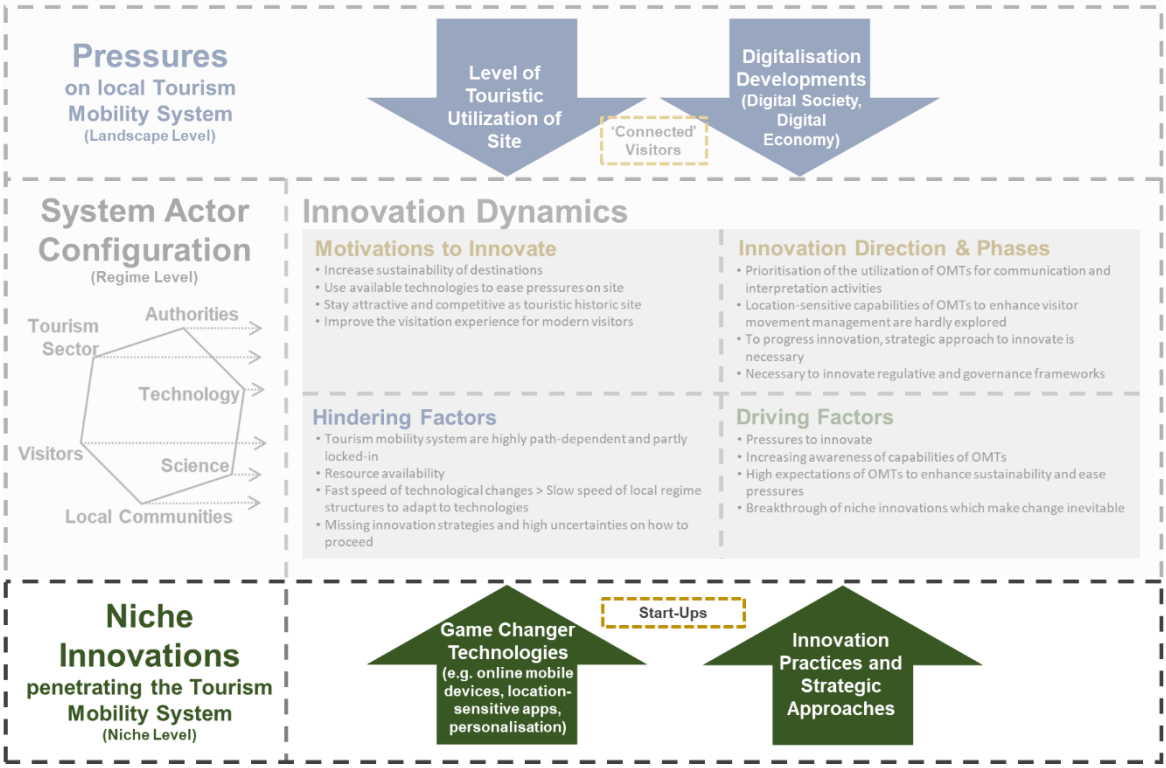

Figure 42 Amended multi-level perspective on current state of tourism mobility systems – Focus on Niche Innovations (Source: own illustration)

'Game-changer' technologies

The findings outline that within current tourism mobility systems, communication technologies are considered leading 'game-changer' technology, penetrating the existing system setups. In particular, the high usability and novel capabilities to provide individualised, ubiquitous communication with the visitor via online mobile devices while exploring the destination are a key advantage (N=81; see Figure 43) and enabling factor to innovate tourism mobility systems.

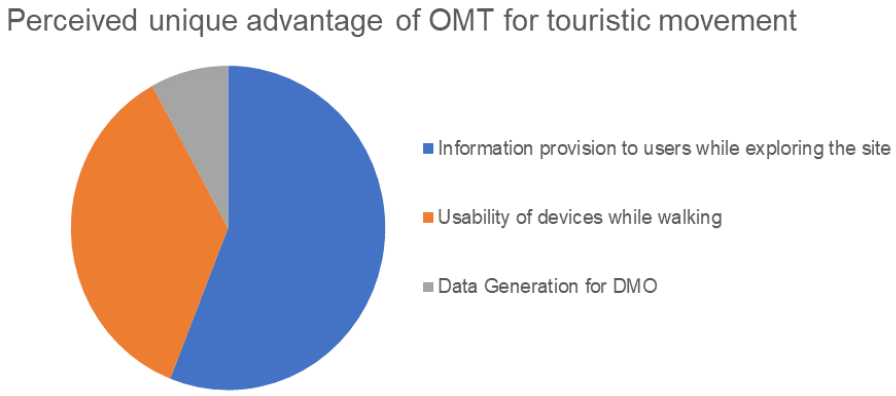

Figure 43 Advantage of OMT devices (Source: own illustration)

Nevertheless, at the time of the survey, the majority of sites in the sample used analogue communication tools (e.g. print maps, guidebooks) to direct visitors around the destination (see Figure 33). One possible factor slowing the digital innovation of sites might be the availability of resources. However, a clearer understanding of the evolution, breakthrough, or failure of niche innovations within the tourism mobility systems needed to be generated in the case studies. The initial results of the survey suggest a certain resilience of analogue tools, which is also a possible hindering factor for the breakthrough of digital innovations.

Furthermore, communicating on the go and sensing and tracking technologies were also considered novel features with great potential to impact the sustainability of tourism mobility systems due to enhanced management capabilities (see, for example, Figure 30). In particular, the perceived potential to quantify and trace walking visitors within built environments was perceived to provide unprecedented insights into touristic micro- and macro-movement patterns, to boost the recognition of tourism-induced mobility impacts and issues at destinations, and trigger a rethinking regarding the valence of applied tourism mobility management. However, the utilisation of sensing and tracking for visitor-movement management was identified to be in an early stage and largely unfeasible to implement (see Figure 39).

Regarding the already identified shortage of necessary resources to innovate, the findings of the survey also indicated that another key hindering factor for a wider adoption of novel technical solutions is a lack of strategic approaches regarding how to innovate.

Innovation practices

The respondents identified missing or unsuitable policies and regulations and business models as a key challenge for the integration and utilisation of OMTs within tourism mobility systems (N=38; see Figure 44).

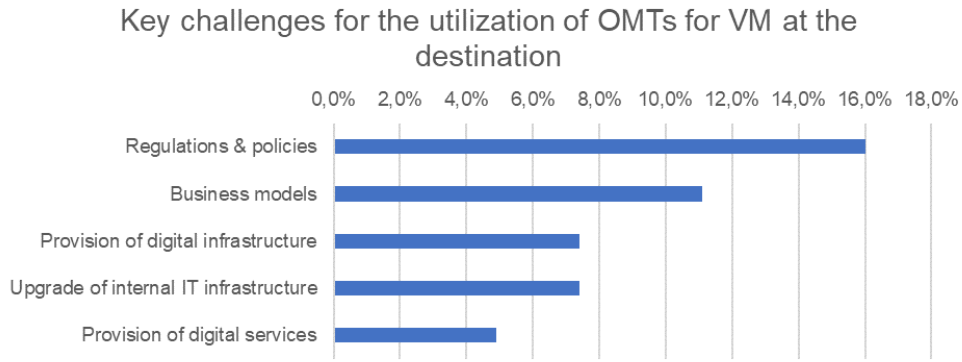

Figure 44 Key challenges for the integration of OMTs (Source: own illustration)

The findings regarding WHSs that had already begun their digital innovation suggest that not only novel technical solutions that enable innovation emerged and evolved on a niche level, but also novel practices and strategic approaches necessary to handle digitally transforming tourism mobility systems had to evolve on a niche level. Despite common approaches and practices for handling innovating system setups emerging from the reconfiguration processes on a regime level (see Section 3.3), the findings indicate that destinations generally lacked the capabilities and resources to handle the necessary changes to enable system innovation on a regime level. The respondents indicated a lack of strategic approaches to planning the integration of OMTs into the system. However, external actors, such as start-ups, that were already using agile practices and business models to keep up with the speed of digital innovations, were considered the driving factor for the innovation of tourism mobility systems.

This finding adds a new aspect to the conceptional discussion regarding the functioning of the niche level within the MLP. Only a technical focus has been pursued in the literature (see Section 3.3.3). However, the findings of this study suggest that the niche level provides not only incubation room for (radically) new technical innovations, but also for organisational and collaboration structures that are more suitable to support changes on regime level and allow for continuous innovation. Findings indicate that also these non-technical innovations can emerge and reach maturity on a niche level. However, further insights on non-technical niche innovations were generated as part of the case analysis.

5.2.4. Innovation Processes at Regime Level

Despite the findings outlined above, which reveal that innovation processes to upgrade existing structures into functioning OMT-supported tourism mobility systems were perceived as highly complex and strategic approaches for innovation were widely missing, the majority of respondents indicated that the eventual integration and use OMTs within tourism mobility systems was inevitable (N=39; see Figure 45).

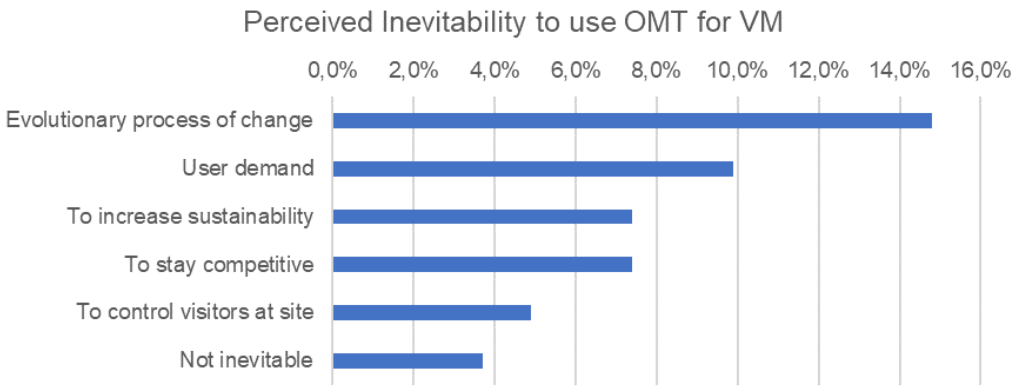

Figure 45 Perceived inevitability to use OMTs (Source: own illustration)

Although landscape pressures were considered a trigger and driver of change, and niche innovations were perceived as an enabler for innovation, the actual system transformation processes occurred at regime level (see Figure 46).

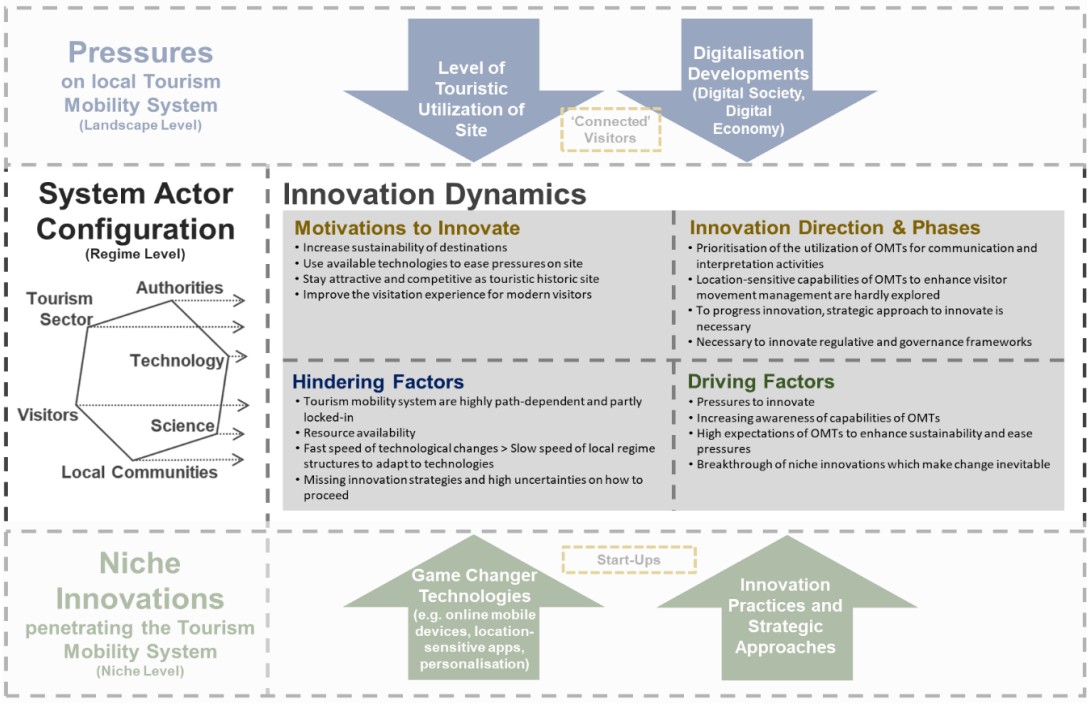

Figure 46 Amended multi-level perspective on current state of tourism mobility systems – focus on regime level (Source: own illustration)

However, the survey did not provide a detailed discussion on innovation dynamics. Due to the low granularity of findings, no flow diagram of change process and transition pathways could be drafted (see Section 3.3.5). Nevertheless, the findings were categorised and summarised under motivations of respondents to innovate, innovation direction, and phases, as well as hindering and driving factors for change.

5.2.5. Hindering and Driving Factors for Innovation

The identified factors that hinder the progression of change processes of tourism mobility systems are summarised below:

- Limited availability of resources is a key factor constraining innovation. Throughout the sample, the following resource-related hindering factors were identified:
    - Digital know-how for the integration and utilisation of new technologies (OMTs, ICTs, sensing, etc.) was widely missing.
    - Very limited expertise and experience with digital transformation processes.
    - Adequate technical capabilities onsite (e.g. computation, data storage, large data processing) were largely missing, and upgrade strategies are unclear.
- Closely related to limited resources is a lack of strategic approaches, suitable business models, and collaboration structures fit for a digitally enhanced tourism mobility system. These components must evolve at niche level and reach a certain maturity to be resilient enough to be introduced at regime level.
- The high speed of technological innovation of OMTs was perceived as a key challenge for change processes at regime level because the interplay of actor groups at regime level was considered ponderous and not capable of addressing rapidly evolving digital transformation processes. Thus, the contemporary collaboration structures and practices among actor groups and within actor groups were indicated to hinder innovation.
- The innovation of tourism mobility systems requires all actors involved to display a certain level of technology awareness, acceptance, and willingness to innovate local systems jointly. However, the survey results reveal that some sample sites, on an organisational level, only had low technology acceptance and willingness to innovate. This level resulted in a low innovativeness and low perceived necessity to integrate OMTs for tourism management. These organisational attitudes also strongly affect the

resources availability for change processes and willingness to amend collaboration and business structures of the organisation to fit the changing tourism mobility system.

On the other hand, several factors driving the innovation of tourism mobility systems were identified as follows:

- A strong driving factor is pressures from landscape level that drive innovation.
    - To increase the sustainability of the destination and ease pressures from touristic utilisation.
    - Stay attractive for ‘connected’ visitors and competitive in the digitalising of tourism markets.
- Increasing penetration of OMTs into all walks of life (‘spill-over’ effect), which leads to:
    - An increasing awareness and understanding of OMTs.
    - Increasing innovativeness among organisations to upgrade digitally.
    - The perception that digital innovation is inevitable at a certain stage.
- Start-ups are penetrating tourism mobility systems and drive change as key innovators due to their agile and flexible business setup, which are adjusted to the rapidly changing new technology market and their focus on new technology integration and use.
- Individual innovativeness and perceived necessity to integrate OMTs for tourism management were very high among the respondents, and professional exchange is increasing innovativeness and the capabilities to innovate.

These initial findings on driving and hindering factors need to be discussed in the context of the three Austrian case cities to obtain a holistic understanding of their relevance and effects on the overall tourism mobility system.

However, the survey findings clearly highlight the close interrelation and high interdependency of processes and dynamics on the three levels (landscape, regime, and niche innovation).

5.2.6. Innovation Motivations, Directions, and Phases

The survey also provided insights into the respondents' motivations to innovate. The majority of identified motivations either emerged from the need to ease pressures on the destination or were based on gaining a competitive advantage and staying competitive in an increasingly digitalising world (see Figure 48). However, these motivating factors only outline an initial approach to identifying and discussing the motives of people in charge of the management and innovation of tourism mobility systems in historic cities. This starting point must be used as a foundation for a detailed discussion of motives and their interdependency and linkage to all elements of the tourism mobility system. Tourism systems are highly complex and highly interlinked; therefore, it is necessary to consider the historical, political, ecological, and economic factors of a site to understand motives for change.

In addition, insights into the directions of innovation and innovation phases were identified in the survey. The innovation phases evolved from the sum of pressures, niche innovations, and change dynamics at regime level and provide a generalised view of how innovation progressed within the sample (see Figure 47).

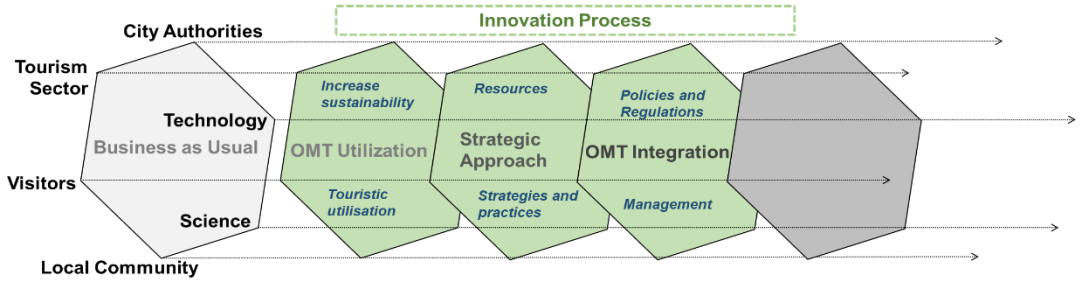

Figure 47 Overview of innovation path based on findings of the scoping study (Source: own illustration)

Throughout the sample, the utilisation of OMTs to improve the tourism mobility system was the most advanced approach (e.g. tour guide apps, online maps). Although the majority of sites focused on improving the touristic utilisation and enhancing the visitor experience, some sites also perceived digitally supported visitor-movement management as a tool to increase the sustainability of the touristic site (e.g. Graz).

Despite a progressive utilisation of digital tools, the innovation of the system seemed to stagnate at a certain point. Although the respondents indicated a high willingness to innovate, missing resources and the lack of strategic approaches on how to progress with innovation were key hindrances to innovation. Only a few sites displayed initial efforts and sufficient resources to develop innovative strategies to overcome stagnation and proceed with

digitalisation. For example, Lyon (FRA) indicated that the digitalisation of their tourism mobility system was driven and supported by the local Smart City initiative, and Vienna (AUT) established city-owned start-ups to continue with the innovation of the local system. Strategic approaches were considered necessary to mobilise and generate resources to advance, optimise, and strengthen the utilisation of digital tools. However, at the time of the survey, this phase was in an early stage; thus, no results or best practice examples could be identified.

In addition to the need for a strategic approach, destinations that displayed a far-advanced utilisation state of OMTs also indicated the necessity to develop, amend, and integrate policies and regulations into management and governance structures that cover the digitalisation aspects of the system.

Figure 48 brings the above outlined key findings of the surveys in a schematised MLP together and provides a basis for the second empirical stage of the study.

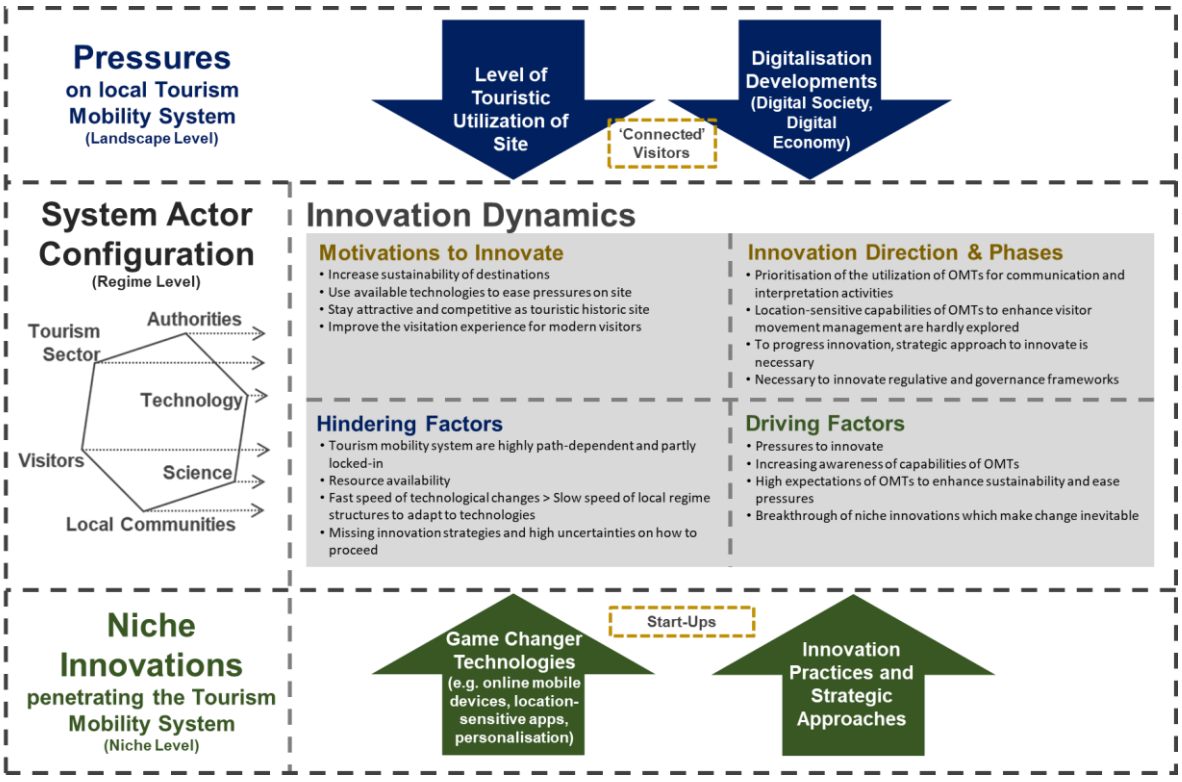

Figure 48 Multi-level-perspective on current state of tourism mobility systems (Source: own illustration)

In addition, findings of the scoping study that were generated in the Austrian case sites provide a first overview of the tourism mobility configuration and innovation level at the case cities as well as act as baseline for the in-depth investigation of the cases.

Overall, the scoping study showed that the three case cities differ in their innovation level as well as approach to innovate.

Vienna (the capital city of Austria) appeared to have the highest innovativeness and was perceived to have already achieved a high innovation level in its tourism mobility system. The respondents of Graz also displayed relatively high innovativeness, and the innovation level was also indicated as high. Salzburg was among the least innovated cities, and with relatively little motivation to drive the digital innovation of its tourism mobility system. These findings indicate the three case cities are a relatively heterogenic set regarding innovation level and the indicated innovativeness of the respondents.

Although the three Austrian case cities align with the general tendency of the respondents' profile of the overall scoping study, namely strong ties with governmental-related organisations at a local level, a heterogeneity regarding perceived lead innovators in the case of cities was identified. In Vienna start-ups were perceived as key drivers for innovation, in Graz the city government took this role. Salzburg was dominated by the local DMO as the lead driver for the innovation of tourism mobility. Since the three case cities indicated being driven by three different key innovators the case studies enable a comprehensive analysis of the underlying factors and motivations for diverse actors to take the lead for innovation.

However, key touristic characteristics of the case cities show that Salzburg and Vienna have also experienced growing touristic pressure. The three cities differ significantly in the extent of touristic pressure on their built environment. In Vienna, touristic pressure was increasing but at manageable levels. Numbers regarding the day-visitors/inhabitant ratio (see Section 5.1.2.3) suggest the touristic pressures in Salzburg are more severe than in Vienna. Also respondents indicated that Salzburg was experiencing significant touristic pressure and even suffering from 'over-tourism'. In Graz, touristic utilisation was increasing, and thus pressures were becoming more noticeable; however, no negative impacts were noticed.

In alignment with these findings, in the case cities touristic movement is also considered a relevant factor for the perceived pressures on the destinations. Salzburg indicated walking visitors were key congestion producers. However, Vienna indicated that tour buses caused most tourism-related congestion. Graz was not suffering from overcrowding or tourism-related congestion at the time of the survey. This heterogenic situation of congestion and overcrowding needs to be further investigated and discussed in the context of the local morphology of the sites and locally applied visitor-management and traffic management concepts.

In addition, a clear correlation between the perceived intensity of touristic pressure and more concrete plans to innovate the destinations digitally is evident (see Table 12). This tendency

was confirmed by the responses of all three Austrian case cities. However, detailed plans for the digital upgrades of the individual cities (see Figure 37) differ. Although Salzburg still focuses on upgrading interpretive solutions (including augmented reality [AR], VR solutions, interactive services, and personalisation), Graz and Vienna are putting most effort into enhancing the digital infrastructure, visitor-tracking capabilities, and their internal systems for processing generated data on visitors.

In the scoping study, efforts to digitally enhance the local tourism mobility system are also clearly correlated with available resources to innovate. None of the Austrian case cities indicated experiencing a shortage of financial resources to innovate digitally. Regarding existing expertise to innovate, Vienna and Graz claimed to possess enough know-how to drive the digital innovation of the cities. In Salzburg, a clear lack of know-how was apparent. In addition, a correlation of lacking both know-how and a strategic plan to integrate and upgrade OMTs into visitor management could also be identified in Salzburg. Thus, in the case studies, an inspection regarding the relevance and impact of the general availability of resources has to be conducted, as well as special emphasis given to establishing the role and type of know-how for innovation.

In close correlation with available resources is the relevance and penetration level of niche innovations in the individual case cities. The scoping study did not provide detailed insights in novel technical innovations penetrating the local tourism mobility systems of the case cities. However, the study highlighted the necessity to develop novel innovation practices and strategic approaches to enable innovation of existing tourism mobility systems. All three case cities indicated their greatest challenge concerned the adaptation of regulations and business models to suit the technical innovation of their tourism mobility systems.

Overall, case specific findings in the scoping study provide a solid foundation for an in-depth investigation of the three Austrian case studies. However, above findings also showed that it is necessary to first gain a better understanding of the national framework the three cities are embedded in to be able to fully understand the stakeholder configuration and their roles and eventually comprehend the innovation processes and dynamics of local tourism mobility systems.

5.3. Chapter Summary

The findings of the online survey highlight that the majority of tourism mobility systems of the participating UNESCO WHSs are still in the early phases of the innovation path; however, their transformation is rapidly progressing. Although the survey sample can be considered

heterogenic in their innovation progress and in their approaches to innovating the local system, common innovation dynamics and influencing factors could be identified and related to reoccurring innovation phases. Within these phases, the majority of sites pursued similar strategies and foci for innovation, as well as encountering similar challenges to innovation progress. Although landscape pressures were identified as key triggers and drivers for innovation processes, the findings reveal that developments on all three MLP levels were closely interlinked and penetrating each other. In particular, the availability of resources and the willingness to change of the lead innovator were key factors for the continuous innovation of the system.

It was also apparent that, due to a lack of experience with digitalisation processes, the digital innovation of tourism mobility systems was mainly based on trial-and-error approaches from the organisations in charge of the management and innovation of the sites. Therefore, a systematic and comprehensive discussion of the innovation phases and a phase-wise discussion of innovation processes and dynamics are essential to understand how contemporary tourism mobility systems function and to sketch the innovation pathway of tourism mobility systems from analogue to digitally enhanced systems.

The scoping study also provided initial insights into the tourism mobility systems of the three Austrian case cities, revealing that the cities can be considered a heterogenic set of cases. In particular, the role and scope of tourism mobility within the city systems and the local approaches to innovate tourism mobility provided insights into a wide spectrum of innovation processes and dynamics, as well as outlining the interplay of actors in the early stages of the innovation of local tourism mobility systems.

6. Tourism Mobility in Austria

Prior to the in-depth discussion on tourism mobility systems in the Austrian case cities of Vienna, Salzburg, and Graz, an overview of the state and structure of tourism mobility at national level in Austria is given. As indicated in the literature review, mobility and its necessary processes for innovation occur on many levels, from the global to the local (see Section 2.1). The global and the local are not only closely related, but also interdependent on each other. Thus, it is crucial to take a holistic approach and zoom in from the overarching, 'global' frameworks relevant for tourism mobility in Austria to the very distinct, local tourism mobility systems in the case cities (see Chapters 7, 8, and 9).

This section provides context for tourism mobility in Austria and highlights the relevance of touristic movement within the overall transport infrastructure on the national and regional levels. Especially in heavily touristic areas such as Vienna, Salzburg, and Graz, tourism mobility impacts not only the city itself, but also the surrounding region and the diverse ways to reach the city.

In addition, the literature review identified that management and governance aspects are of growing importance for the establishment of functioning tourism mobility systems and their innovation (see Section 2.10). Furthermore, previous research has argued that the quality, status, and feasible innovation of local mobility systems, such as tourism mobility systems in cities, depend highly on existing transport infrastructures, which commonly reside with national authorities (see Section 2.10.3). Thus, local mobility systems are largely limited by overarching national or regional frameworks and activities.

To elaborate these interdependencies and to set an overarching frame for the in-depth discussion on the innovation of local tourism mobility systems in the case cities, this section outlines statistics, discusses political agendas, and sketches the stakeholder structure of actors involved in tourism mobility at a national level.

The findings outlined in the following sections were compiled from published studies and papers and the interviews during the second empirical phase. Information that helps to understand and outline the national situation of tourism mobility was extracted from the case interviews and incorporated into the national overview.

6.1. Tourism Mobility at the National Level in Austria

Tourism mobility as a joint subject was not formally considered as mobility nor as an economic indicator in the Austrian administrative framework. However, the necessity of establishing

tourism mobility indicators, integrating the topic into national, regional, and local policy frameworks and development agendas, was increasingly recognised by authorities, and the first steps towards this were initialised in the second half of the 2010s (Zech et al., 2013).

At the time of this study, statistical data on tourism mobility in Austria were unavailable. Therefore, this study used available tourism and mobility indicators which provide an overview on tourism volumes and relevant, tourism related mobility activities.

6.2. Facts and Figures

Tourism is a key pillar of Austria's economy and accounted for 15.3% of the country's GDP in 2018 (WKO, 2019). Touristic utilisation and tourist volumes grew in the past 10 years by +44% and were forecast to grow by +4.1% annually (Tourism Austria, 2019). In the World Economic Forum Travel & Tourism Competitiveness Index 2019, Austria ranked overall 11th of 136 countries, and first regarding tourist service infrastructure (WEF, 2020). This continuous touristic growth, which was significantly fostered by rapidly advancing globalisation and 'freedom of movement', has entailed increasing pressures on tourist areas and the overall transportation network (WKO, 2019).

Austria's location in the centre of Europe is a key factor for the high ground-based transportation volume, making it one of Europe's leading road transit countries. In addition to the 509.9 million tonnes of freight transported via Austria's road network in 2018 (BMVIT, 2019), increasing tourism- and leisure-related traffic also added to the growing pressures on the national traffic infrastructure.

Of the 46 million tourist arrivals in 2019, 75% used a car to travel to and within Austria, whereas only 7% arrived by plane, 6% by bus, 3% with RVs (Recreational Vehicles), and 1% by motorbike (see Figure 49), with the majority of visitors living in a catchment area of 500–1,000 km of Austria (WKO, 2020).

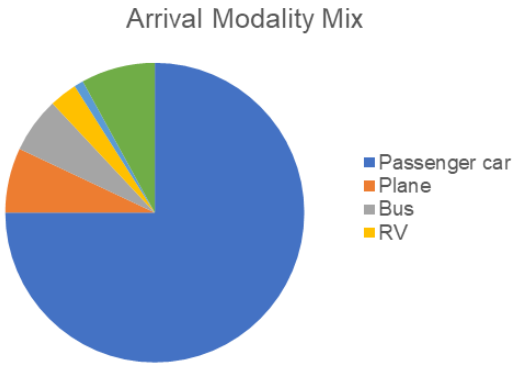

Figure 49 Mobility mix – arrivals in Austria 2019 (Source: WKO, 2020)

The geographical mix of tourists arriving in Austria showed that 37.1% of tourists arrived from Germany, 26.7% were domestic (Austrian) travellers, followed by Dutch (6.8%), Swiss (3.5%), British (2.6%), Italians (2%), and others (21.3%) (Tourism Austria, 2020).

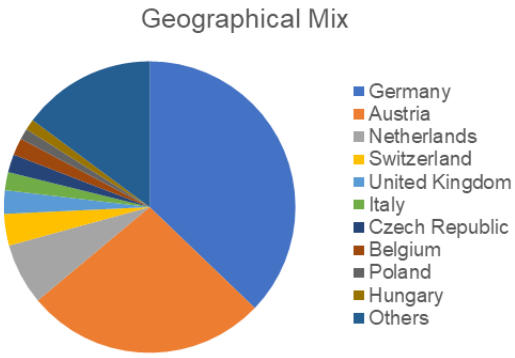

Figure 50 Geographical mix – arrivals in Austria 2019 (Tourism Austria, 2019

The above tourism statistics only reflect the volume and mobility mode of registered tourist arrivals and overnight-staying tourists. This means that day-visitors to and in Austria were not included in tourism statistics, despite their same-day arrival and departure placing significant pressure on infrastructure. This shortcoming was caused by the limitations of current data generation methods regarding distinguishing between qualitative aspects of movements, including reason, intention, purpose, and choice of movement. Online mobile technologies were perceived as offering new solutions to revolutionise data generation for tourism and mobility statistics, and could eventually enable the development of dedicated tourism mobility indicators on a national level (Zech et al., 2013).

6.3. Political Agendas and Tourism Mobility Governance

The joint-disciplinary exploration of tourism mobility as a strategic subject is a relatively new and underdeveloped area in Austria. From the middle of the 2010s onwards, the national level increasingly departed from the approach of considering tourism and mobility as separate issues and started to promote the recognition of tourism mobility as a joint subject. This rethinking process was driven, on one side, by increasing touristic pressures on infrastructures and environments in the country, and, on the other side, by more rigorous mobility, climate, and energy agendas on the supranational and national levels, which identified tourism-related mobility as a significant factor impacting overall sustainability (Professor Information Technologies at Technical University Vienna, 2019).

The first tourism mobility concepts were mainly descriptive papers used to raise awareness of the topic and to increase know-how among actors regarding tourism mobility issues and the effects on environments (Zech et al., 2013). Later tourism mobility publications from governmental bodies reflected the growing attention to climate change issues and mainly focused on suggestions to make tourism mobility more sustainable. In particular, the application of new technologies to improve customer services, site management, and the sustainability of tourism mobility modes gained rapid importance on tourism mobility agendas of the late 2010s (see in detail Appendix IV). Despite the growing recognition of the relevance of tourism mobility, competencies and responsibilities to cope with tourism mobility were not assigned within the administrative body. This situation was perceived as a key obstacle to an effective breakthrough in tourism mobility as a governance objective (CEO Austria Tourism, 2018).

Since the early 2010s, the European Union (EU) has displayed a growing interest in tourism mobility. A wide range of EU-funded projects has investigated various perspectives and issues related to tourism mobility (see Appendix I). Since touristic mobility is a significant share of the overall mobility volumes within Europe, the EU and the European Council (EC) also took regulative steps to trigger a shift in the mobility behaviour of passengers, from car-focused touristic traffic towards more sustainable public transport and multimodal mobility behaviour. However, a review of the project summaries indicated a lack of harmonisation of technical standards and transnational collaborative structures, which is a key obstacle to innovating touristic mobility on a European and transnational level.

A turning point regarding the acknowledgement and significance of tourism mobility was the 2010 release of the Delegate Regulation 2010/40/EU (EC, 2010) on the framework for the deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport. In particular, the supplementing Delegated

Regulation (EU) 2017/1926 on the provision of EU-wide multimodal travel information services, which was enacted in 2017 by the European Commission (EC, 2017), was the key trigger for national authorities and organisations to include touristic mobility on their innovation agendas.

In Austria, the ITS Regulation was enacted in 2012 as a national execution of the EU Directive and the supplementing priority actions, which include the provision of seamless, cross-board, cross-provider, and multimodal travel information (National Councial, 2010). However, the first strategic approaches to adjust relevant technical, regulative, and collaborative activities in areas relevant to tourism mobility were only addressed from 2017 onwards. Nevertheless, at the end of 2018, the department for 'Tourism and Regional Politics' was established as a sub-section of the Federal Ministry for Sustainability and Tourism (BMNT) and has since been in charge of tourism mobility matters.

However, in the federalist governance structure of Austria, federal states perform a key function, not only connecting the national and local levels, but also supporting the local level to implement innovation plans. Federal states pioneered the development of joint tourism mobility initiatives and conducted trendsetting work to establish an awareness and recognition of tourism mobility issues in Austria long before tourism mobility was established as a joint objective at the national level or its significance was recognised at city level (Professor Information Technologies at Technical University Vienna, 2019; Chairperson of Mobility Forum Salzburg, 2019).

Overall, federal states are the supervisory authority for regional and communal development plans. Federal states play a crucial role in defining strategic directionality and the thematic emphasis of state development, including the definition of spatial commitments, frameworks, dimensions, and concepts within and across states. In their role as a 'connecting' hub, federal states also provide multi-level political support, access to financial resources and funds, and support the regions and local actors with professional know-how and expertise.

At the regional and local levels, not only the impacts of tourism mobility become visible, but also the success of national and federal strategies, and the implementations to innovate tourism mobility systems and ease impacts are reflected.

6.4. Tourism Mobility Stakeholder Structure

The tourism mobility stakeholder structure is illustrated in Figure 51, which is a tourist-centric model, incorporating actors based on their importance and key functionality for tourism mobility provision. The inner-circle lists key actors, whereas the outer circles include more

general actors and supporting frameworks and regulations. The illustration uses the model published in Zech et al. (2013) and is complemented by and adapted from findings from the in-depth interviews of the second empirical phase This finding is crucial for further discussion because it indicates a strong interwovenness and dependence of the tourism mobility system with the city system.

As stated in Section 4.4.4, interviewees in higher positions (e.g. CEO, head of a government department) within actor groups were selected in the case cities. This approach was taken to obtain an overview of the activities and overall developments within the actor group and to identify interlinkages and cooperation between the actor groups and activity fields relevant to the innovation of the local tourism mobility system. Actor group tourism was represented by CEOs of the national and individual city tourism organisations, mobility was represented by the head of the planning or traffic department of the city, and insights from dedicated mobility associations (e.g. Mobility Forum Salzburg) were generated. A good understanding of digitalisation actors and relevant developments was gathered from digitalisation departments from city governments, city-owned start-ups or academia. The only actor group not directly interviewed was tourists (both ‘connected’ and ‘unconnected’ tourists). The chairpersons of tour guide associations were interviewed to obtain a better understanding of the aspects affecting mainly ‘unconnected’ visitors.

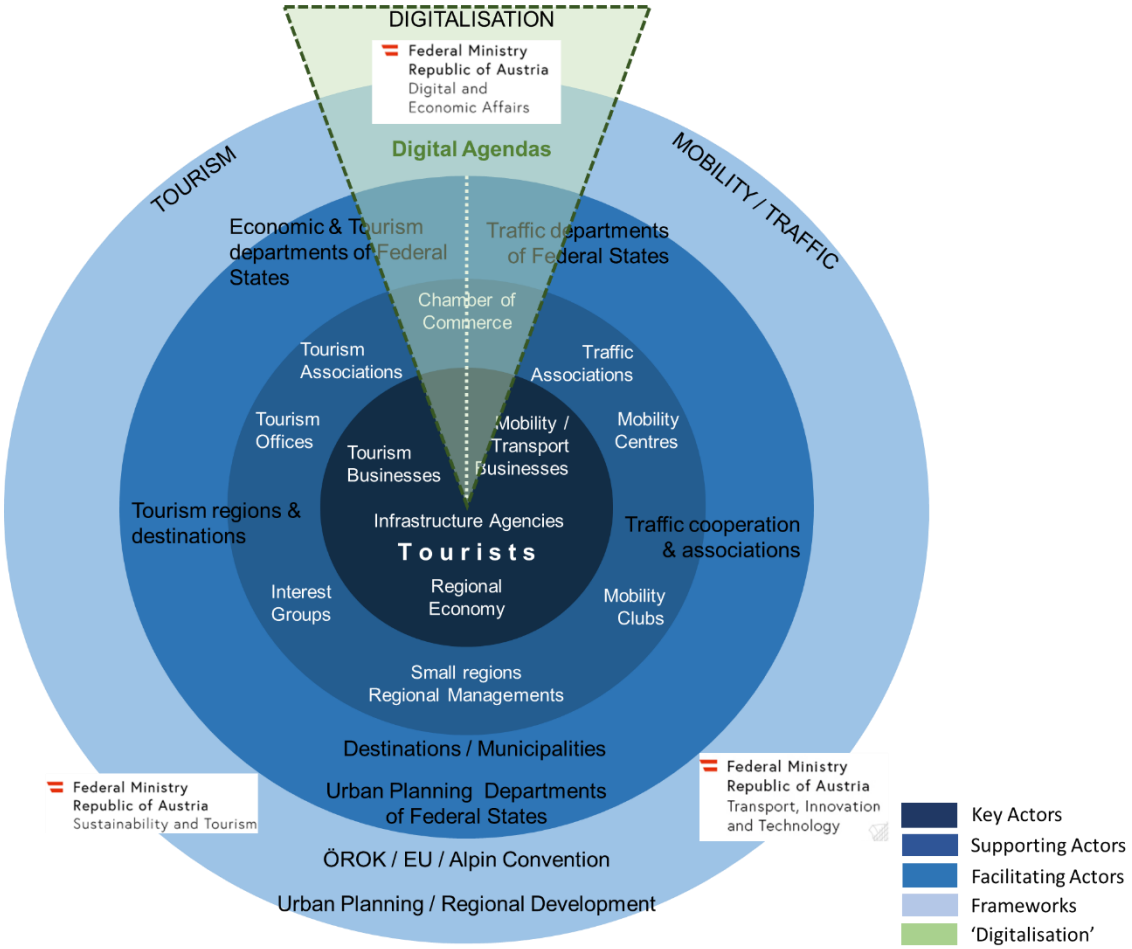

Figure 51 Key Stakeholders Tourism Mobility System, Austria 2018 (adapted from Zech et al., 2013)

6.5. Chapter Conclusion

The above discussion highlights that tourism mobility is a new conceptualisation of old subdomains. Tourism mobility as a joint field is only beginning to impact at a national level and is already facing new challenges in the form of digital transformation processes. Figure 51 highlights the diverse and large set of actors involved in the provision of tourism mobility. Factoring in recent digital transformation developments, the OMT-enabled tourism mobility structure is becoming even more complex, and administrative considerations are not only required to integrate tourism and mobility actors, but also digitalisation actors, which themselves are new concepts to many national governments.

Although the first efforts to establish a regulative and administrative framework that considers tourism mobility an objective were identified, the above summary of Austria's tourism mobility landscape delineates a rather embryotic tourism mobility structure at the national level.

7. Vienna – Pioneering Innovation Towards an Inclusive 'Smart' Destination

The findings of the above scoping study are integrated into the MLPs of the case studies in the following chapters and used as a basis for a comprehensive analysis of the innovation processes and dynamics in Vienna, Salzburg, and Graz. However, due to the relevance of a phase-wise evolution of tourism mobility systems, a sequential approach to analysing the innovation phases of the tourism mobility systems in the three Austrian case cities was adopted. However, in the scoping study, it was evident that the context and the site characteristics of the individual case cities are essential for shaping the overall innovation of the local tourism mobility systems. Thus, the case studies begin with a brief contextual overview of the study area's characteristics and historical development regarding the evolution of the local tourism mobility systems of Vienna, Salzburg, and Graz.

7.1. Contextual Overview of the Tourism Mobility System of Vienna

Vienna is characterised by a historically high motivation to innovate and upgrade the city and integrate a wide range of stakeholders into this process. This statement is supported by the initial findings of the scoping study, which indicate that a collaborative and proactive approach to digitalising the tourism mobility structure within the city system was pursued. In particular, Vienna's approaches to not only technically innovating the system, but also to finding suitable collaboration and business structures to enable a resilient and durable transformation are key aspects investigated in this case study.

7.1.1. Tourism Mobility in Postmodern Vienna

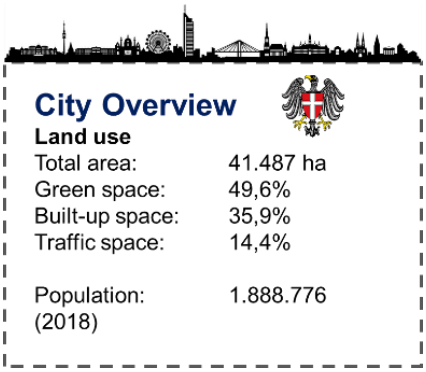

Figure 52 City space overview Vienna (Statistik Wien, 2019)

Throughout history, travel has played a crucial role in the development and innovation process of Vienna. Like many European towns, Vienna's location on a major river and being connected to a road and train network helped the city to grow and flourish.

Vienna evolved from a Roman settlement to become an innovative European city. As the former capital of an empire, Vienna has retained its pomp and grandeur but modernised its infrastructures, communication, and governance setup to make it a 'Smart' and digitally adapted, historic city. The city continues to benefit from its major restructuring in the 19th century, such as the construction of the *Ringstrasse*, which broke-up

old and entrenched structures and introduced a forward-looking, innovative ethos in city development and management still deeply ingrained in contemporary Vienna (Spring, 2006; Meissl, 2000).

Tourism mobility and visitor-movement management were already important components of urban design, planning, and city management in the 19th century (Spring, 2006). Furthermore, at that time, Vienna was one of the first destinations to provide guidebooks and interpretive guiding services onsite to enhance the visitor experience but also to control touristic movement (Koshar, 1998).

Vienna pursued an active management approach regarding touristic pressures on the city and continues to employ novel technologies and solutions regarding the city's touristic utilisation.

In the 21st century, strategic destination marketing and the creation of a liveable, 'smart'-historic city image significantly enhanced Vienna's popularity. These efforts made Vienna not only successful as a tourist destination, but also a best practice example for liveability and integrating smart technologies. Among others, in 2019, Vienna was awarded for the 10th time in a row as the most liveable city in the world (by Mercer), and was ranked for the second time in a row as 'Smartest City' according to the Smart City Index by Roland Berger, and received for the first time the 'Smartest City 2019' award from UNESCO (APA, 2019b; Stadt Wien, 2019b). To a certain extent, these awards exemplify the lived innovation culture that has shaped the city for many centuries.

However, Vienna's popularity, paired with globalisation developments, has opened large touristic markets for the city, mainly reflected by the continuously growing tourist numbers (see Figure 53).

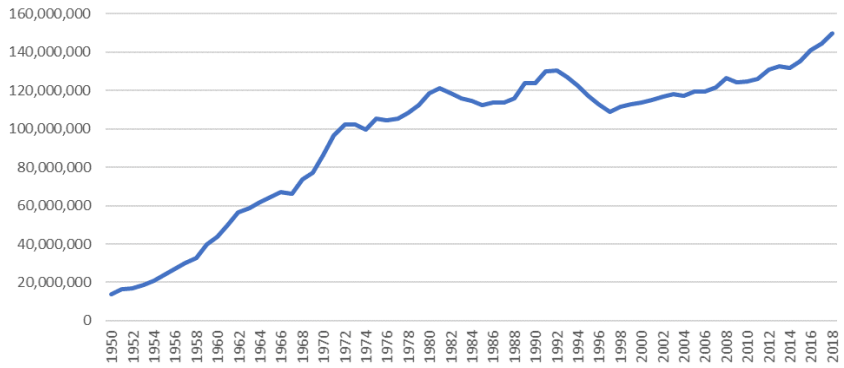

Figure 53 Overnight stays 1950–2018 Austria (Statistik Austria, 2019)

7.1.2. Key Touristic Areas in Vienna

Vienna has a wide range of touristic sites in its city area; however, the major touristic spots are the UNESCO World Heritage-listed historic city centre of Vienna and the UNESCO WHS *Schönbrunn* Palace (see Figure 54).

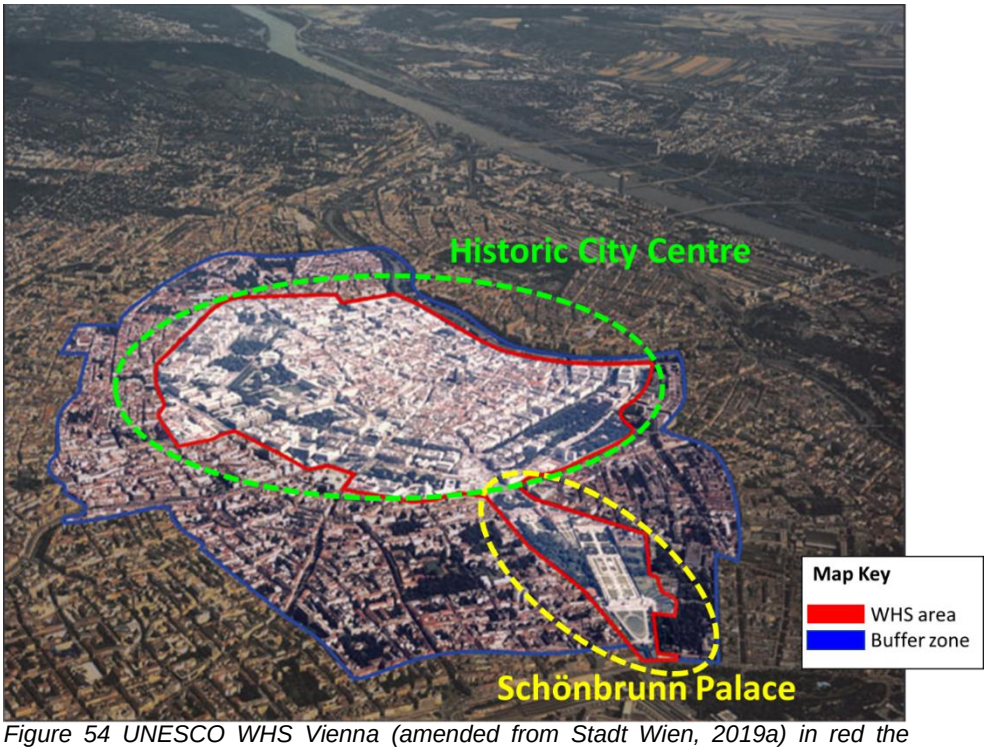

Figure 54 UNESCO WHS Vienna (amended from Stadt Wien, 2019a) in red the UNESCO WHS zone and in blue the buffer zone

Schönbrunn is a largely uninhabited, museum-like, demarcated area covering 189.23 hectares (UNESCO, 2018b), with 4,255,000 visitors in 2019 (APA, 2020). Tourism mobility impacts the adjacent urban living environment mainly due to the approximately 160 tour buses (in 2018) per day that drop off tourists and severely impact the traffic situation near the palace (ORF, 2019b). In 2019, the construction of a tour bus terminal and parking facility began, which is meant to resolve the impact on local traffic.

The UNESCO-listed historic city centre of Vienna is a living environment of 287 hectares, home to 16,450 inhabitants in 2018 (0.9% of the Viennese population), and provides working spaces for more than 100,000 people (highest density of working spaces among all the districts of Vienna; (Statistik Wien, 2019). Local stakeholders estimate day-visitor numbers to the historic city centre to reach between 20 to 30 million a year in recent years (Vienna City – Tourism, 2018). However, official estimations have never been released. The findings of the

online survey (see Section 5.1.2.4) reveal that touristic movement within the historic city centre have mainly focused on walking tourists, who increasingly display year-round high usage and localised overcrowding of pedestrian zones, places, and walkways and peak-time congestion caused by sightseeing groups.

The centre of Vienna was listed as a UNESCO WHS in 2001 and covers an area of 371 hectares (including *Schönbrunn Palace*; see detailed map Appendix V). In 2017, the historic city centre was listed as a 'Site in Danger' by UNESCO (UNESCO, 2018a). This intervention from UNESCO was, among other things, mainly triggered by a significant increase in loft conversions, which was perceived to lead to a changing roofscape, as well as a proposed redevelopment concept for a hotel property adjacent to the historic city centre that would drastically alter the cityscape of the historic city centre. UNESCO criticised the insufficient control mechanisms of building laws and urged the City of Vienna to introduce amended urban development guidelines that considered the 'Outstanding Universal Value'.

WHS - Historic City Centre of Vienna	
Land use	
Inscription year:	2001
Danger List:	2017
WHS area:	371 ha
Buffer zone:	467 ha

Table 13 Overview of WHS in Vienna (Source: own illustration)

The 'red-listing' of Vienna was perceived as largely incomprehensible by Viennese stakeholders and impacted the relationship between UNESCO and the Viennese city government and the tourism industry but had no noticeable effects on tourism numbers.

> We cannot stop urban development. After all a city is an evolving, living space […] the distinction between progress and endangerment needs to be reconsidered […] in the 1860s the historic city walls were demolished to make room for the innovation of the city, to create the Vienna of today – which is obviously a Vienna worth to be put on the UNESCO WHS list. […] and now we are told that innovation was ok back then, but not today. (CEO - Vienna Tourism, 2018)

The stakeholders stood united against the UNESCO decision, including the City of Vienna, which prioritised the upgrade of the city's infrastructure and built environment to facilitate contemporary living standards

> It is not a question of demolishing historic buildings, but about making the city and its living environments fit for the 21st century. […] we do not want to make Vienna into a living museum. (Head of Urban Planning of City of Vienna, 2018)

In April 2020, the federal ministry for arts and culture submitted the action plan 'Desired State of Conservation' (DSCOR) to UNESCO headquarters in Paris. The plan included measures and suggestions to comply with the UNESCO requests (BMKOES, 2020), as well as the introduction of conservation laws into city legislation. The Austrian UNESCO commission reacted positively to the action plan and especially endorsed the multi-stakeholder approach the plans were based on. However, critical voices in the city questioned the willingness of

political actors and the city government to enact these far-reaching conservation laws because they would limit the city's urban development and innovation possibilities.

7.2. Vienna's Tourism Mobility Stakeholder Structure

The above-mentioned focus of the city government to maintain a 'healthy' balance of city utilisation between conservation and innovation was also reflected in the approach to integrate and innovate tourism mobility.

Vienna's city government has been dominated for many years by a social-democratic leadership focused on improving living standards and optimising the utilisation of the city space and creating a stable economic foundation for the city.

> In the last 15 years Vienna was spared political quarrels and change of political directions and agendas like many other cities have to go through every 5 years or so [after elections]. […] For us, this stability means that we can actually take our time and develop and implement long-lasting, useful and sustainable plans and do not have to come up with unrealistic pre-election bonuses every few years. (Head of Mobility Management of City of Vienna, 2018)

In 2010, the Social-Democratic Party of Vienna formed a coalition with the 'Green Party'. Thus, the focus of the city governance expanded with ecological and climate-friendly agendas, including a strong focus on urban mobility and a more critical view on the touristic utilisation of the city. This shifting focus also brought the joint objective of tourism mobility onto the agenda of Vienna's city council.

At the beginning of the 2010s, the tourism mobility stakeholder structure (see Figure 55) was characterised by a clear division of competencies into tourism and mobility. On a micro-level (including frontline or executing actors such as departments and sections of city authorities and tourism organisations), joint tourism mobility approaches were scarce, stakeholders were focusing on their individual, fixed subject areas and acted only in established, predefined structures that did not consider tourism mobility.

When zooming out on the competencies ladder, the shifting political focus on tourism mobility was soon evident, and an increasing cross-sectoral approach towards tourism mobility issues was apparent. Supervisory actors, such as higher-level officials in the city government and the C-level of organisations (e.g. CEO, CFO, CIO), started to recognise the interwovenness and interdependency of tourism mobility and entered exploratory discussions for tourism mobility strategies and activities. The driving force behind the establishment of a joint approach was the city government. Although, its main focus was safeguarding high living standards for

inhabitants, the city government attempted to foster a sustainable coexistence of tourism and city life.

> Tourism is a substantial part of Vienna. It is not only a significant economic factor, but it is also a part of our culture. Vienna was always a travel hub. However, in the last years, tourism has changed, and so has the city. We still think and act in established, potentially outdated frameworks. This is not the way to successfully lead the city into the 21st century. We need to adapt to these changes. Synch the city and the 'live within' again. (CEO Austria Tourism, 2018)

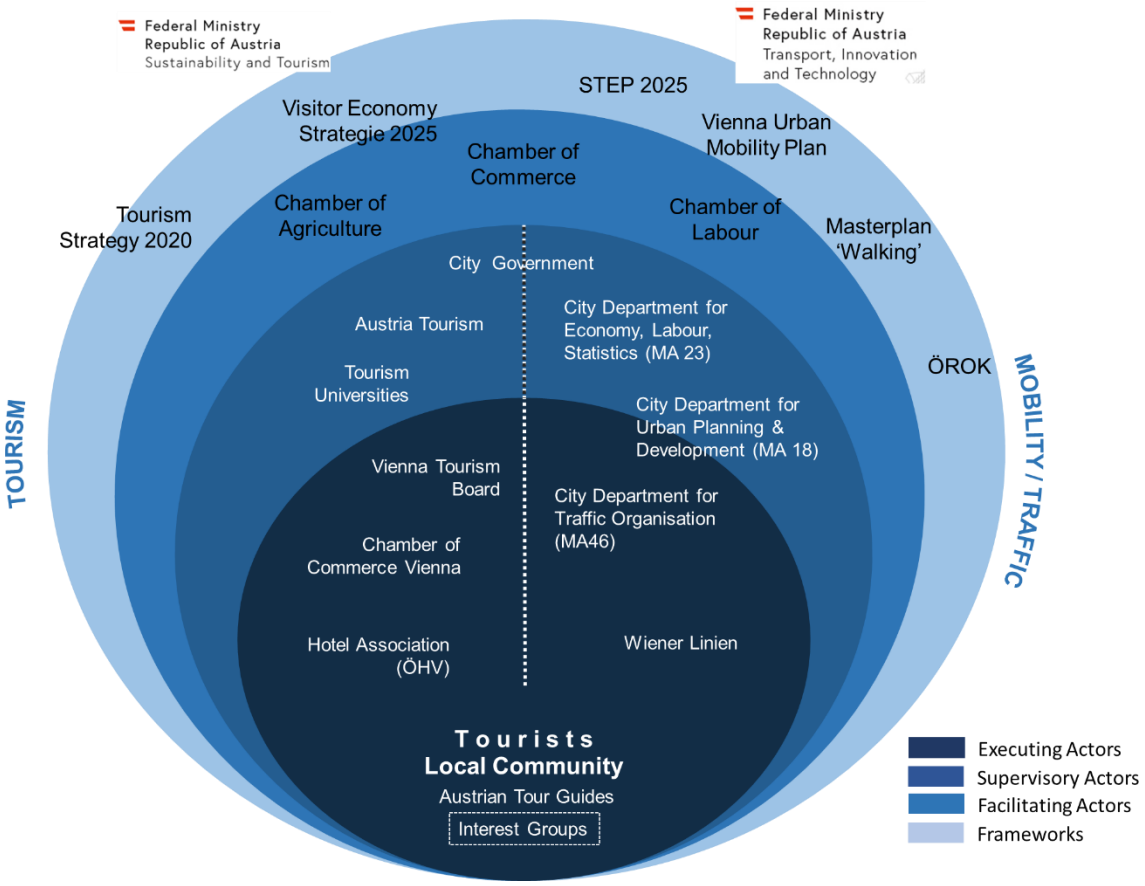

Figure 55 Tourism mobility system Vienna – stakeholders (Source: own illustration)

7.3. Tourism Mobility Mode Structure

Even before tourism mobility was recognised and gained relevance, the city government worked actively achieving balanced touristic utilisation of the city.

One approach of the city administration to prevent and ease touristic pressures on infrastructures was a diversification of mobility modes. Already in the early 2000s, the city administration initiated first projects to increase the range of micro-mobility modes for exploring the city centre.

Although the 200 *Fiakers,* (horse-drawn carriage service since 1693), as a remnant of the empire, are a very popular but high-priced mode for exploring the city centre, the city administration tried to establish more budget-friendly tourism mobility solutions.

In 2003, City Bike Vienna was launched, and today offers 1500 city-owned bikes at 121 stations. Especially in the inner city, the bike-sharing scheme gained popularity among tourists and residents and is considered a highly sustainable mobility solution, especially due to the first hour being free.

In 2009, a tram was converted into a city-owned sightseeing Ring-Tram designed to take pressure off the highly frequented narrow lanes in the city centre and divert sightseeing tourists to the outer section of the historic city by providing alternative tour routes. This logic also applied to the hop-on sightseeing buses that also circle the *Ringstrasse*.

In addition to the high-volume sightseeing transportation by bus or tram, a multitude of small-scale mobility providers started to offer alternative touristic mobility modes, such as Segway rentals, E-Old-timer tours, or bike-guide tours. These alternatives are available today and

> are not only a fun and different way for visitors to explore the city, but they act as a 'healthy' competition to old-established tour providers. For example, the E-Old-Timers shake-up the *Fiakers* and force them to be more innovative and creative (CEO - Vienna Tourism, 2018).

In 2016, sharing schemes of free-floating vehicles also started in Vienna. First, bike-sharing providers inundated Vienna. As in many other cities, this new scheme caused citywide problems due to an oversupply of bikes, uncontrolled parking, and improper usage of the bikes. The city administration reacted by regulating the permitted number of shared bikes in the city and introduced a penalty scheme, making bike providers liable for their bikes. The regulations were based on a minimum maintenance level of bikes, to ensure customer protection and traffic safety, and introduced a time limit for broken and abandoned bikes to be recovered and removed from the city. These regulations made Vienna unattractive for bike-sharing providers and boosted the city-owned bike rental scheme.

However, soon after, free-floating e-scooters emerged on Vienna's streets. The number of scooters was regulated from the beginning to avoid an overflow, but the speed and ease of use of the scooters led to severe traffic safety issues, especially in the inner city. The scooters were also considered significant competition to the Vienna City Bike due to their convenience and global popularity. At the time of the interview, no solution to these issues had been developed.

In the 21st century touristic city, a sophisticated and agile balance of providing state-of-the-art tourism mobility solutions, monitoring them, regulating them, and informing the right individual

at the right time about it, is of growing importance and seems to be a decisive factor for the innovation of tourism mobility.

7.4. The Immeasurability of Tourism Mobility

From the turn of the millennium, Vienna's tourism sector became the lead driver for the touristic utilisation of the city and started far-reaching campaigns to promote Vienna as a leading touristic destination in Europe. Vienna's visitor volume continuously grew, and nearly doubled from 4.8 million in 2010 to a forecast nine million in 2020. As a major economic pillar of the city, tourism contributed six billion euros (7%) of Vienna's GDP in 2018 (Statistik Austria, 2019).

The flourishing touristic utilisation of Vienna, paired with urbanisation developments, entailed growing pressures on social structures, infrastructure, and the built environment (see Figure 68). To ensure a balanced and sustainable growth of Vienna, the city government became more actively involved in the touristic exploitation of the city by intensifying cooperation with tourism actors and enhancing the emphasis on the monitoring and control of the touristic utilisation of the city.

However, the available data on touristic activities in the city were only providing insights into arrival numbers and overnight stays but did not grasp the much-larger proportion of unquantifiable day-visitors roaming the city.

The tourism sector was satisfied with the available data and was using them mainly as economic indicators. However, the data were of little significance for the city administration and the discussion on how to manage tourism mobility issues within Vienna.

With growing concerns regarding perceived pressures caused by the rising numbers of visitors roaming the streets, an interest-led debate on 'healthy tourist levels' started. This debate revolved around the impossibility of generating representative data about walking day-visitors.

Viennese tourism stakeholders were reluctant to release estimates, and used technical limitations to generate quantitative data on individuals on the streets as an excuse to avoid discussions on potential carrying capacity concerns.

> In Vienna, we are far from concerning touristic levels, like Salzburg or Hallstatt are facing […] putting an unconfirmed number on day-visitor volumes might only raise unnecessary outcries […] after all, day tourists are not to be perceived as an 'infestation of locusts' […] Vienna's tourism industry and its multipliers are benefiting from day tourism (Chairlady - Vienna Tour Guides Association, 2018)

However, by the middle of the 2010s, even tourism actors started to admit a growing "noticeability" (CEO - Vienna Tourism, 2018) of day-visitors and perceivable changes of visitation behaviour.

> I still think that tourism in Vienna can be considered [to be] at a 'healthy' level. However, in the last 10 years, travel patterns of visitors have significantly changed. The volume of day-visitors increased disproportionately and drastically, and the length of stay dropped significantly. […] They often need more time to travel to Vienna than they spend in Vienna. […] we have peak times and hotspots of day tourists. […] The majority of visits are by bus, between 9am and 6pm, and are commonly dropped off at key sights, such as *Schönbrunn Palace* or in the historic city centre. (CEO - Vienna Tourism, 2018)

To counteract starting 'over-tourism' debates in the city, the local DMO conducted a study in 2018 that found that the perception of Vienna's citizens regarding touristic pressures on the city was low. Nine out of 10 Viennese felt no disturbance due to the increasing tourist utilisation of the city (ViennaTourism, 2019). Tourism statistics supported this statement and showed that Vienna had a relatively low annual tourist-per-inhabitant ratio of around four throughout the first half of the 2010s, compared with around 18 tourists per inhabitant in Salzburg (Eurostat, 2019).

However, the city government argued that the available statistics neglected to incorporate estimations on the rapidly growing number of day-visitors (Head of Urban Planning of City of Vienna, 2018). Based on estimations of local stakeholders (see Section 7.1.2) the visitor-per-inhabitant ratio of the inner city would be around 1,200 to 1,800 day-visitors per inhabitant.

From the early 2010s onwards, the city government started to focus on the impacts of day-visitors on the city and pleaded for an urgent introduction of bus management schemes and a limitation of visitor numbers to the inner city to minimise visitor impacts on the historic built environment and the social balance of the living environment. Due to a very strong tourism lobby and a lack of 'hard' evidence, such as concrete day-visitor numbers, to argue for 'over-touristic' usage of the city, the city government was unable to push these regulations through (Head of Urban Planning of City of Vienna, 2018).

The confrontation between the city and the tourism sector was the first common acknowledgement of tourism mobility being a relevant aspect for city and destination management in Vienna. However, it also became apparent that the inability to produce representative figures for all types of tourists and the lack of a united approach to defining 'healthy' tourism volumes for the city were key aspects hindering the breakthrough of a joint approach towards tourism mobility in the first half of the 2010s.

Despite all these issues, a first dialogue was opened to work jointly towards sustainable visitor mobility management and to start reconsidering tourism mobility issues from multiple perspectives. Furthermore, the utilisation of new technologies to improve visitor-movement management also started to be considered.

> We need to know what is going on in the streets. Accurate and citywide data on visitor behaviour would give us an immense advantage to manage the city. It is not about sanctioning tourism but about better yielding urban space […] to develop an effective urban tourism mobility design, [so] we first need to understand the status quo. New technologies were on the horizon at the time [early 2010s] and we perceived them to be the key to finally better understand the city and all aspects of its utilisation. (Head of Urban Planning of City of Vienna, 2018)

Research projects using new technologies for tracking visitors in cities illustrated the potential of new technologies to generate more representative data, including on micro-mobility behaviour (Calabrese and Ratti, 2006; Ratti et al., 2007; Girardin et al., 2010). Although these embryotic technologies were not ready to be used on a commercial scale, both the city authorities and the tourism industry recognised the unprecedented opportunities these technologies might hold also for the innovation of the tourism mobility system in an urban context.

Within the MLP analysis, this constellation can be considered the initial phase of the digital transformation of Vienna (see Figure 56).

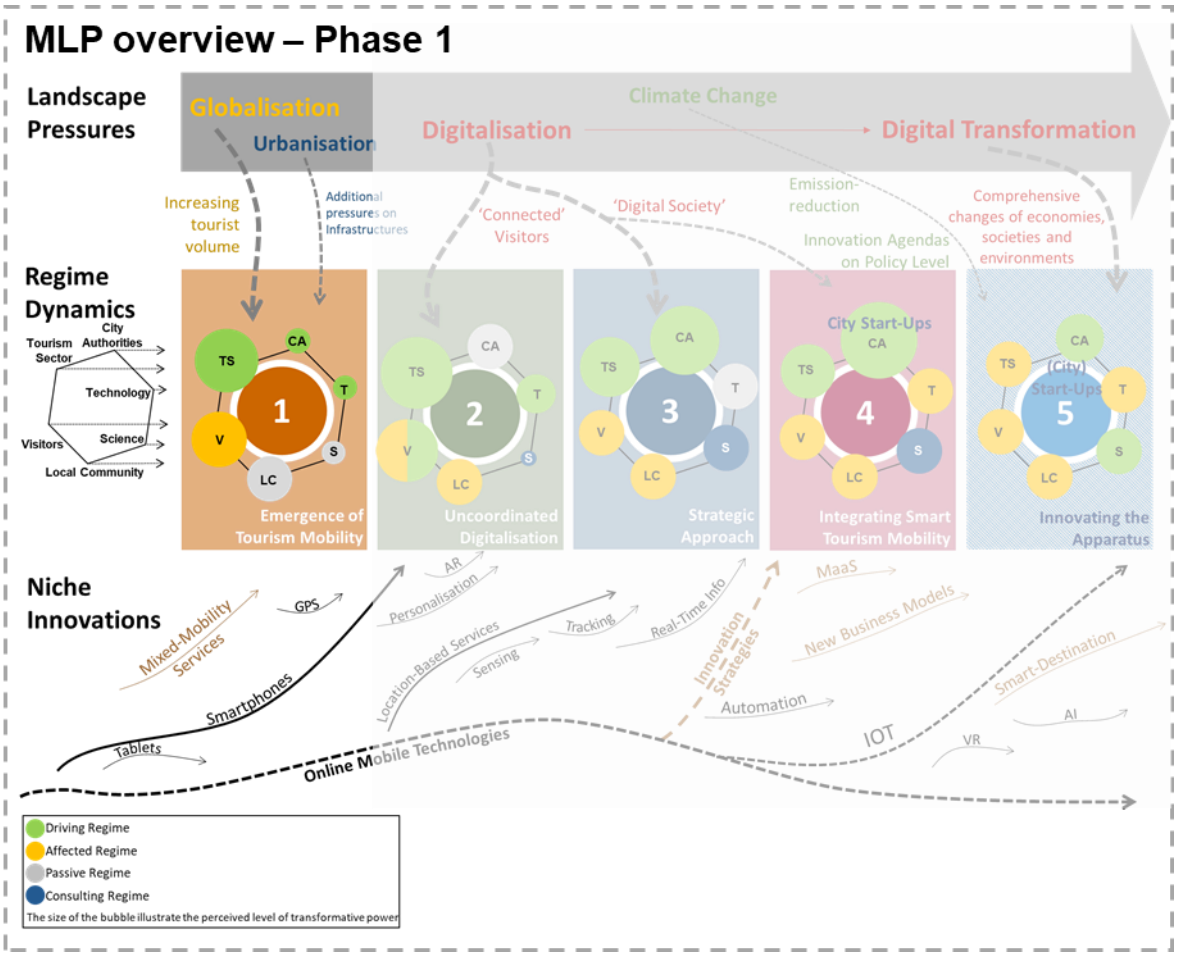

Figure 56 MLP analysis Vienna – Phase 1 (Source: own illustration)

7.5. The Digitalisation of Tourism Mobility

Despite the novel opportunities new technologies were perceived to offer, the early phase of the digitalisation (Phase 2) of Vienna's tourism mobility system focused on new ICT capabilities, which were driven by the increasing penetration of the smartphone. In particular, the tourism sector tapped into these new possibilities to interact with the visitor on-the-go and explored digital solutions to enhance interpretation and guiding services.

The Viennese DMO already provided in 2012 'Smart Guides' for tourists (see Figure 57), which were supposed to innovate the established heritage interpretation structure of Vienna. The 'Smart Guide' was a rentable tablet providing GPS-supported guided tours. Alternative solutions, such as online tour guide apps for smartphones, were already available, but the usage rate was moderate due to potentially costly data roaming charges for foreigners.

Vienna was one of the first destinations to offer this type of online guiding device to visitors. The introduction of the ‘Smart Guide’ was mainly motivated by the DMO wanting to explore the potential of these devices. The DMO perceived the digital innovation of communication methods with visitors as necessary to remain competitive in the European historic city tourism market.

> Online devices were a global phenomenon. We had no idea how these technologies would develop and impact tourism, but we quickly understood that mobile technologies will not disappear soon. We had no clear idea what these technologies are capable of. So, we started testing how to integrate them into Vienna’s tourism and tourism mobility structure. (CEO Austria Tourism, 2018)

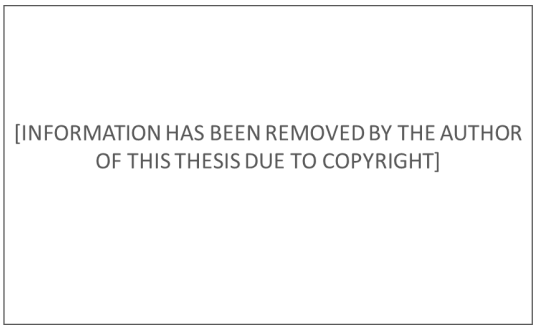

Figure 57 'Smart Guide' Vienna (Smartguide, 2013)

The first ‘Smart Guide’ was challenged by poor GPS reception in the narrow lanes of the densely built-up historic city centre, and the interpretation style was perceived as outdated and boring because the tour app simply used digitised information from analogue tour guides (Wollrab, 2013). The DMO realised that digital expertise and experience and the necessary technical frameworks and digital communication techniques were missing; thus, they converted the ‘Smart Guide’ into a test device to trial diverse software, technical capabilities, and communication and interpretation methods on the customer. After several reconfigurations, the device developed into a very popular digital tour guide tool and was heavily used until 2017, when the EU roaming law was enacted. The success of the ‘Smart Guide’ exemplified the growing relevance and user-demand for digital tools to explore the city and highlighted the necessity of enabling the increasing number of ‘connected’ visitors to use their own smart devices at reasonable costs onsite.

Driven by the business sectors, the city government agreed to mobilise funds for the installation of Wi-Fi hotspots in the inner city in 2013. This project required large-scale and costly upgrading of the physical and digital infrastructures in the city. At that time, digitalisation investments were not included in the city’s budget nor any urban innovation fund.

> City development and infrastructure upgrades are commonly planned long ahead. ‘Digitalisation’ as a coming trend was not new, and we had already integrated digital tools for traffic management or e-government. But with the breakthrough of the smartphone, everything changed ‘overnight’. The existing digital infrastructure was not able to cover the booming data demand. And we also

> quickly realised that planned upgrades of infrastructures would not be enough for the coming changes. […] Planning upgrades was very difficult at that time because we had no real experience with digital transformation dynamics. How fast and how much would data demand grow? What was the right technical solution? How long would the upgrade last? […] What about ROI [return on investment] calculations? We consulted other cities, but all of them went through the same troubles. (Head of Department - Digital Vienna, 2019)

In 2015, the city management began the installation of Wi-Fi hotspots all over the city, which initially only provided complimentary access to the City of Vienna website, including city maps and guided tours for visitors. After completion in 2017, the Wi-Fi network comprised 400 hotspots across the city and granted free access to the internet.

The city also introduced test areas for other new technologies that would support city management, such as sensing technologies (e.g. beacons) or near-field technologies. Although the city saw great potential in these new technologies to improve mobility management, pilot projects found that existing technologies were potentially capable of supporting traffic management but were not advanced enough to cope with the micro-movements of pedestrians.

In this phase of the digital innovation of Vienna's tourism mobility system, stakeholders mainly focused on gaining experience with these new technologies. In particular, the effects on users and user behaviour were questioned, followed by far-reaching uncertainties regarding the available technical solutions and necessary resources for effective OMT use.

The two lead stakeholders, namely the tourism sector and the city government, took very distinct approaches to gaining experience with new technologies in the city. These approaches were strongly tied to their motivation to innovate. The tourism sector used a trial-and-error approach when introducing new, digital tourism mobility features, which was mainly motivated to utilise new technologies to optimise services and processes to improve the touristic exploitation of the site.

> It is new terrain. To gain experience, we test apps, activities, offers, and so on and react to the feedback. If a product works or does not work in any way, we have learned a lesson. (CEO - Vienna Tourism, 2018)

However, the city administration had to take a more considerate approach due to its responsibilities and obligation towards citizens. The city's projects were also commonly larger and more costly (e.g. infrastructure upgrades, citywide Wi-Fi network) than those of the tourism sector and were financed mainly from tax revenue. Therefore, citizens had to be the main beneficiary of newly introduced technologies, and innovations had to be compatible with

the city's overall development agenda. These preconditions also applied to the innovation of the tourism mobility system.

> We cannot afford to trial-and-error. In the beginning, we did not have experience with digitalisation, but still, everything we did – big or small – needed to be supported by research or profound evidence, proving that it is a suitable solution for Vienna. (Head of Mobility Management of City of Vienna, 2018)

Furthermore, the city was increasingly confronted with digitalisation developments in diverse areas of the city system, and thus had to take a holistic approach to innovate the city systematically, with the urban mobility system as one of the priority areas for digital upgrade.

7.5.1. User-Centric Innovation of Tourism Mobility

The city government took a predominantly observing role in the early phase of the digital innovation of tourism mobility, whereas the tourism sector was the driving actor, testing and integrating technological novelties and digital approaches. The key foci were the digital upgrading of communication and marketing techniques, as well as improving the customer journey and experience (CJX). However, the tourism sector quickly realised that digitalisation goes far beyond merely introducing new digital devices and applications into established systems; it affects and intrinsically transforms the dynamics and structures of these systems.

The 'visitor' was one of the first regime actors within the tourism mobility system affected by OMT-induced changes. These changes became mainly visible due to significant differences in 'connected' visitor behaviours.

> From 2013 onwards, we started to feel the effects of digitalisation. By 2016, it was inevitable to adjust to digitalisation. Everything was affected. It was a user-led and user-centric transformation, which means that what we offered so far did not really match the 'new' customer's demand anymore. The way we interacted and communicated with our customers did not really engage them anymore. Whatever we did, we were not able to suit their significantly changing behaviour anymore. (CEO - Vienna Tourism, 2018)

'Connected' visitors were perceived to increase rapidly in numbers and were characterised by increasing impatience, shorter interest spans, ad-hoc decision-making, highly volatile movement patterns, and a strong belief in sharing and rating platforms.

For the tourism mobility system, these intrinsic changes in visitor behaviour required a complete rethinking of interpretation, visitor management, and guidance methods.

> It was not enough anymore to provide online tour apps – there were already too many available – it was necessary to start with personalisation of information, to make interpretation interactive, come up with completely new routes, enhance storytelling and gamify the city tours. And also to start reacting to rating platforms and shared content. […] But next to developing a new, digital experience for 'connected' visitors, it would be a great mistake to neglect the still larger number of visitors walking analogue through Vienna. So, the tourism industry had to do two jobs at the same time. (Professor Information Technologies at Technical University Vienna, 2019)

Although tourism stakeholders in Vienna had been digitally upgrading marketing divisions over recent years, they soon realised they were lacking expertise, know-how, and the resources to address the 'digitalised' interpretation and visitor management of 'connected' visitors.

As a result, the DMO began close cooperation with network providers to gain access to mobile phone data, with the city government to coordinate interpretation strategies and visitor-management projects, and with a variety of external IT partners to process data and develop OMT solutions.

Mobile phone data provided novel insights into the movement patterns of visitors and, combined with data-mining techniques, the DMO was able to generate the first visitor-movement maps of the city.

> For example, the data showed us which location is preferred by which nationality, or which area is not explored at all but would offer interesting sites, and which place is potentially overvisited. (CEO Austria Tourism, 2018)

Although these data generation methods were only in their infancy and provided a rough overview of visitor-behaviour patterns at the destination, the results were a breakthrough for the tourism mobility management of Vienna and reawakened the interest of the city government to become more actively involved in tourism mobility management.

7.5.2. Visitor Experience as a Key Objective

The improvement of the visitor experience on the go and greater control of visitors exploring the city was the overarching objective of the DMO's innovation endeavour. However, a global market for digital interpretive services had rapidly emerged and a vast number of specialised IT business dominated the provision of visitor experiences at most destinations. These external providers rarely consulted with local partners on content, value creation, or visitor-management strategies, nor shared generated data on visitors, and thus were perceived as

unsustainable competition, impeding the establishment of OMT-supported visitor management (CEO Austria Tourism, 2018).

Vienna's DMO was, however, incapable of providing competitive in-house ICT solutions (e.g. tour apps, AR interpretation), and therefore redefined its role in the 'digital' destination configuration and started to act as an intermediary between the 'connected' visitor and external IT partners that provided OMT solutions. The DMO provided its thematic know-how on the destination (e.g. historical facts, local knowledge) and its dominance in the Viennese tourism market (e.g. marketing, promotion) as the unique selling point (USP) for technology providers. In return, the DMO increased its control of distributed digital content, gained access to greater data on users, and could actively intervene in the digital destination marketplace, which was already oversupplied with a multitude of different tour apps, mobility apps for guests, tour guide apps, and sharing and rating apps of local businesses and sights.

Selected example

One cooperative project used AR to explore the inner city (see Figure 58). The app was designed as a quiz rally that guided the user on a tour through the historic City of Vienna and provided historical information on sights or important events through augmented visualisations on smartphones. To ensure the necessary seamless internet access, Wi-Fi hotspots and AR spots were aligned. The app was not only an economic success, but more importantly, the collected user and usage data provided insights into 'connected' visitor-behaviour patterns and highlighted the potential of AR for tourism mobility management.

The key findings revealed that the gamified interpretation technique strongly engaged the users in the exploration of the historic centre and had proven to be very effective in conveying not only facts, but also the historical and social values of the site. Furthermore, the app displayed great control over the spatial and temporal aspects of visitor movement, which made the app a promising tool to control and guide visitor movement: for example, for the regeneration of less-visited parts or to divert visitors from highly frequented sites during peak hours to sites with free capacity. Even micro-movements could be controlled to a certain level: for example, by locating AR viewpoints off the beaten track and away from busy places, adding to a certain reduction or dispersion of spectators across the available space.

The app was developed by an external IT business partner of the DMO and was initially merely considered an AR test version to generate data on these interpretation methods. Although the findings highlighted the potential value of AR for destination and city management, they also showed that the effective use of AR required a dedicated IT division constantly maintaining

and updating content, and an ideally real-time and interconnected tourism mobility network (e.g. IOT approach), and an agile visitor-management operation. Neither the DMO nor the city were able to cover these prerequisites at the time. Thus, the DMO continued to cooperate with external app providers to offer AR interpretation to enhance the visitor experience, but they could not use the full potential of AR applications.

Figure 58 Augmented reality tour app Vienna (VARS VR & AR Studio, 2018)

Even today, an IOT approach for tourism mobility management is not available in Vienna. However, the DMO has fine-tuned and upgraded the AR approach for exploring the destination and launched a test patch of 'Smart' AR goggles in summer 2019. The newly released Bose Frames sunglasses have a specially designed *Beethoven* AR and audio tour, which guides the users through Beethoven's Vienna. The *#RelatedToAustria-App* was developed mainly as a gimmick for Vienna2020 – Vienna as Capital of Music – and to honour the 250th birthday of *Beethoven* in 2020.

7.5.3. Counterbalancing Digitalisation

With the increasing use of OMT solutions, conflicts between 'connected' and 'unconnected' visitors emerged, and the negative effects of OMT-supported city explorations became more apparent. As a reaction to these developments, the

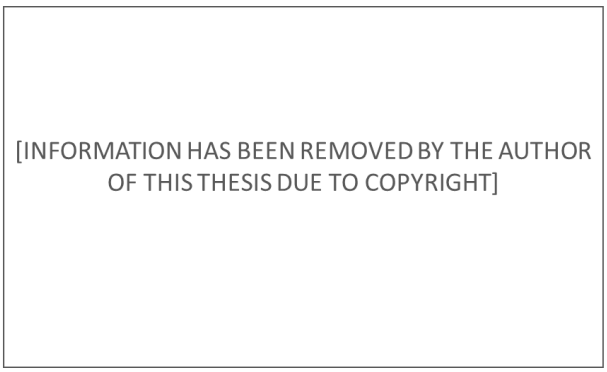

Figure 59 'Smart' AR goggles (Vienna Tourism, 2019)

national tourism organisation (Austria Tourism) initiated a discussion on the re-conceptualisation of the perception, consumption, and use of touristic-utilised space, which was meant to open a dialogue between the DMO, urban planning, heritage interpretation, and tourism stakeholders to reconsider the 'digitalisation' effects on visitor management, heritage consumption, and touristic movement from a cyber-physical perspective. The initiatives resulting from this rethinking process attempted to provide a counterbalance to the perceived 'over-digitalisation' of the touristic experience.

Selected examples

The enormous expansion of the online interactivity of visitors to connect, exchange experience, share recommendations, and post statements or images triggered the idea to "translate the digital life of our visitors back into the physical world" (CEO Austria Tourism, 2018), creating real-world meeting spaces that also engaged in the 'Digital Society' for physical interactions.

> People connect online without any hesitation. We wanted to re-introduce people to actual physical interaction. Create a cyber-physical social experience which adds to their overall experience and image of Vienna. (CEO - Vienna Tourism, 2018)

The DMO cooperated with several city departments, including urban planning, traffic management, mobility section, and the digitalisation department, to use *urban acupuncture* techniques to stimulate socio-spatial and socio-cultural interactions. For example, urban furniture – a concept employed since 2007 in Vienna – regained importance. **Urban furniture** started as an art project in the city but developed into a useful analogue tool for contemporary visitor management and had already been applied for short- and long-term urban movement interventions across the city.

By equipping squares, places and streets with usable, urban furniture, people are not only attracted to visit, but also to linger. Thus, urban furniture is a tool to create points-of-interest as well

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Figure 60 Urban acupuncture examples (MQ, 2018)

as influence the character and speed of exploring a site. (CEO Austria Tourism, 2018)

One example of urban furniture is the courtyards of the MQ (Museum Quarter), which are equipped with the *Vienas* and *Enzos*, sitting furniture that is free to use and free to rearrange within the MQ area (see Figure 60). The MQ was already a point of interest for visitors due to its 60 cultural institutions and museums; however, the placement of urban furniture expanded the use of the site from a mere museum with visitors passing through, to a meeting and communication space for locals and visitors. The MQ area has evolved into a leisure area that diverts significant visitor volumes from the inner city.

The project ***Per Pedes*** was designed to promote *flaneurism* and tried to make people aware of digital effects on the perception and consumption of space. Smartphone-led city explorations steer visitors from site to site, but the overall impression of the built environment, Vienna's famous *Vista* (Spring, 2006), and the enjoyment of the thoughtful urban design of the city are often lost in the details or on the smartphone screen.

Figure 61 Per Pedes – layout plan in front of the city hall (author, 2005)

Per Pedes tried to highlight this issue and raise awareness among visitors, locals, and tourism stakeholders about the limitations of the digital experience. The city government, in cooperation with the DMO, printed layout plans of districts and displayed them on the floors of squares (see Figure 61) to highlight "how much could be missed when using tour apps and how much could be explored when just strolling the streets in the spirit of discovery" (Head of Urban Planning of City of Vienna, 2018).

Another project by the Austrian Tourism organisation continued the critical approach of digital interpretation and addressed the selfie and hashtag trend of recent years. This project attempted to raise awareness among the 'Sharing Society' regarding enjoying the physical object in the moment and not becoming lost by taking selfies, posting, commenting, or sharing. Next to the perceived increasing disconnection between visitors and the site, visitor-movement management had to cope with a growing number of obstructions and safety issues caused by selfie-taking visitors. The **'Unhashtag Vienna'** campaign tried to address these issues. Although the campaign was considered bad for business by tourism marketing stakeholders, it was regarded as a valuable project by site interpreters, city management, and urban planners. During the campaign, posters with hashtags across tourist pictures of famous sites were posted all over Austria (see Figure 62), and famous sights such as *The Kiss* by Gustav Klimt were also covered with a hashtag.

Vienna's DMO learned several lessons from these diverse projects, but also from continuously observing visitor behaviour in the city. As a reaction to the emerging changes and trends, the DMO adjusted digital communication and interpretation strategies. To continue to serve visitors with polished information ready to consume, the DMO started initiatives to activate the creative powers of visitors.

Figure 62 'Unhashtag' Vienna (Vienna Tourism, 2018)

For example, the DMO tested alternatives to conventional, predefined guided tours and launched an online platform with thematic tour suggestions, which provided the user only with the topic and relevant key sights. The users were not asked to explore the destination but to explore the given topic within the urban environment and find the best routes and most interesting sights relevant to the theme and share them on the platform to create collective, user-led knowledge.

This approach was one of the latest trials of the DMO to manage 'connected' visitors, understand emerging dynamics, and respond to changing behavioural patterns. Although the platform received very positive feedback, the solution required a high level of content maintenance.

The early phase of the innovation of the tourism mobility system was characterised by a rather uncoordinated utilisation of the available solutions. However, the increase in experience with OMTs for tourism mobility services provided the actors involved with a more comprehensive understanding of digital transformation processes. Although new technologies were considered to enable a more effective and sustainable tourism mobility management in the historic city, stakeholders realised that the introduction of an OMT-supported visitor-movement management would entail fundamental changes to established business practices and organisational structures, as well as requiring substantial investment.

These insights affected the innovation dynamics negatively and had a dampening effect on the innovativeness of several stakeholders. Figure 63 summarises this phase within the MLP analytical framework.

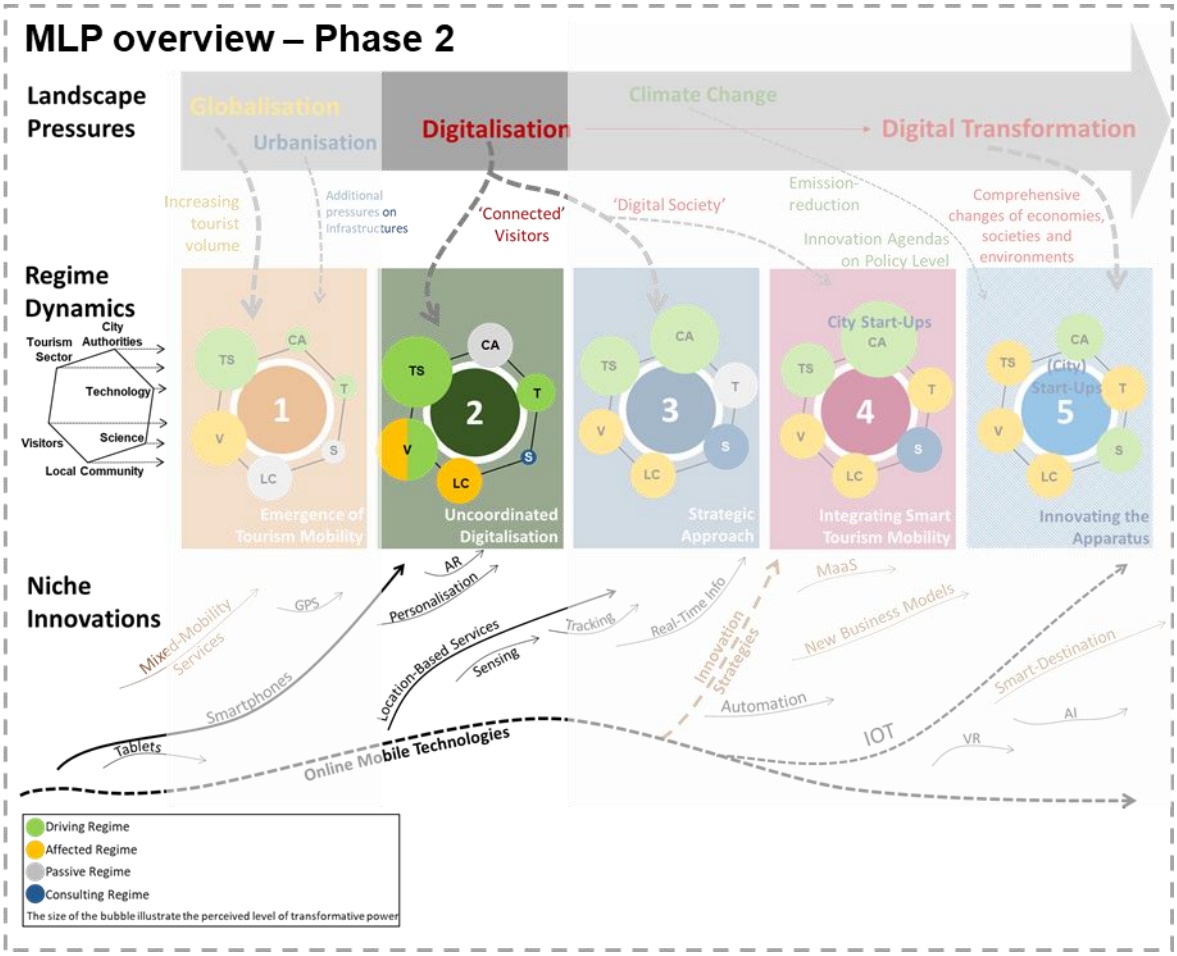

Figure 63 MLP analysis Vienna – Phase 2 (Source: own illustration)

7.6. New Perspectives on the Changing System

The city government did not want to lose the momentum of innovation and took over as lead actor to push the transformation of the tourism mobility system forward.

> The tourism partners were the ideal and logical leading actors to drive the use of OMTs. However, eventually we had reached a point when the utilisation of OMTs had become the norm, and new priorities to advance the tourism mobility structure were necessary. (Head of Department - Digital Vienna, 2019)

The utilisation of OMTs for tourism mobility activities in Vienna had produced valuable data and insights into mobility behaviour of visitors. Although the city lacked the capacity to process and effectively use these data at the time, it was clear that OMT-supported visitor management was the future of the destination management of Vienna.

By the middle of the 2010s, the city government had also gained more experience with digital transformation processes in other parts of the city system and could use this experience to develop a strategic concept to drive innovation for tourism mobility. A trial-and-error approach

was not an option for the next innovation steps. Thus, the city established a panel of representatives from all relevant sectors and experts from science and research to evaluate the status quo and develop an innovation strategy for Vienna's tourism mobility system.

The panel identified three key areas that required fundamental rethinking and a strategic, multi-stakeholder approach to continue the innovation of tourism mobility:

- The concretisation of the strategic positioning and setup of OMT-supported tourism mobility. It was still unclear which organisational structure and affiliation to government sections and business areas would be most suitable for tourism mobility.
- The identification and feasibility of infrastructure upgrades necessary to expand and optimise OMT-supported tourism mobility.
- The formulation of a sustainable and inclusive process of innovation to achieve maximal benefits for citizens, visitors, and the overall city system.

For the long-outstanding formal concretisation of the form of tourism mobility, the panel evaluated three possible options: 1) to create a dedicated tourism mobility department; 2) to establish tourism mobility as a sub-section of either the tourism or the urban planning department of the city apparatus; or 3) to embed tourism mobility as a key objective in the city management plan.

Although a large proportion of the panel agreed that a physical representation would be most effective "for sending the message that touristic mobility is of high relevance for city management" (Head of Urban Planning of City of Vienna, 2018), this solution was finally rated unfeasible. The suggestion to create sub-departments was perceived as counterproductive to previous efforts to decrease 'silo-thinking' and develop a joint approach towards tourism mobility. Thus, the panel decided to establish tourism mobility as a cross-sectoral and multi-level objective in the city's management plan.

Under this new conceptualisation, each department, section, and business unit would be responsible for identifying and assessing their share and input for tourism mobility and would regularly meet in working groups to discuss and coordinate tourism mobility issues and jointly devise development and innovation plans.

The strategic upgrade of relevant infrastructures and the development of an inclusive innovation process were also part of this new decision-making setup. Although the city government was still considered the lead driver for the innovation of the tourism mobility system, the complexity and sheer scope of tourism mobility was perceived to be most effectively dealt with as a joint, cross-sectoral effort.

> From the start of the ‘tourism mobility offensive’, the working groups showed good cooperation and high productivity. […] The still-prevalent ‘silo-thinking’ of the individual departments became even more apparent and the wide scope of different perspectives on what tourism mobility actually is surprised all participants. […] We quickly learned two major things: to have an open mind, but, more importantly, to consider perspectives of the other participants. It was clear to us that we could only progress in a joint effort, and that all of us still underestimated the far-reaching effects digitalisation already had on mobility and tourism. (Head of Urban Planning of City of Vienna, 2018)

These developments are reflected in the third phase within the MLP analysis and highlight that a shift of lead drivers among the actor groups was necessary to continue with the innovation of Vienna’s tourism mobility system (see Figure 64).

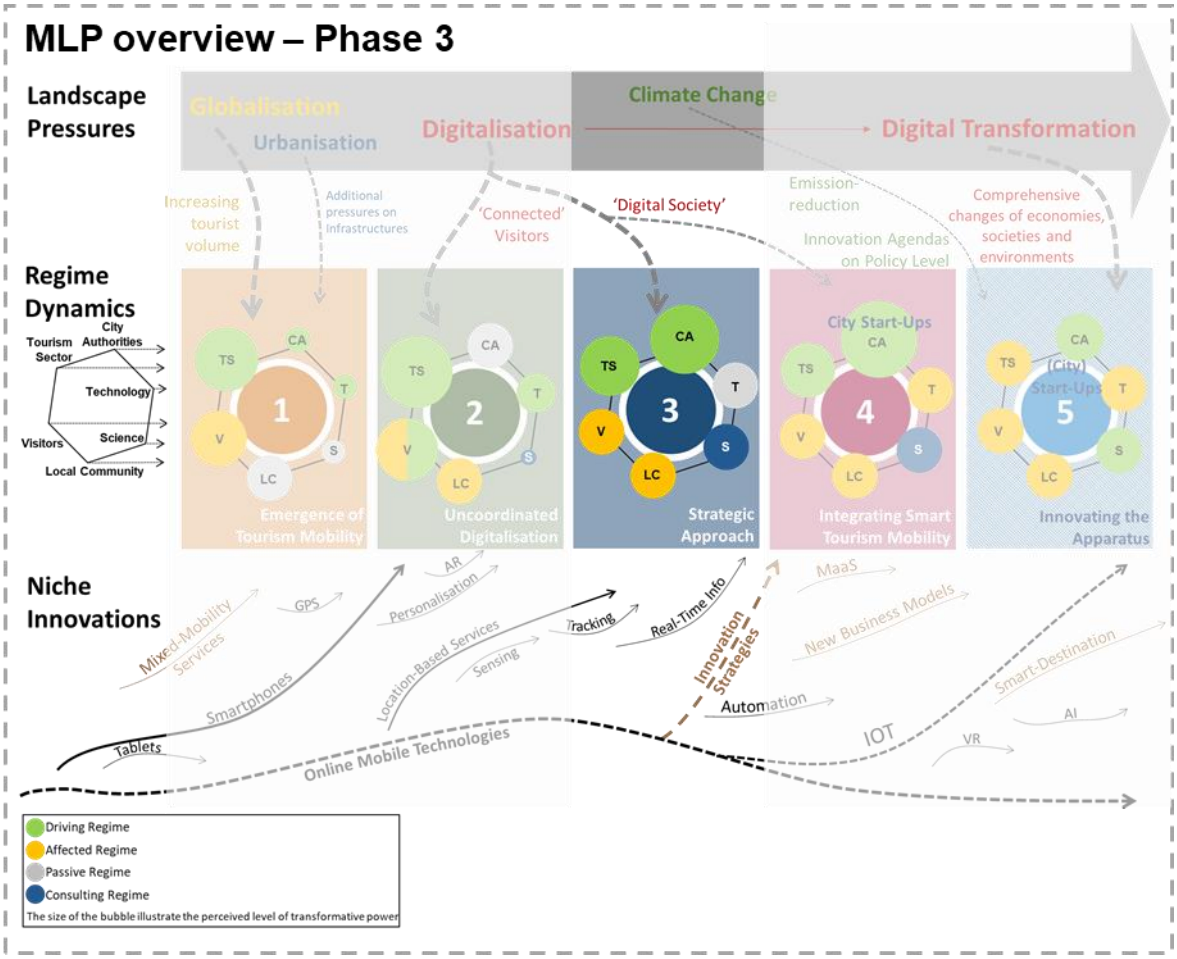

Figure 64 MLP analysis Vienna – Phase 3 (Source: own illustration)

7.7. Towards the Integration of Tourism Mobilities in the Digital City

Tourism mobility management was never more concrete and feasible in an urban context than in the second half of the 2010s. The innovation process of Vienna's tourism mobility structures exemplified that the co-evolution of actors involved was the foundation for a dynamic and stable transformation path. Although individual stakeholders displayed different innovation levels, different priorities, and different capabilities to innovate, the growing cooperative approach enabled a structured and balanced integration of OMTs into the tourism mobility system.

> I think online mobile devices had reached a fairly complete technical development status after the middle of the 2010s, and we could not expect any significant changes of available devices after then. […] In the last 10 years, new technologies have altered our world substantially and deeply affected people, societies, and economies. It is now our challenge – the challenge of the 2020s – to make the leap from just 'using' new technologies to 'making use of' new technologies. This means that we need to responsibly integrate these technologies – and everything that comes with it – into our established structures and adapt administrative, regulative, and legal structures to the changes of these last 10 years, so we can drive innovation but do this in a structured, controlled, and safe way. (Head of Department - Digital Vienna, 2019)

7.7.1. Innovating a Governmental Apparatus

In the middle of the 2010s, when the strategic appraisal of the city system was conducted, the city realised that digitalisation developments had turned into digital transformation processes that started to affect the fundaments of governmental and economic systems. The actors involved were still largely lacking the capacity, expertise, and experience to accommodate these far-reaching transformative powers. As a reaction to these insights, the city decided to integrate a dedicated digitalisation department – Digital Vienna – in the government apparatus to drive the digital transformation of the city, provide digital expertise to all departments, and to act as an intermediary among internal and external partners.

> We knew we needed a section to cope with digital transformation developments. […] It was a great challenge to set up and structure the department because digitalisation was so intangible. We had no idea of the current digitalisation status of the city, nor did we know how to handle a digitally transforming city. Also, it was very difficult to estimate the extent and future development of digital effects on the city. […] But we understood that we needed to disrupt the established administrative apparatus to be able to tackle the disruptive digitalisation developments. […] So, we established the *Digital Vienna* department within the city government, which acts as an intermediary between actors. And we tried to find employees who were lateral thinkers. (Head of Department of Digital Vienna, 2019)

The first projects of the Digital Vienna (MA1) department were still very much praxis-orientated and focused on a digital upgrade of urban mobility, energy efficiency, and the establishment of an e-government.

The first key finding of cross-sectoral discussions, which were moderated by the department, was the necessity to "not just work for Viennese citizens but work with them" (Head of Department - Digital Vienna, 2019). Thus, the city administration took a participative approach, involving the public in decision-making processes to shape the digital future of the city. On one hand, citizens were integrated into the practical upgrading of the city and asked to test novel apps and devices developed by the City of Vienna and provide feedback on usability; on the other hand, they were also directly involved in creating digital development plans for the city.

> During these participative sessions, we also discussed how to handle tourism in the digital city. Although we thought this topic would be of low interest to citizens, a large share of citizens was very much interested in actively participating in shaping digital tourism tools. As it turned out, many of them were even increasingly using touristic apps. (Head of Department - Digital Vienna, 2019)

These participative sessions resulted in the publication of the *Digital Agenda 2020* for Vienna in 2015 (Stadt Wien, 2015). This agenda was the first digital agenda in Austria and inspired other federal states, cities, and even the national government to develop digital development plans.

Although the team of the Digital Vienna department took a highly innovative and sophisticated approach towards driving a sustainable and long-lasting digital transformation of the city, the department itself was still subject to the ponderous administrative procedures of a governmental body.

> The digital world evolved at a speed government procedures could never keep up with, and this rather hindered innovation. (Head of Mobility Management of City of Vienna, 2018)

As a result, the city government established city-owned start-ups for all areas affected by digital transformation processes, including mobility, communication, and urban innovation.

As separate business units, city start-ups were part of the city system but not embedded in the governmental apparatus, and thus not subjected to slow administrative processes, and could act freely and agile. City start-ups were established to conduct research and develop pilots and projects to test innovative approaches, and to cope with the scaling-up of successful innovative solutions into the city system.

7.7.2. Tourism Mobility as a Start-Up Objective

Tourism mobility was accepted as an integral part of Vienna's city system and management plan and considered an ideal area to be innovated by start-ups. Start-ups that focused on the innovation of mobility solutions for the city especially showed great interest in integrating tourism mobility into their research and development (R&D) scope and developed applications.

Selected examples of tourism mobility solutions of city-owned start-ups

One of these start-ups was Up-stream (est. 2016), a start-up of the *Wiener Linien* (Vienna Transportation Company), which was dedicated to developing innovative, citywide mobility solutions. Up-stream was conducting research to improve linkages, networking, and interface solutions of multimodal mobility systems. Over the long term, Up-stream was working on the establishment of a 'smart', real-time mobility management system for the city that would also include real-time visitor-movement management. However, these goals were "quite far in the future" (Head of Mobility Management of City of Vienna, 2018).

For Up-stream, tourism mobility was an essential part of the overall mobility system of the city that provided insights into the changing mobility behaviour and mobility service consumption of 'connected' and 'unconnected' users and enabled a better understanding of touristic mobility demand.

One of the first implemented projects of Up-stream was the *WienMobil* app, which is a MaaS (Mobility as a Service) service that bundled available mobility modes, ranging from walking to cycling and taxi services, and public transport to sharing options, in one real-time application. After its launch in 2017, the app rapidly gained popularity and had approximately one million users at the beginning of 2018 (City of Vienna - Mobility, 2018). The first version was mainly designed for residents, but quickly gained popularity among visitors, so was translated into five languages, started to offer special registration possibilities for short-term users, and offered special mobility offers for tourists.

The app had high user ratings in app stores; however, after several software updates, ratings dropped significantly due to incompatibility with the operating systems of updated smartphone versions and external systems (e.g. online paying systems). This example illustrates that OMT solutions for mobility services are in high demand, even if they are not properly working, but

the pressures and struggles for even highly specialised IT start-ups to keep up with technological updates are clear.

Another city start-up with tourism mobility aspects integrated into its R&D focus is PACE. PACE is a start-up of the Digital Vienna department and was established in 2017. The start-up mainly focuses on the innovation of the city's communication and engagement solutions with people in the city, including citizens (e.g. e-government) and visitors to Vienna.

One of PACE's tourism mobility-related projects was the development of a digital version of the destination card – the Vienna City Card. The start-up was working on a blockchain-based City Wallet, which could be used as a payment method for mobility services, tickets for sights, theatres, museums, etc. as well as in restaurants and cafés. The idea to create the Wallet emerged during a participative workshop with citizens and was meant to become a useful tool for residents and citizens. At the time of the interview, this app was still under development and struggling "with interface solutions to link all the different systems" (Head of PACE City of Vienna, 2019).

PACE also created the *WienBot*, which is a digital assistant for the City of Vienna. The first version of the AI-based Bot was designed to answer government-related and administrative questions for citizens, but a taskforce team began working on an extended version to "create a companion while walking the city, for residence and visitors alike" (Digital Vienna, 2019).

Start-ups became the new leading drivers behind innovation in Vienna. However, this driving force is highly fragmented, detailed, and produced in small units due to the setup of the start-up as a small, agile business.

To enable a coordinated and effective innovation of the city – with the overall goal to make Vienna a 'Smart' city – another start-up was established in 2017. Urban Innovation Vienna (UIV) acts as a competence centre dedicated to developing, coordinating, and supervising Viennese innovation projects and bringing relevant stakeholders together to foster a balanced and sustainable transformation of Vienna into a 'Smart' city. This start-up is not only involved in project-based innovations, but is also supporting the city government to restructure established government structures and seeks to establish a novel approach towards cooperation for a more effective and smooth connection between agile start-ups, ponderous government bodies, and long-established economic structures.

7.7.3. Digitalising the Tourism Mobility Stakeholder Structure

The above examples illustrate the highly creative and innovative level of digitalisation in Vienna, but they also indicate the wide range of changes the integrative use of OMTs in the city entails.

Published digital agendas have raised awareness that digital transformation entails far-reaching changes, but they have been relatively vague regarding discussing concrete effects, problems, and potentials, and have offered only very general suggestions regarding how to cope with future digital transformation developments or how to integrate digital processes into existing structures.

The digitally diffused tourism mobility stakeholder structure (see Figure 65) is only a snapshot of the actors involved at the time of the interviews but highlights that the structure became more complex, integrating strategically developed start-ups on the mobility and city management side, whereas the tourism side continued working on old structures or cooperated with external partners. Nevertheless, the established cross-sectoral working groups (which are not reflected in the stakeholder structure) provided a good balance between the different organisational structures, interest groups, and innovation levels.

Another emerging development illustrated in the stakeholder structure is the eroding distinction of tourists / visitors and residents. The use of OMTs has created a cyber-reality that provides common ground for users; thus, the significance of the physical space in which cyber-activities are conducted is losing importance: “Home is wherever my phone is” (Head of Mobility Management of City of Vienna, 2018).

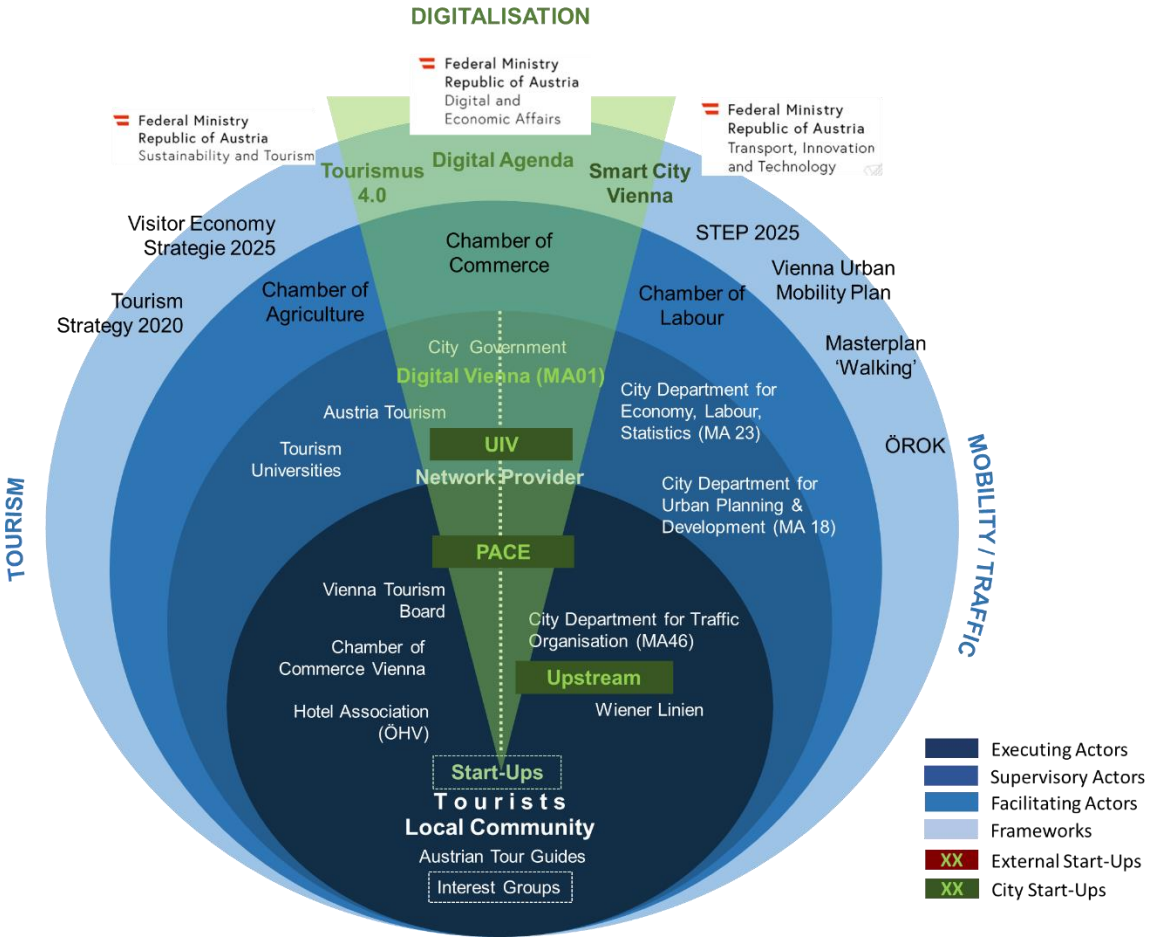

Figure 65 Digital Tourism Mobility stakeholder structure (Source: own illustration)

The fourth phase of the innovation pathway was dominated by the implementation of the strategic considerations of Phase 3. In particular, organisational and collaborative aspects were at the centre of this phase. The city authorities increased their leading role and not only pursued a strong coordinative role among the stakeholders involved, but also worked on organisational solutions to enable the continuation of innovation (see Figure 66).

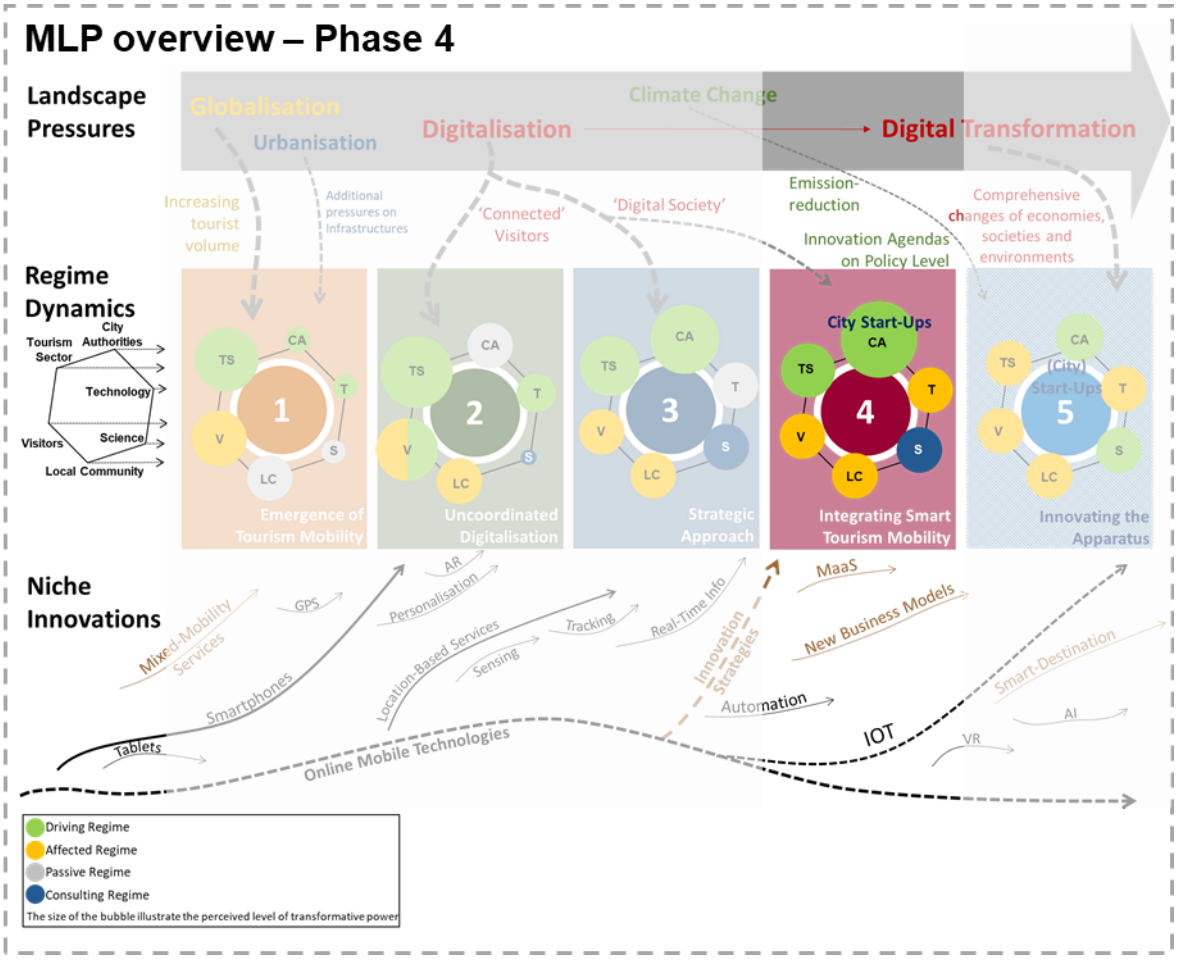

Figure 66 MLP analysis Vienna – Phase 4 (Source: own illustration)

7.8. Institutional Innovation for Tourism Mobility

At the time of the analysis, the tourism system in Vienna had already undergone far-reaching changes in its stakeholder structure, functioning, and even conceptualisation. However, the deeply embedded regulative and policy frameworks the tourism mobility system was built upon had barely started to change.

Although the necessity of amending laws, policies, and regulatory frameworks had been recognised by stakeholders, it was unclear what this process would look like.

> The institutionalization of tourism mobility had already started when it was accepted as an integral part of the city management concept. […] I think its further innovation will be an integral process. At the same time as we change organisational structures, process, and policies, we also need to amend laws and regulations. (Head of Department - Digital Vienna, 2019)

The enactment of the EU Roaming Regulation in 2017 and of the General Data Protection Regulation (GDPR) in 2018 was a milestone for the institutionalisation of digitally penetrated

systems and underpinned the institutional acknowledgement of the extent of digital transformation effects on societies, economies, environments, and socio-cultural structures.

> We had to follow the example and also be more critical in analysing digital transformation effects on the city environment […] but also find more courageous solutions to finally adjust governance to a digital world. (Head of Department - Digital Vienna, 2019)

In particular, the EU Roaming Regulation was perceived as a 'game-changer' for digitally diffused urban tourism systems and marked the transfer from digitalisation to the digital transformation era. In the digitalisation era, the focus was on optimising the utilisation of digitised data and innovating business models and processes to exploit digital opportunities, and digital transformation was the next phase, which dealt with system-level restructuring processes of digitally diffused economies, institutions, and societies.

The EU regulations exemplified how far advanced the "unstoppable and irreversible digital transformation processes of socio-technical structures" (Head of Mobility Management of City of Vienna, 2018) in European countries had progressed. The mere practical integration of digital tools and processes was no longer sufficient; fundamental adaptations of the underlying institutional frameworks became necessary.

> I think trying to adjust the institutional structure of the city to changes is not an adequate approach anymore. We need to institutionalise change. Only then will we be able to sustainably handle the city's transformation into a 'Smart City'. (Head of Department - Digital Vienna, 2019)

7.8.1. Lessons Learned and their Implications for Institutional Integration

At the time of the study, the innovation process had reached a stage in which the initial results from past innovation efforts had taken effect, and stakeholders were reflecting on past innovation processes and assessing their implications for the further evolution of the local tourism mobility system. The following are some key reflections:

Innovative progress

The newly established cross-sectoral working groups proved to be a functioning approach to addressing digital transformation processes holistically.

Prior to the establishment of the cross-sectoral working groups, an interest-led exploitation of OMTs for visitor management dominated. The tourism side used OMTs to rapidly increase the volume of information conveyed to visitors to enhance touristic profits, but this also created

highly volatile movement behaviour of ‘connected’ visitors that was unpredictable and difficult to manage. This strategy made the government’s efforts to use OMTs to increase the control of visitor location ineffective and redundant.

In working groups, the perspectives and concerns of both sides were evaluated and considered in light of the continuously growing tourist numbers in the city. Therefore, the tourism sector agreed to not fully exploit digital capacities of personalisation and mobile e-commerce but amend business strategies to foster the sustainable growth of tourist volumes in the city.

This agreement entailed a re-conceptualisation of the DMO’s business strategy from its former focus on the development of Vienna as a leading ‘one-time destination’ (i.e. working with high tourist and day-visitor numbers) to a sustainable business development concept that put “quality before quantity” (CEO - Vienna Tourism, 2018) and henceforth focused on high-priced tourist markets, which might result in lower visitor numbers but in an increasing multiplier effect on the entire city.

Furthermore, the city was finally able to obtain the consent of the tourism sector to enact bus management regulation. From 2020, only a certain daily number of tour buses was granted access to enter the inner layers of the city.

Rethinking established processes

The rapid pace of changing technologies challenged the city’s finances and prompted debates on the feasibility, relevance, and usefulness of continuous costly technological installations that might be replaced by other new technologies after only a short period.

> We need to make compromises between reaching ROIs and providing our citizens and visitors with a state-of-the-art infrastructure. (Professor Information Technologies at Technical University Vienna, 2019)

Upgrading infrastructure is a costly endeavour and subject to long planning and execution phases. However, the established project management and financing frameworks are perceived to be unsuitable for digital innovation process.

The discussion on this issue was fuelled after the EU Roaming Regulation became effective and the, mainly touristically used, citywide Wi-Fi hotspot network became largely obsolete overnight. The city government faced increasing pressures to justify investment in digital infrastructures, especially because the 5G network was imminent, and financing options for 5G pilot areas had to be agreed upon.

The city government established several 5G test areas but passed the problem on how to cope with ever-increasing investment costs for large-scale digital transformation to the national government, with a request to find national solutions for digital infrastructure upgrades.

This issue is only exemplary and went far beyond mere tourism mobility issues; however, it highlights the necessity of adjusting budgeting and project management mechanisms to the rapidly changing technological landscape.

One first step of the city government was shortening budgeting periods and economic projection periods and introducing a cross-sectoral budgeting team because “in a diversified and fast-changing world it is not possible to plan far ahead but it is crucial to plan holistically, in detail, but agile for a foreseeable future” (Head of Urban Planning of City of Vienna, 2018).

The expansion of the IT infrastructure and computation capacities of the city’s IT department fell under this new regulatory framework and involved tourism and tourism mobility representatives because Vienna had integrated a real-time visitor-movement-management scheme into the urban mobility management agenda.

> For these projects [e.g. IOT, real-time guidance] the share of engineers [in the meetings] is decreasing and the number of lawyers is increasing. Foci are again changing. There are no technical capabilities under question anymore, but laws, appropriation, and ethical matters [are under question]. (Head of Urban Planning of City of Vienna, 2018)

A new paradigm for innovation

The pressure of ‘uncertainty’ is a constant companion in the innovation of the tourism mobility system in Vienna. However, the active and participative approach to driving innovation has enabled Vienna to pursue a balanced and smooth innovation process.

Nevertheless, it was clear to all stakeholders that digital transformation had only just begun, and after the phase of using and getting to know new technical gimmicks, the phases of intrinsic system changes and the far-reaching amendments of fundamental frameworks that regulate everyday life are inevitable.

Therefore, the city started a research fund to concretise and globally promote the idea of ‘Digital Humanism’. Since 2019, the city has invested two million euros in several research projects that mainly take sociological perspectives on digital transformation, but which also started to discuss this topic on a meta-level. Fundamental concepts such as ‘space’ or ‘place’ risk becoming outdated and inadequate in a cyber-physical world but still act as fundamental

concepts for economies, societies, and jurisdictions. The OMT-supported tourism movement in urban spaces is considered an insightful example for this novel discussion.

> In times of alternative realities, where do we draw the demarcation between physical space and cyberspace? […] Tourists using an AR app to explore the city seem to have adjusted to this cyber-physical reality quite nicely. […] So, what lessons can we learn from this? And where will the app guide us?" (Professor Political Sciences at Ludwig Maximilian University Munich, 2019)

Overall, Phase 5 was still at a very early stage at the time of the study. However, the initial innovation tendencies and shifting priorities to continue the transformation of the tourism mobility system could be identified and are summarised in the MLP framework (see Figure 67).

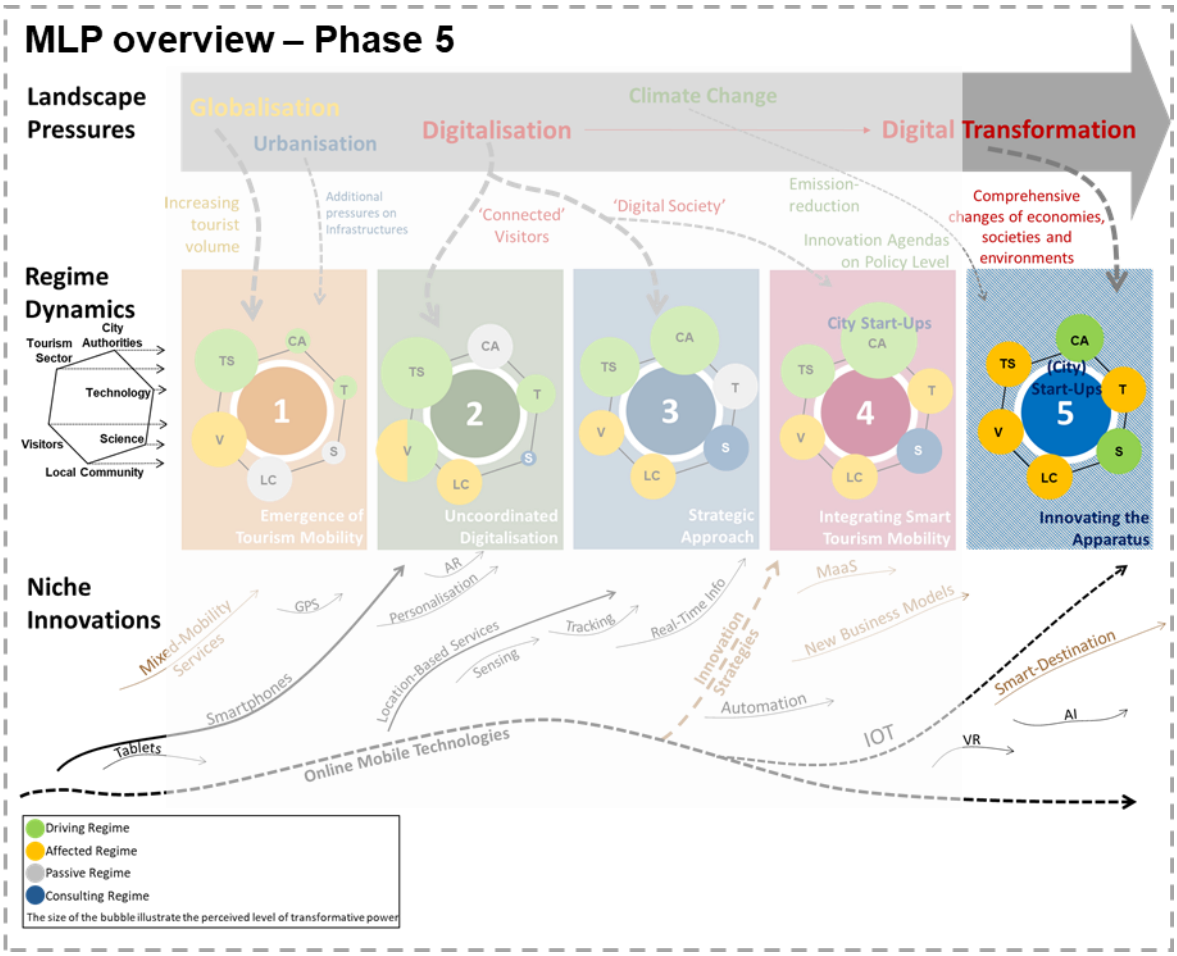

Figure 67 MLP analysis Vienna – Phase 5 (Source: own illustration)

7.9. A Multi-Level Perspective on Vienna's Tourism Mobility Innovation Path

Summing up the above innovation phases of the innovation pathway of Vienna's tourism mobility systems (see Table 14 and Figure 68), a stepwise adjustment of the incumbent regime actors to external pressures by realigning their internal configuration and by integrating relevant niche innovations into the tourism mobility system was evident. Overall, a transformation pathway (Geels and Schot, 2007; Weber and Rohracher, 2012) was identified that is characterised by a continuous but stable innovation of the socio-technical tourism mobility system. Pressures were considered triggers for change but could be addressed by incumbent regime actors who changed the regime setup and role configuration. However, with growing digital enhancement, the innovating tourism mobility system evolved beyond the capabilities of the incumbent regime actors; thus, new actors were integrated who could drive forward the innovation of a digitally enhanced tourism mobility system. These changes affected the foundations the tourism mobility system was built upon and increasingly required the regulatory and policy structure to change. At the time of the study, Vienna's tourism mobility system was in the fourth phase of innovation, with Phase 5 to follow.

Innovation Phases		Pathway	Phase Specifics
Phase 1	Emergence of Tourism Mobility	**Transformation** Incumbent actors adjust the regime configuration to accommodate pressures and integrate niche innovations to optimise the tourism mobility system in situ	Tourism mobility is a long-established aspect of site management – continuous, ongoing, stable innovation.
Phase 2	Uncoordinated Digitalisation		Increase of visitor numbers combined with breakthrough of digitalisation trends trigger perceived need to provide digitally enhanced, user-centric tourism mobility features to keep up innovation of tourism mobility system; digitally enhanced visitor-movement management perceived as unfeasible due to technical readiness.
Phase 3	Strategic Approach		Uncoordinated utilisation of digital solutions leads to lack of innovation focus for optimal innovation, incumbent actors started strategic approach to realign innovation directions to ensure stable innovation.
Phase 4	Integrating Smart Tourism Mobility		The scope of the tourism mobility system had multiplied due to digital enhancements and went beyond the capabilities of incumbent actors new adjusted actors are integrated (start-ups) to handle the agile and rapidly changing innovation and operation of digitally enhanced tourism mobility.
Phase 5	Innovating the Apparatus		New actors and forms of collaboration forms require not only readjustment of regime actor alignment, but also of 'rules' and frameworks (policies, regulations, business models, etc.).

Table 14 Innovation pathway – Vienna tourism mobility system (Source: own illustration)

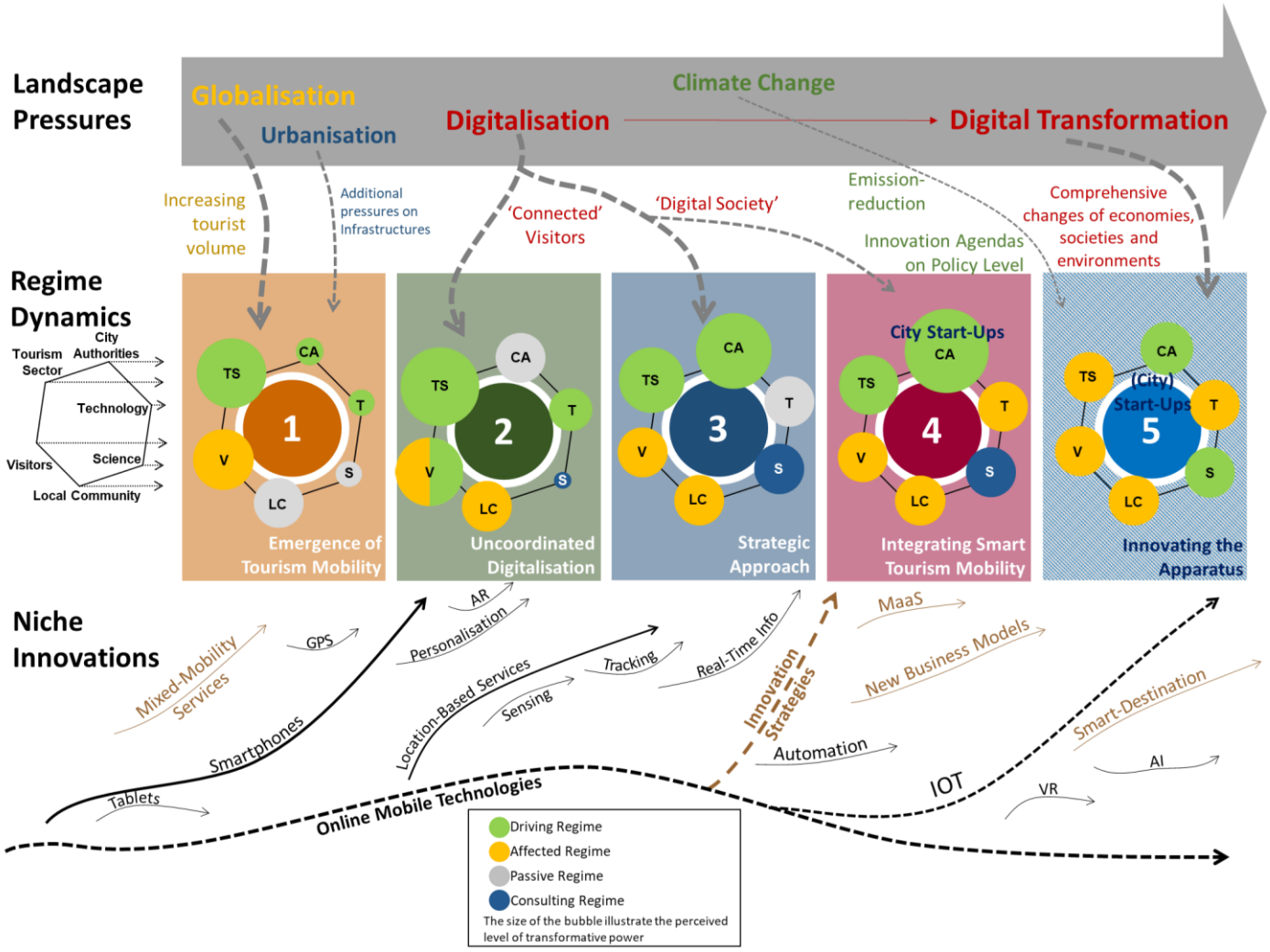

Figure 68 Multi-level perspective on Vienna's tourism mobiliy innovation pathway (Source: own illustration)

8. Salzburg – a City Between Protection and Exploitation

Salzburg's significant touristic success is built on its rich heritage and famous historical figures. However, the findings of the scoping study (see Chapter 5) indicate that a market-led, 'over-touristic' utilisation of the site is negatively affecting the built and living environments of the city. Although digitally enhanced tourism mobility management was considered as a remedy to ease pressures at the site, the relevant stakeholders lacked a clear strategy and joint approach to drive the innovation of tourism mobility. The case study helps reveal the relevance of a harmonised and balanced collaboration of local actors to foster innovation and enable a sustainable and long-term transformation of the socio-technical system.

8.1. Contextual Overview of the Tourism Mobility System of Salzburg

To comprehend the current state and the innovation processes that led to the evolution of Salzburg's contemporary tourism mobility system, it is necessary to first provide an overview of the historical development of touristic Salzburg to characterise the built environment and its stakeholder structure.

8.1.1. Heritage as the Foundation of Touristic Salzburg

As the name Salzburg ('Salz' Eng. salt, 'Burg' Eng. castle) indicates, the city's establishment in the sixth century BC was based on rich rock salt deposits in the region. Throughout its history, trading salt helped the city to flourish, brought wealth to its citizens, and made the city not only an economically significant hub in Central Europe, but also a political hub. The first mention of the name *Salzpurc* dates to 755 AD, and the settlement received its town charter in 996 AD, which makes it one of the oldest towns in Austria (Ammerer and Matern, 2003).

In 1996, the historic city centre (Altstadt) was listed as a UNESCO WHS. The site comprises an area of 236 hectares, which includes not only the historic Old Town, but also the surrounding mountains that acted as natural fortification and still provide a unique backdrop for the townscape (see Figure 79). Within the Old Town of Salzburg, buildings in the Romanesque and Gothic styles and the Renaissance and Baroque periods are located directly next to each other and are complemented by buildings from the Classicism and Art Nouveau periods. The historic city centre was spared major damage during the Second World War and preserved much from these diverse cultures and periods.

WHS - Historic City Centre Salzburg	
Land use	
Inscription year:	1996
WHS area:	236 ha
Buffer zone:	467 ha

Table 15 Overview of WHS in Salzburg (Source: own illustration)

Salzburg's inscription as a UNSESCO WHS is founded on three tangible and intangible WHS heritage criteria: (1) Salzburg's crucial role in the interchange between Italian and German cultures; (2) Salzburg as an exceptionally important example of a European ecclesiastical city-state; and (3) the city's association with the arts, and in particular with music, in the person of its most famous son, Wolfgang Amadeus Mozart (UNESCO, 2019a).

Furthermore, the city has gained international popularity as a film setting, such as *The Sound of Music*, as well as regularly hosting the *Salzburger Festspiele* (transl. Salzburg Festival).

Today, the City of Salzburg is the capital of the Austrian Federal State Salzburg, located in the Salzburg basin and directly bordering Germany with its neighbouring city Freilassing (GER) (see Figure 70). In 2020, 155,021 inhabitants occupied a total city area of 6,567 hectares, while the historic Old Town of the city was home to 2,465 inhabitants in 310 hectares (Stadt Salzburg, 2021).

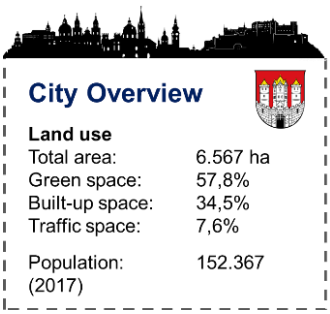

Figure 69 City space overview Salzburg (summariesed from Stadt Salzburg, 2021)

Figure 70 Map of Salzburg (Wikipedia, 2010)

The historic Old Town of Salzburg is divided into two by the river *Salzach* (see Figure 79). The left side (see Figure 71) is bounded on its right by the river *Salzach* and surrounded by three mountains, *Festungsberg* – with the fortress *Hohe Salzburg*, *Mönchsberg,* and *Rainberg*. The smaller, right side of the historic centre includes Mirabell Palace and is demarcated by the mountain *Kapuzinerberg* and connects the Old Town with newer parts of the city (*Neustadt*; see Figure 73).

Figure 71 Salzburg Old Town left side of Salzach (Salzburg Info, 2019a)

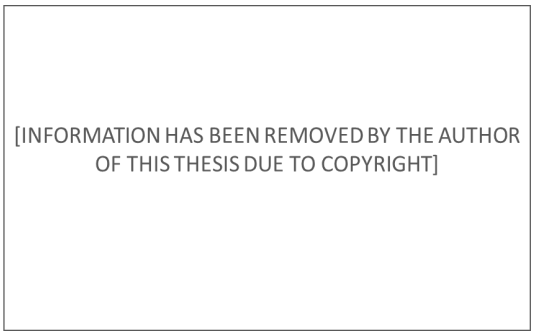

Figure 72 Salzburg Old Town view from Mönchsberg (author, 2019)

Figure 73 Salzburg Old Town view from castle Hohe Salzburg (author, 2019)

Figure 76 Getreidegasse pedestrian zone (left side) (Salzburg Info, 2019a)

Figure 76 Domplatz – Salzburg Cathedral & Salzburger Festspiele stage (left side) (Salzburg Info, 2019a)

Figure 76 Festungsbahn – funicular railway to the castle (left

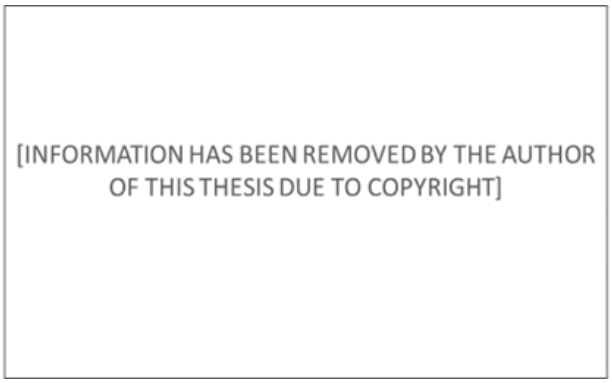

Figure 78 Kapitel Square (left side) (Salzburg Info, 2019a)

Figure 77 Mirabell Palace gardens (right side) (Salzburg Info, 2019a)

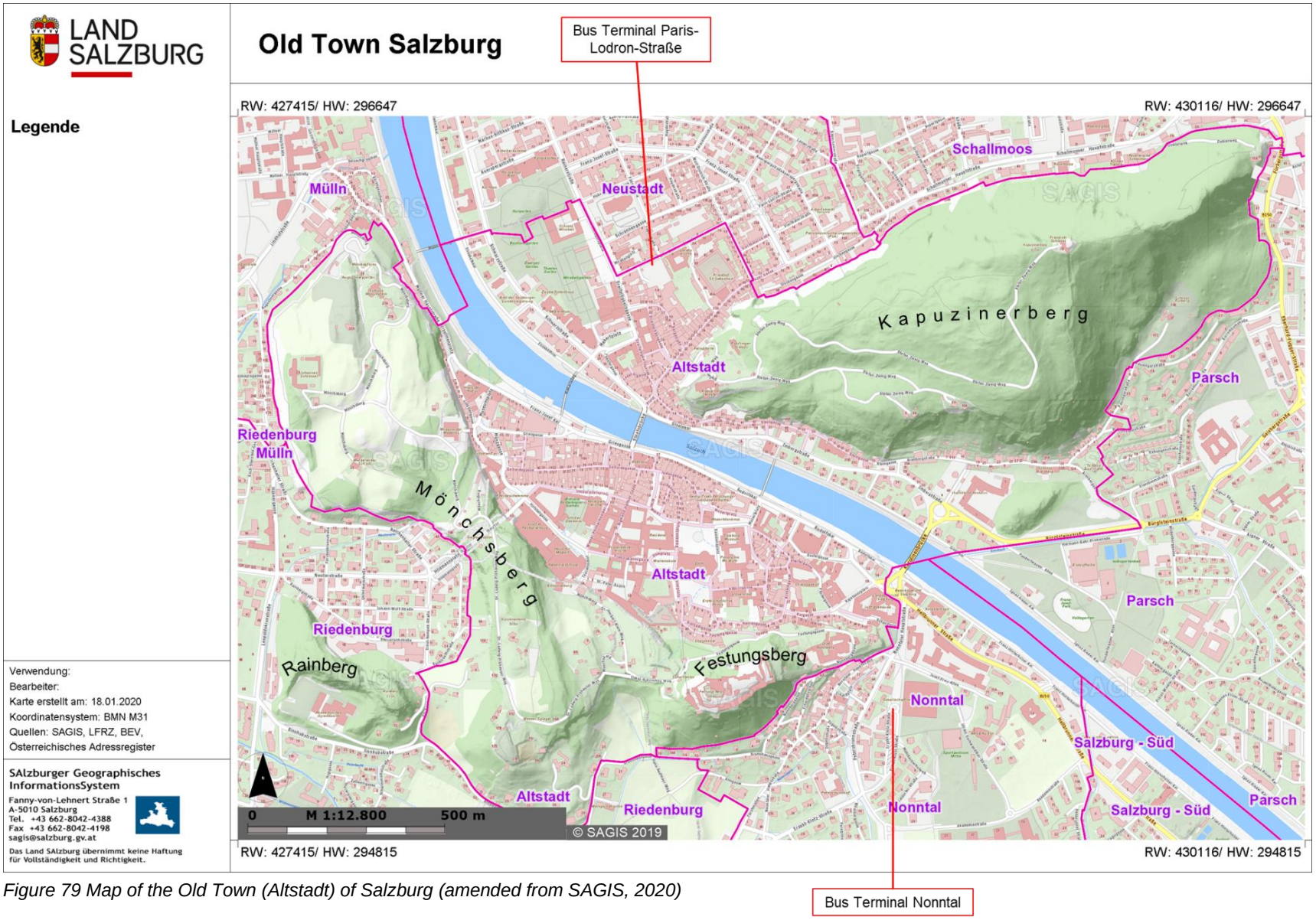

Figure 79 Map of the Old Town (Altstadt) of Salzburg (amended from SAGIS, 2020)

8.1.2. The Controversial Development of Touristic Salzburg

The touristic utilisation of the city has a long history dating to the start of the commercialisation of Salzburg's historic built environment in the 18th century (Ammerer and Matern, 2003).

By 1900, the tourism sector started to dominate Salzburg's economic landscape and systematically professionalised and organised the touristic utilisation of the city. One of the first examples of the strategic commercialisation of the city's touristic potential was the *Salzburger Kollevtivkarte* (transl. Salzburg Collective Card), an early form of the destination card, which offered discounted or complimentary entrances for several sights and theatres and was launched in the early 1900s (Haslinger and Mittermayr, 2001).

From 1945 onwards, tourist numbers in the city rapidly grew and doubled the number of inhabitants for the first time at the beginning of the 1950s, with 220,000 (1950) registered visitors in a city of 102,235 (1952) inhabitants (see Table 16). The dominant arrival mode of visitors at this time was the bus.

	1898	1910	1950
Registered arrivals	100,000	180,000	220,000

Table 16 Travellers to Salzburg (Salzburg Statistik, 2019)

By the middle of the 1950s, touristic traffic volume put significant pressure on the city's infrastructure and triggered debates on 'healthy' levels of bus tourism in Salzburg. Citizens requested the development of guiding principles for the touristic utilisation of the city, as well as an effective tourism traffic management concept and a driving ban for tour buses in the Old Town. After a series of protests in 1955, the city government enacted a tour bus driving ban for the inner city during the period of the *Salzburger Festspiele* but took no further actions to control or sanction tourism in the city.

On the contrary, the city council considered the historic urban fabric and cityscape as the USP of Salzburg. This approach made the conservation and maintenance of the historic built environment a priority for the city and led to the enactment of the Old City Preservation Law in 1967, long before Salzburg was listed as a UNESCO WHS.

The city government's initial clear focus on the protection of the historic city started to shift with the increasing success of the touristic brand 'Salzburg'. The political setup of the city council was increasingly influenced by touristic opinion leaders and tourism service providers, who displayed a strong economic-centric focus on the city's utilisation but increasingly neglected social and ecological aspects.

This unbalanced development of the city led again to outcries from the opinion-strong citizenry and to the 'Revolution of the Citizens', which lasted from 1972 until 1982 (Hörl, 2014). One perceived success of the citizens' uprising for a more balanced and inhabitant-friendly

utilisation of urban space was the closure of the inner city to traffic and the conversion of large parts of the Old Town into a pedestrian zone in 1975.

> In retrospect, the conversion of the Old Town into a pedestrian zone was the kick-off for the tourism industry to systematically and unconditionally commercialise the historic city centre. (Professor & Head of Transcultural Communication at Salzburg University, 2018)

The citizen uprising impacted Salzburg's political setup for several years, but the city's economic dependence on tourism hindered a long-term rethinking and shift towards a more diversified city utilisation.

> Although the 'Revolution' began fiercely, the tourism lobby in the city was already the dominant actor and too strong to overthrow. Salzburg's economy is based on tourism. So, they argued to bring wealth and prosperity to the citizens by creating jobs and generating income for the city to safeguard Salzburg's heritage by investing a lot of money for conservation measures as well as to boost Salzburg's image. It was, for a politician, hard to argue against jobs, money for citizens, and a prosperous city. […] Back then, the touristic pressure on the population was not as severe as today. (Councilman City Council Salzburg, 2018)

8.1.3. Tourism Mobility Stakeholder Structure

After the 'revolutionary' times in the 1980s, Salzburg's political setup and the configuration of leading actors for tourism mobility returned to a tourism-dominated stakeholder structure, which remains the case today (see Figure 80). In the 2000s and early 2010s, only a small 'Green Elite', with predominantly academic backgrounds, managed to continue its role as a controlling actor in the tourism mobility system. This 'elite' mainly used university or academic research to highlight tourism-induced pressures and effects on Salzburg's social environment, housing market, and mobility infrastructure, as well as representing the political opposition in the city council. The integration of tourism mobility and touristic traffic management measures into the overall city development and management activities were also high on the agendas of the opposition. However, within the city council, these topics were considered low priority during this period and this is reflected in the relative frequency of updates of relevant policies. For example, the Old Town preservation and maintenance were considered high priority for touristic utilisation, and thus received large funds and were subject to regular policy updates, with the last update in 2017. Transport and traffic management were considered less relevant for city development and are, to date, using the city traffic concept last updated in 1997.

The tourism side of the system consisted of the influential DMO (Tourism Salzburg Ltd.), the hotel association, and the Old Town Tourism Ltd., which took care of site management,

marketing, and event coordination. As discussed in greater detail in the following sections, regarding tourism mobility initiatives, the tourism actors displayed a moderate level of activity and mainly focused on coordinating interpretation and guidance services for visitors.

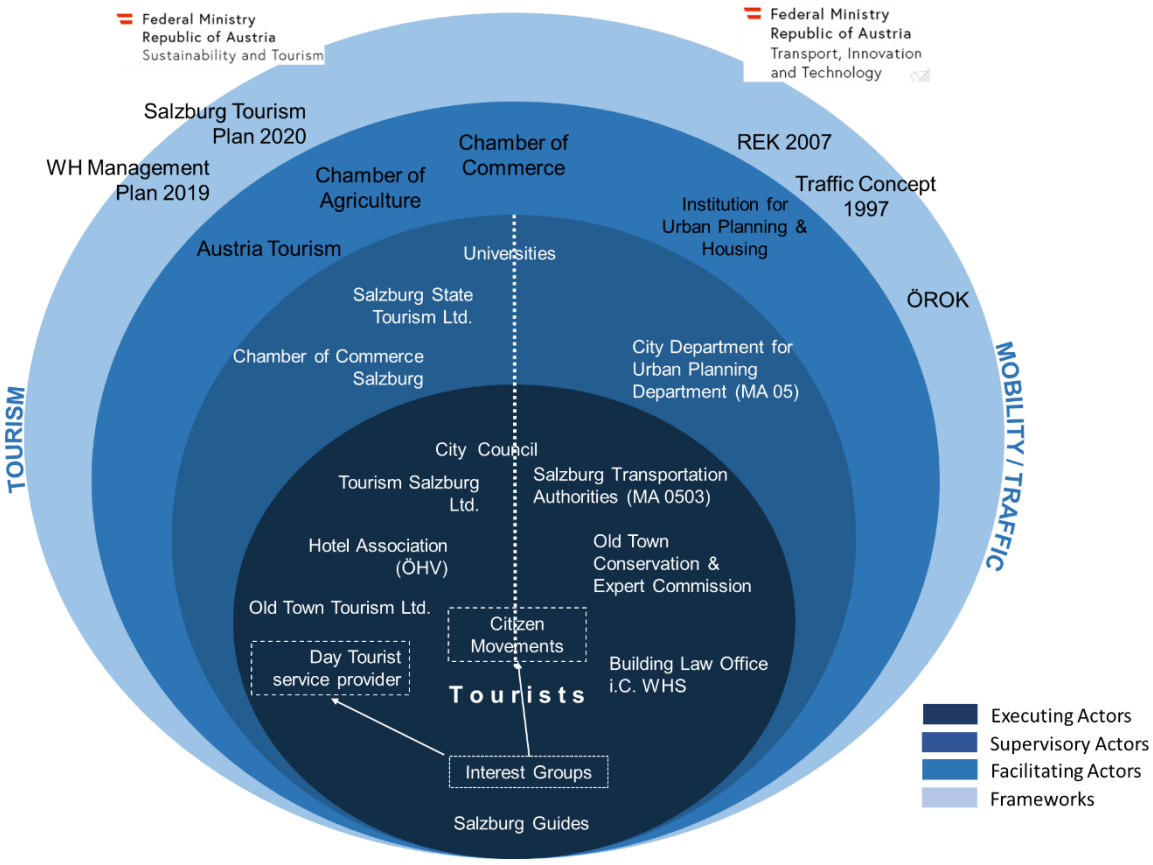

Figure 80 Tourism mobility stakeholder structure (Source: own illustration)

8.1.4. Tourism Mobility Facts and Figures

Tourism is one of the key economic pillars of Salzburg. In 2018, the city had 3.1 million overnight stays produced by 1.8 million registered tourists (City of Salzburg, 2020). This touristic utilisation accounted for a tourist-per-inhabitant ratio of 11.9 in 2018, which is far higher than the ratio in Vienna (4) and can be compared to destinations such as Amsterdam (NL; 10), Florence (ITA; 13.9), and Lisbon (PRT; 10.7); (Eurostat, 2019).

However, experts estimated a day-visitor number of up to 9 million for 2018, which marked a significant increase over the past 10 years and amounts to a visitor-per-inhabitant ratio of 60 in 2018 (Professor & Head of Transcultural Communication at Salzburg University, 2018) see Figure 81).

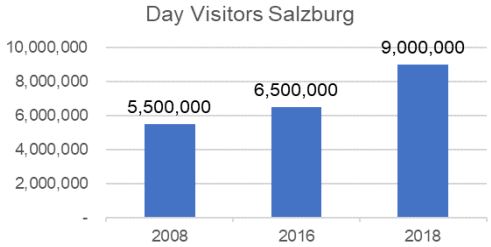

Figure 81 Day-visitor number estimations (Professor & Head of Transcultural Communication - Salzburg University, 2018)

The geographical mix of registered tourists reveals that domestic tourists, followed by Germans and tourists from the USA dominate Salzburg's tourism market (see Figure 82). The most common arrival mode was by car, with an estimated 80% share (CEO - Salzburg Tourism, 2018), and the rest arrived mainly by bus, whereas plane and train are minor arrival modes.

However, day-visitors displayed a different mobility mode choice, with almost an even share between buses and cars for travelling to Salzburg (Salzburg Statistik, 2019).

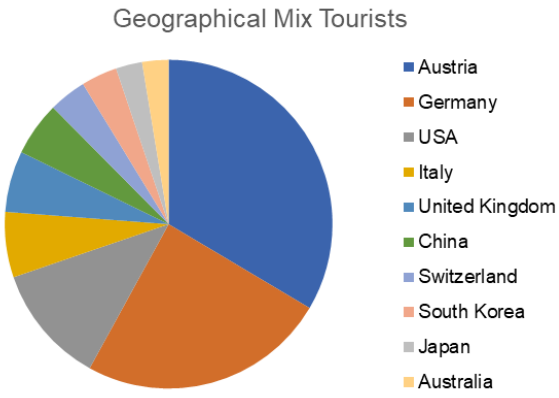

Figure 82 Geographical mix of tourists 2018 (Salzburg Statistik, 2019)

8.2. Urban Planning Strategies to Address Tourism Mobility Issues

Touristic bus and car traffic constituted key challenges for Salzburg's mobility management and placed the city's infrastructure under significant pressure. The authorities estimated that at least four million visitors arrived by car in 2017 (Head of Urban Planning of City of Salzburg, 2018).

8.2.1. Gateway Management Approaches to Limit Individual Traffic

As a reaction to the ever-growing protests of inhabitants, who were significantly affected by the increasing traffic volume, the city council introduced tourism traffic management and gateway control initiatives.

Gateway control initiatives were designed to encourage day-visitors who arrived by car to use the park-and-ride facilities outside the city (approx. 4,000 spaces) combined with public transport to travel into the city centre.

The DMO had launched the Salzburg Card in 1995, which was a destination card designed for day-visitors that included public transport fees, access to all sites and museums, and offered discounts for theatres and concerts. The card was fairly well used by visitors but did not greatly impact the touristic traffic levels in the city.

Nevertheless, a special park-and-ride combi ticket that included parking fees for 24 hours and public transport tickets into the city was created in 2016. For peak periods in the summer months, a shuttle service from parking facilities (approx. 3,000 parking spaces) at the Salzburg exhibition grounds were established, which offered a complimentary transfer into the Old Town. Furthermore, on-street parking spaces in the Old Town and its vicinity were subject to rigorous parking management with high fees and short-term parking as control mechanisms to reduce pressures on the traffic infrastructure of the city.

> The gateway transport initiatives for individual visitors are only a drop in the ocean. The idea is a good start, but the implementation is full of flaws. First, the parking capacity [of the park and rides] is fine for slow or medium days, but on peak days the capacities are not nearly enough. Second, the park-and-ride solution is still not very popular among day-visitors, which is fortunate for the city because Salzburg's public transport system is struggling to handle daily local passenger volumes and would break down if large amounts of day-visitors also used these facilities. […] The 'outsourcing' of touristic traffic pressures onto the public transport infrastructure will eventually backfire on the city authorities because it will become apparent that Salzburg's public transport is antiquated and badly maintained – usually two-thirds of the fleet are out of order – and the service frequency is far below any standards. (Chairperson of Mobility Forum Salzburg, 2019)

Despite the acknowledged pressures from individual, touristic car traffic in the city centre, the city government agreed to expand the parking garage in the city mountain *Mönchsberg* by 650 parking spaces. The construction was planned to start in 2020, finish in 2022, and was budgeted to cost 26 to 28 million euros (Head of Urban Planning of City of Salzburg, 2018). This plan was designed to reduce the number of on-street parking spaces in the Old Town

and free-up space to expand pedestrian and 'meeting' zones. However, the construction activities have been criticised for being large investments into climate-unfriendly infrastructure and for conveying a car-friendly image for visitors, which potentially will attract even more visitors to use the centrally located garage on the southwest boundary of the historic Old Town. Furthermore, the *Mönchsberg* garage was not subject to the Old Town driving ban (see below); thus, its expansion counteracts the city's own traffic management scheme.

The city council has not introduced any citywide plans to control or limit car access for visitors. The only restrictive traffic management initiative was enacted in 2012. The Old Town driving ban prohibits access for cars and buses (expect public transport) in the summer months from 10am to 2pm. This ban was created to reduce touristic-induced traffic jams and the traffic impact on the built environment during Salzburg's touristic high season (see Figure 83).

Figure 83 Driving ban in Old Town (Stadt Salzburg, 2018)

8.2.2. Tour Bus Traffic Pressures on the City

Tour buses are still permitted to drive in the City of Salzburg up to the boundaries of the historic city centre, where two bus terminals have been set up as drop-off points for bus tourists (see Figure 79).

In 2017, around 51,000 tour buses entered Salzburg, with daily tour bus numbers reaching up to 300 buses (APA, 2019a) driving through the city towards the historic city centre. With an ever-growing number of tour buses coming to Salzburg and traffic infrastructure regularly running over capacity in the summer months, the city had to introduce a new tour bus management scheme in 2018. Tour buses needed to register online in advance to obtain 20-minute slots to drop-off and pick-up guests at one of the two tour bus terminals. The registration cost 50 euros per bus. Tour buses could wait at dedicated tour bus car parks close to the city centre. However, the bus management scheme did not include a daily limit of tour bus numbers allowed to enter Salzburg.

	2005	2017	2018
Tour Bus Number	39,000	51,000	40,000

Table 17 Number of tour buses (Salzburg Tourism, 2018; APA, 2019a)

The tourism sector released figures stating that the introduction of the bus regulation had decreased tour bus numbers by around 10,000 buses in 2018 (see Table 17). The 'dark number' of violations of the registration regulation or the irregular utilisation of alternative drop-off spots by bus drivers were not included in the above figure.

> Already in the first six months [January to June 2018] of the compulsory online registration for tour buses, we had to issue around 1,000 fines for non-registered buses. […] Slowly, tour bus companies adjusted to the new regulation, and we expect that the regulation will have a significant impact on the bus numbers. (Head of Urban Planning of City of Salzburg, 2018)

Despite the new regulation and the city administration's perception of having found an effective solution for the tour bus problem, a growing body of criticism and counterarguments to the published figures grew louder in the city. One argument criticised the conditions of the penalty system.

> When the registration costs 50 euros – which is only around one euro per passenger – and the penalty is only 70 euros – which is around 1.50 euros per passenger – it is understandable that tour bus companies are not taking their obligation to register too seriously. We would need a

> penalty point system for bus companies, higher fees, much higher penalties, and we desperately need a daily limit for tour buses. (Chairman - Mobility Forum Salzburg, 2019)

Another argument scrutinised the reliability of the published figures. Increasing day-visitor numbers from around seven million in 2017 (Chairperson of Mobility Forum Salzburg, 2019) to around nine million in 2018 left a question open regarding the arrival mode of the significantly growing number of day-visitors. Since tour bus numbers fell to 40,000 in 2018 and there was no significant increase in the arrival mode of day-visitors by car, train, or plane it is unclear which arrival mode the growing number of visitors used. Thus, the actual tourism mobility situation of Salzburg is highly unclear.

8.2.3. The Impact of Walking Tourists on the Historic City

Within the Old Town, cars and buses were not granted access, and the topography of the district, with its narrow lanes on steep hills, makes walking the dominant mobility mode (see Figure 84).

With ever-growing numbers of visitors to the Old Town, discussions regarding carrying capacity levels became more vociferous. The narrow lanes were more frequently overcrowded.

> In peak times, we counted around 50,000 pedestrians on the *Getreidegasse* in one day [main shopping street 350m long (see Figure 74)], on the *Makartsteg* [pedestrian bridge over river *Salzach* 101m long (see Figure 85)] we had around 25,000 pedestrians in 24 hours crossing on some days in 2017. (Head of Urban Planning of City of Salzburg, 2018)

Figure 84 Makartsteg Salzburg (Salzburg24, 2019)

Figure 85 Old Town lane Salzburg (left side) (SN, 2018)

Alternative mobility solutions in the Old Town were *Fiakers* (horse-drawn carriages) or rental bikes, but these impacted only minimally on the tourism mobility mode choice. The rental bike scheme was introduced in 2012 and piloted in several parts of the city. However, a scaling-up from the pilot to a citywide scheme was never successful due to a lack of funds.

8.3. 'Over-tourism' in the Tourist-Historic Town

Figure 86 Salzburg city brand (Salzburg Info, 2019a)

The over-tourism debate regarding Salzburg revolved mainly around the effects of uncontrolled and unregulated touristic traffic including walking visitors in the city. However, the touristic utilisation of the city seemed to have reached not only capacity limits in the Old Town, but the side effects of the thriving commercialisation of the brand 'Salzburg – The stage of the World' also impacted its citizens deeply, including the housing market and social structures.

> The tourist-industrial interests of the city leaders foster a rapidly spreading urban segregation. (Professor & Head of Transcultural Communication at Salzburg University, 2018)

8.3.1. The Demise of the 'Living' Old Town

The vision of the 1967 Preservation Law (Stadt Salzburg, 1967) to not create a living museum seemed forgotten. The population in the Old Town shrank by 50% in 10 years to around 5,100 inhabitants in 2017 (Stadt Salzburg, 2019). In the Festival Districts, only 54 inhabitants remained, and around the *Domplatz* (transl. cathedral square), only 73 people were still registered in 2017 (Neuhold, 2018).

This drastic decrease of population was mainly due to the substantially increasing living costs, the decline of local suppliers for daily essentials, increasing noise nuisance, overcrowding in pedestrian areas, and traffic jams (Professor & Head of Transcultural Communication at Salzburg University, 2018).

In 2019, the consulting company Roland Berger published a study indicating that Salzburg is subjected to severe 'over-tourism'. The study analysed 52 European tourism destinations regarding 'over-tourism' symptoms and classified Salzburg as one of four destinations that are 'Mass Traps'. The study identified the main causes for the persistent 'over-tourism' situation as the lack of touristic capacity control (e.g. hotel bed number limit), the shortcomings of

tourism mobility management, and the lack of control over of access (e.g. number of tour buses, number of visitors in sights; (Roland Berger, 2019).

However, surveys conducted by Salzburg's tourism sector sought of downplay the citizen-tourist tensions and highlighted that the majority of Salzburg's citizens were not personally affected by the touristic utilisation of the city (CEO - Salzburg Tourism, 2018).

Although Salzburg has a long history as a heavily frequented tourism destination, protests against the entrenched and market-led tourism politics of the city government gained momentum in 2017 after new record visitor numbers.

> In 2017, it seemed that the city had reached the point of no return for many citizens and even tourists. The inner city started to become a living museum. A museum with no entrance fee and no control on visitor numbers. […] Citizens of the inner city started to feel overwhelmed by the never-ending streams of visitors. They felt increasingly displaced in their homes, and their concerns were largely ignored by the city council, which seemingly fostered the exploitation of their living environment. […] Even tourists started to complain about the masses of people on the streets; however, mainly because it was not possible to take nice pictures of the sites anymore. (Professor & Head of Transcultural Communication at Salzburg University, 2018)

At this stage, Salzburg's 'over-tourism' situation also gained the attention of the media and international organisations (e.g. UNESCO). Out of concerns this debate could negatively affect Salzburg's image as a tourism destination, the city council reconsidered its approach towards tourism politics and initiated an innovation offensive for Salzburg's visitor-management scheme based on the utilisation and integration of new technologies to ease touristic pressures on the city.

However, critical voices argued the city placed it hopes in new technologies simply to avoid making difficult decisions, such as limiting visitor numbers.

> The city government benefited from the digitalisation hype of these years and 'sold' the new technical possibilities as a panacea for Salzburg's problems. (Chairman - Mobility Forum Salzburg, 2019)

The MLP analysis illustrates that increasing pressures on Salzburg's destination system triggered this first phase of innovation of the local tourism mobility system (see Figure 87).

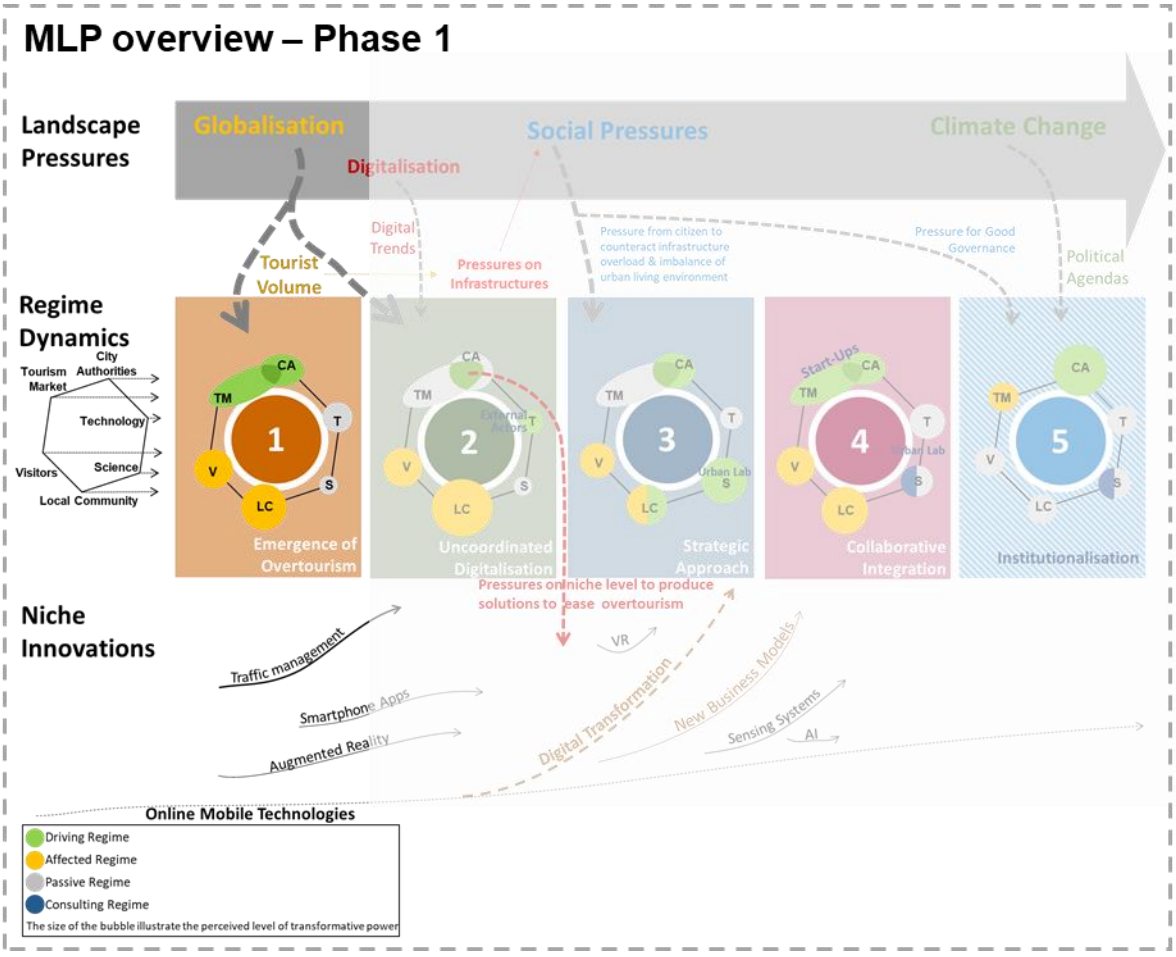

Figure 87 MLP analysis Salzburg – Phase 1 (Source: own illustration)

8.4. Catching Up with Digitalisation

Digital tools employed for heritage interpretation and visitor guidance through the city emerged in Salzburg in the middle of the 2010s. Over 20 tour guide apps were available in app stores in 2017. However, local tourism and mobility stakeholders largely relied on external businesses to provide digital solutions for Salzburg and hardly engaged in the digitalisation of the visitor experience or visitor management. Due to the lack of participation of local actors, external actors strongly shaped this first phase of the utilisation of digital tools for tourism mobility purposes. This passive approach of local actors resulted in the uncontrolled and uncoordinated provision of new digital tools for visitors, which was dominated by a focus on the digital upgrading of commercial aspects of the visitor experience but neglected to upgrade visitor-movement management and control solutions.

This neglect to engage in the digital innovation of guidance and interpretive solutions for visitors was mainly the result of the predominant focus of local actors on tour group tourism. Tour groups explored the city via predefined routes, were accompanied by their tour guide, and only stayed for a few hours in the city, and thus did not require individualised and personalised digital services. The smaller share of individual travellers used digital solutions provided by external businesses.

However, to enable foreign visitors to use online guiding solutions in the historic city centre without incurring high roaming costs, the City of Salzburg equipped the historic city centre with free Wi-Fi hotspots in 2011.

The DMO's focus remained on the provision of analogue interpretive solutions (signage, relief models, information boards), rentable audio guides to convey information, and local tour guide services.

> Somehow, Salzburg is not meant to go beyond the quirky tour guides with umbrellas, guidebooks, paper maps, and signposting. […] Maybe once this antique tourism interpretation form will also be included into Salzburg's intangible cultural heritage. (Professor & Head of Transcultural Communication at Salzburg University, 2018)

At the end of the 2010s, and with growing pressures on the urban and living environments of Salzburg, the local tourism and city management actors started to participate more actively in the digitalisation of Salzburg's tourism mobility system. The key focus was on introducing digital solutions to ease touristic pressures on the city, but at the same time maintaining the existing levels of touristic utilisation.

The initial approache of the city actors to use OMTs for visitor management focused on the digital enhancement of site interpretation. Although the DMO did not develop an interpretive or guiding app in-house, it sought cooperation with external partners to provide comprehensive solutions to enhance visitor mobility management on-the-go and to generate data on the movement of visitors.

One example was the gamified tour app Snitzl, which was launched by a Salzburg-based start-up in 2018. The app was designed as an interpretive scavenger hunt through the city that provided historical information on sights and offered recommendations for gastronomy and other leisure facilities on the way. Despite the promotion of the app by the DMO, the app received low ratings and had only moderate user numbers.

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Figure 88 Snitzl app (Salzburg Info, 2019b)

The first experiences with developing OMT solutions for visitor management highlighted that existing tourism mobility actors lacked the expertise, know-how, and experience to utilise digital solutions strategically for tourism mobility purposes. The initial reaction of the actors was to return to well-known practices to influence visitor-movement behaviour, and a range of analogue visitor-movement management measures was introduced.

Selected examples

As an analogue contribution to diversify tourism mobility in Salzburg, the DMO began the campaign *'Stadtwandern'* (transl. City Hiking), which provided the visitor with alternative routes to explore the city. Themed hiking trails along the river or on the city mountains were promoted to disperse tourists in the city.

> We launched the campaign, on one side, to show our visitors new sides of the city and guide them to points which offer a spectacular view on Salzburg. But, of course, with increasing pressures from tourist groups on the roads and squares in the Old Town, we tried to provide our guests who stay longer than a few hours the opportunity to escape the crowds and still enjoy the city. […] We have also a themed route which is called 'Instagram-able Salzburg'. It is a footpath which brings you to spectacular viewpoints. Guests can take pictures and post them on Instagram and on our social wall to become part of the #visitsalzburg community. […] of course it is a modern marketing campaign which engages the visitor and, at the same time, promotes our destination to potential customers we might never had the chance to get hold of. (CEO - Salzburg Tourism, 2018)

The DMO continued to introduce additional themed walking paths off the beaten track to disperse visitors. In addition to the existing 'Instagram-able Salzburg' path and the 'City Hiking' path, the 'Walk of Modern Art' (see Figure 89), the AR-supported bike path along the river Salzach, the 'Beer Path', the 'Creative Walk', and the 'Church Walk' were launched, not only diversifying the touristic experience in the city, but also providing alternatives to the highly frequented Old Town area.

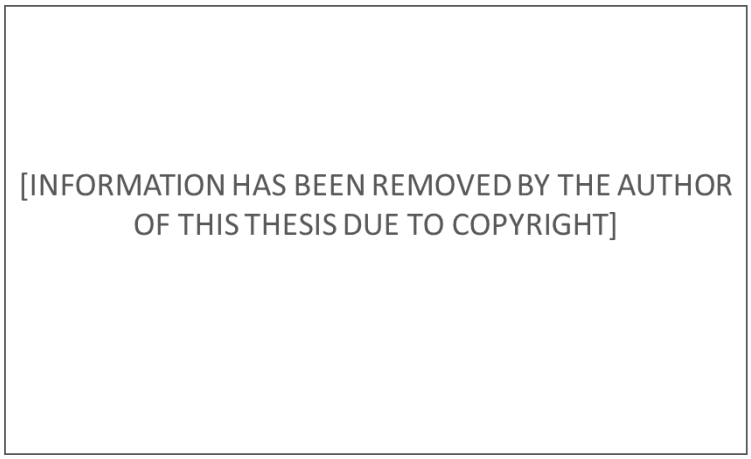

Figure 89 Gigantic cucumber sculpture parkour on the 'Walk of Modern Art' (Salzburg Info, 2019a)

Despite the efforts of the DMO to employ digitally enhanced visitor-management solutions to ease pressures on the tourist-historic city centre, the challenging situation in the Old Town did not improve. The city government still refrained from limiting visitor numbers and bus numbers from entering the Old City, nor did they reconsider the touristic utilisation concept of Salzburg but pursued its vision to use new technologies to ease tourism mobility pressures.

The MLP analysis summarises developments in this second phase of Salzburg's innovation pathway (see Figure 90).

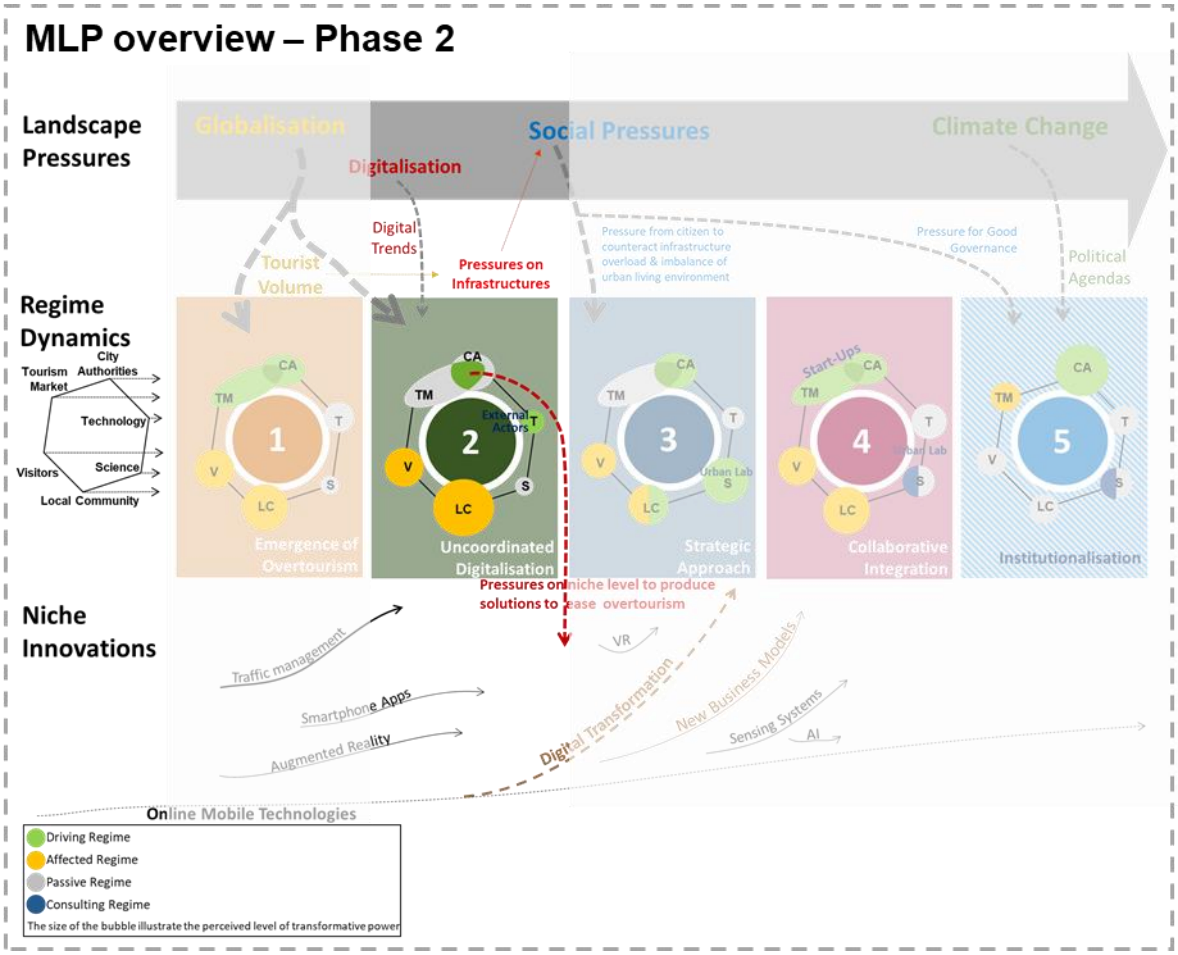

Figure 90 MLP analysis Salzburg – Phase 2 (Source: own illustration)

8.4.1. Evaluating Digital Potentials Against 'Over-tourism'

The city council increasingly supported research activities to understand tourism mobility dynamics in the city, to identify key challenges of Salzburg's tourism system, and to work on solutions to ease pressures on the city.

> After the tourism record year of 2017, the city finally realised that drastic measures were necessary to appease the growing phalanx of city governance opponents. It was clear that sanctions on the touristic utilisation of the city were inevitable. To base these tough decisions on solid facts, research institutions were involved in the decision-making process. (Chairperson of Mobility Forum Salzburg, 2019)

Salzburg's science and research sector and the city government agreed that the key objective for a sustainable touristic utilisation of the city was the development of "a sophisticated and economically viable tourism mobility concept" (CEO - Salzburg Tourism, 2018) that employed OMT-supported visitor mobility management.

Although the city government has had moderate success diffusing touristic traffic through driving bans and tour bus management schemes, the research sector focused on data-driven innovation solutions.

Science and research actors took the lead role in rethinking urban innovation and mobility management and started a far-reaching, systematic discussion of the 'over-tourism' problem in Salzburg. Salzburg's universities, Salzburg Research, and cooperation partners coordinated research activities and initiated locally and nationally funded (city or federal state funded), as well as EU-funded research projects.

A strategic analysis of Salzburg's tourism mobility system identified thematic areas that were considered decisive factors for a sustainable innovation of the system. These thematic areas covered digital communication and interpretation, the development of knowledge transfer platforms, and the upgrading of urban mobility management with sensing technologies (Professor & Head of Transcultural Communication at Salzburg University, 2020).

8.4.2. The City as Innovation Lab

The Urban Mobility Lab (UML), which was integrated into the Salzburg Institution for Urban Planning and Housing (SIR), became the innovation hub for tourism mobility research (Head of Urban Planning of City of Salzburg Holding, 2018). The UML was not meant to conduct projects by itself but was designed to support traffic and mobility projects from research facilities, businesses, service providers, etc. and act as a networking platform and think tank. The key focus areas covered multimodal mobility solutions and integrated mobility management.

Recent projects of the UML regarding tourism mobility issues have included MOBLE, a project that used algorithmically designed, 'smart' urban furniture to influence pedestrian movement in the Old Town (UML, 2020b); projects focusing on the digital improvement of intra-modality interfaces, such as MobilityIntegrator (UML, 2020a); and holistic reconsiderations of mobility concepts that addressed 'Mobility of the Future' topics and climate change agendas, such as ULTIMOB (UML, 2020c).

In addition to UML projects, other research projects investigated the potential of OMTs to improve digital communication, digital interpretation, and digital valorisation of historic sites, as well as better understanding the possibilities to influence visitor behaviour via online mobile ICTs. One leading project was the INTERREG project ViSIT (virtually connected systems and information technologies for the touristic exploitation of cultural heritage), which investigated

valorisation possibilities for cultural heritage sites based on digitally induced structural changes of sites, visitors, and communication techniques (Salzburg Research, 2020).

> Authentic enactments, the amalgamation of digital and physical networks, and educational work are the future of the historic site. (CEO - Salzburg Tourism, 2018)

However, the key research focus was on projects in the field of sensing and motion-data generation to produce movement profiles of the city.

> Of all the considered research approaches, from our perspective, sensing made the most sense to focus on. It seems that the biggest underlying problem of the city government is the lack of understanding of how the flows of the city function, especially how traffic and tourism flows function. […] None of the conflicting parties in the 'over-tourism' debate really had data to support their claims. […] If you do not know what is happening, it is very difficult, to impossible, to find working solutions for the problems. So, this is where we started our approach to innovate Salzburg. (Professor & Head of Transcultural Communication at Salzburg University, 2020)

An earlier project of the UML (2017–2018), in cooperation with the national network provider A1, used mobile phone data to trace users and generate a movement map of the city. However, these maps and data were never used or related to existing visitor-management strategies and interpretive concepts.

With the digitalisation offensive of the city government to innovate the local tourism mobility system, data-driven research teams started to focus on the development of a real-time sensing network in the city to provide detailed data on movement in the city to improve city management, urban planning, and visitor (movement) management.

The sensing technologies and real-time communication solutions matched the innovation focus of the city government, which continued to pursue its strategic direction to ease touristic pressures in the city by upgrading to an OMT-supported 'Smart' visitor-movement management.

Although several sensing research projects were launched in the city and received substantial funds, the results of these projects fell below the expectations of the city government.

> It is still a long way until we produce viable sensing data on qualitative-supported movement patterns, and an even longer way to use that data for movement management. Too long for a city government under pressure to wait. […] When we started to develop city sensing projects in 2017/18, our research was in the centre of political attention and propagated the view that digitalisation would be the 'cure' for 'over-tourism'. The city leaders celebrated Salzburg already as a Smart City and intelligent, real-time visitor-movement management was promised to be soon available.

> After a while, the city leaders realised that our research did not work like that. It was too slow, too embryotic, too costly, and too complex for smooth slogans. […] We were not able to deliver sophisticated solutions as quickly as the politicians promised the citizens. (Professor & Head of Transcultural Communication at Salzburg University, 2020)

The research-led approach to innovate the urban touristic system in Salzburg was perceived as a valuable accumulation of knowledge and useful analytical discussion of the status quo of the tourism mobility system, but it was criticised for lacking practical solutions to problems by the city government.

> After some years of research on how to ease touristic pressures – or better – on how to sync touristic utilisation and urban life in the city centre, we might be more aware of issues, pressures, potentials, and challenges but we are still missing solutions. (Head of Urban Planning of City of Salzburg, 2018)

8.4.3. Involving Everybody

At the end of 2019, a crowdsourcing initiative was started to gather innovation ideas for Salzburg. The competence platform Open Innovation Lab (OIL) launched the call, which asked everybody, including citizens, visitors, students, and entrepreneurs, to forward ideas on the topic 'Rethinking tourism in Salzburg' (Salzburg Research, 2019). The competence platform was a joint project by Salzburg's research institutions, which were still seeking ideas to innovate tourism mobility. As part of the crowdsourcing initiative the OIL launched the first idea contest at the end of 2019 under the motto *'(er)lebenswertes Salzburg'*, in an attempt to find solutions to make Salzburg a liveable and touristic city. The winning idea was called *'SalzART',* which suggested using street art to divert visitor streams from highly frequented areas to more locations in the city (FH Salzburg, 2020).

This participative initiative received positive feedback from the citizenry and had a high participation rate. However, critical voices argued the following:

> It seems that the city council was outsourcing the 'over-tourism' problem to the science sector and the science sector is now outsourcing the problems to the citizens and call it a participative approach to find solutions for a liveable and, at the same time, touristic attractive Salzburg. (Chairperson of Mobility Forum Salzburg, 2019)

In addition to research activities on data-driven innovations, interest groups and citizen lists also started a strategic, political discussion on tourism mobility-induced issues in the city and developed suggestions to ease problems in the city.

The propositions ranged from developing a one-way system in major pedestrian zones to improve visitor flows, an expansion of parking facilities in the city mountains dedicated to tourists and visitor vehicles and acting as gateways to the Old Town, to the idea to revitalise or create attractions in other city areas, and thus disperse touristic volume over the city (Chairperson of Mobility Forum Salzburg, 2019).

A reformation of the destination management and city management concept, including a revision of the city's tourism strategies, was also suggested by the science sector and by interest groups and citizens. The reformation requests included a shift towards a more qualitative and less quantitative tourism approach. Specific ideas suggested a change of touristic business goals, and thus a shift from the prevailing focus on an increase of overnight stays to introducing added value of visitations as a key indicator for economic goals and touristic valorisation. This idea was based on the finding that day-visitors were the largest touristic group but had the lowest added value for the site (Professor & Head of Transcultural Communication at Salzburg University, 2018; Councilman City Council Salzburg, 2018).

As illustrated in the MLP (see Figure 91), within this innovation phase, the focus at regime level was to find strategic approaches to decrease perceived pressures on the city environments but still allow the touristic exploitation of Salzburg.

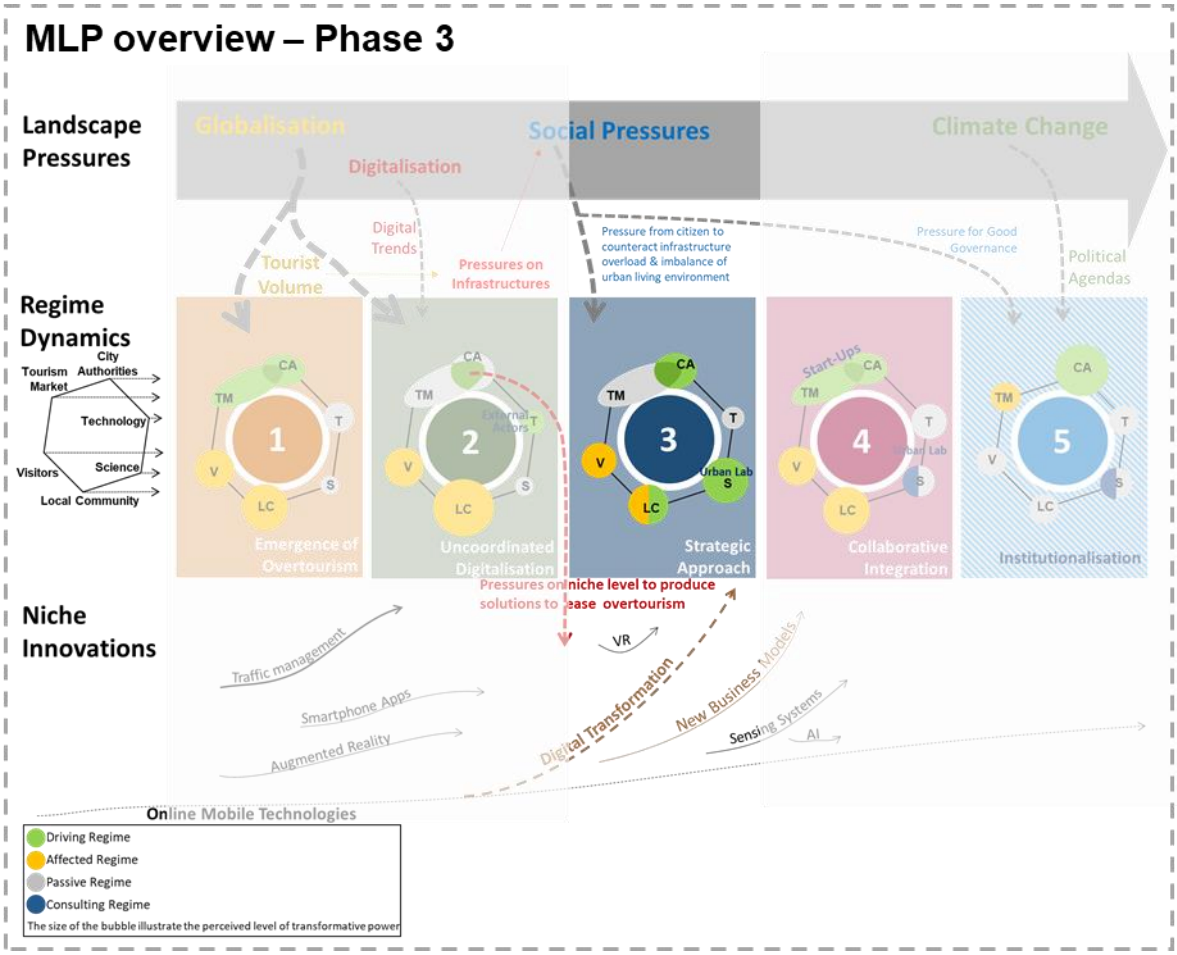

Figure 91 MLP analysis Salzburg – Phase 3 (Source: own illustration)

8.5. Co-Evolution of an Innovative Tourism Mobility System

At the end of 2019, Salzburg's tourism mobility system was still in a volatile state. Salzburg's nomination as the number one destination to travel to in 2020 (Lonely Planet, 2020) and the 100-year anniversary of the *Salzburger Festspiele* favoured another touristic record year for the city.

Over the years, a range of strategies to address tourism mobility issues in the city had been launched. However, neither market-led, research-based, nor citizen-led approaches led to an effective solution for a more sustainable utilisation of the tourist-historic city centre. Nevertheless, each attempt added to a better understanding of the tourism mobility system, partly broke-up hardened positions of opposing sides, and brought the actors involved closer to finding a balanced co-evolutionary setup.

In particular, the participative engagement of recent years seemed to have triggered more cooperative and holistic thinking among all regime actors and served as a catalyst to pursue a more sustainable and reflective tourism and mobility development path.

The DMO developed a cooperative network of relevant tourism and tourism mobility stakeholders and jointly developed a digital version of the destination card, which was planned to be available as a smartphone app starting from spring 2020. The app was also designed to be interlinked with a ticketing platform that connects all relevant tourism services providers (e.g. hotels, restaurants), sights, museums, and transportation providers (e.g. public transport, taxis), and enabled the customer to reserve, book, and pay for tickets and services.

Cooperation with research partners worked on solutions to upgrade the destination card app with a real-time 'waiting time' information to enhance time management for visitors, but mainly to act as tool for visitor-movement management in the historic city.

To enable this next step in the innovation of tourism mobility management and to continue state-of-the-art work on the 'over-tourism' issue, Salzburg's digital infrastructure and digital competences needed to be further enhanced.

Start-ups were perceived as a new stakeholder with the potential to drive the digital transformation of the tourism mobility system. To improve the connection of start-ups with established business sectors, science, and governmental bodies, the think tank and platform *Next Floor Accelerator* was established in Salzburg (Professor & Head of Transcultural Communication at Salzburg University, 2018). The *Next Floor's* sub-division, Tech for Tourism Accelerator*,* focused on digitalisation, new tourism concepts, sustainability, strategies for dealing with limits of growth, and mobility concepts in tourism. The Accelerator closely cooperated with the city and the federal state of Salzburg and regularly released calls for innovation, such as in spring 2020, searching for start-ups with innovative mobility solutions for tourism (Next Floor, 2020).

> Start-ups are the driver of a digital city. Other cities, which are further along in their digital innovation, demonstrate the necessity to foster a good start-up environment and to support the start-up scene in the city. Digital trends are too fast growing and changing; only agile businesses are able to really exploit new digital solutions. (Professor & Head of Transcultural Communication at Salzburg University, 2020)

One idea to ease tourism-induced pressures on the city was introduced by the Salzburg-based start-up VR-Coach*.* The start-up developed a VR app that provided VR walks through Salzburg. The slogan of the app was 'App instead of flight ticket' and was meant to provide potential visitors with a VR experience at home, so they would not need to fly to the actual site. The start-up had already launched VR tours of London and Paris and received support from DMOs of several 'over-touristic' destinations. The app seemed especially popular in Asian markets. In Salzburg, the app was planned to launch in 2020 and received support from the local DMO (Lorbeer, 2019).

The below MLP illustration summarises the phase at the time of the study. The MLP outlines the efforts at regime level to adapt the existing tourism mobility system to the ongoing changes by introducing alternative business models and collaboration frameworks.

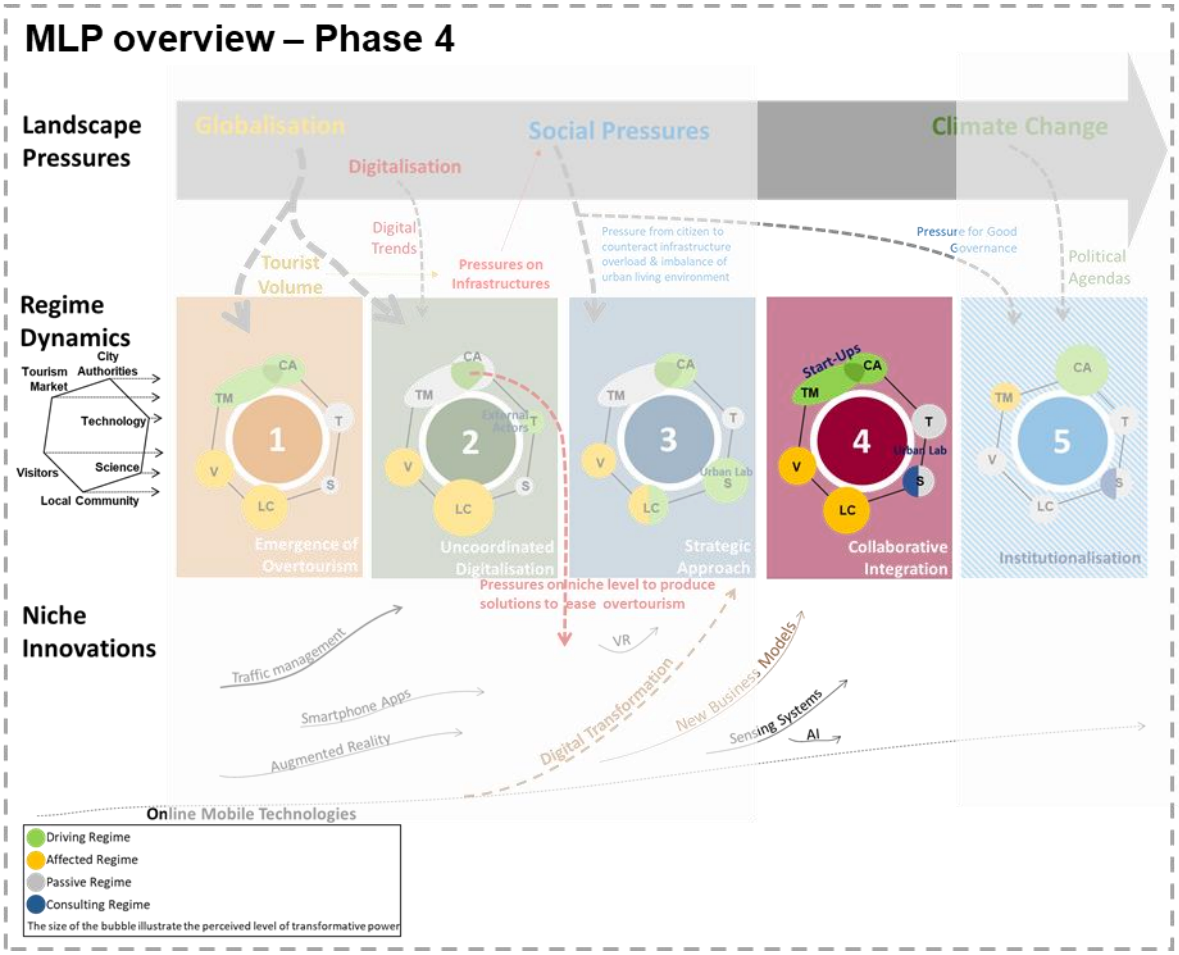

Figure 92 MLP analysis Salzburg – Phase 4 (Source: own illustration)

8.6. Institutionalisation as the Next Logical Step and Stabilising Force

At the end of 2019, Salzburg's tourism mobility system was still in a critical phase of innovation. Although the transformation processes at that time were concentrating on the integration and operationalisation of available technological innovations, the city was still subjected to increasing touristic and tourism mobility-induced pressures and their effects on social, economic, environmental, and cultural environments were not controllable nor effectively manageable.

> We need to start integrating successfully reformed processes into our regulative framework, so we could build-up a viable basis to continue the transformation of the city into a sustainable direction. (Chairperson of Mobility Forum Salzburg, 2019)

At the time of the study, strategic considerations at policy level had started. These discussions revolved mainly around strategic revisions of management and development concepts of the city and its many ecosystems, such as tourism mobility. An overall goal was the development of a jointly agreed (re)direction of Salzburg's utilisation to enable the city to evolve into an attractive, economically strong city but also a liveable and eco-friendly city.

'Friendly' pressures for more sustainability

In the foreseeable future, pressures from the institutionalised climate-protection agendas of the national and federal state levels are expected to impact Salzburg's city management policies, and thus the tourism mobility system.

> Another key challenge for the urban development of Salzburg is on the horizon: the growing relevance of mobility for climate change goals. The national and federal governments are already discussing far-reaching initiatives to promote public, eco-friendly transport and penalise private, motorised traffic. […] The first climate change agendas have been released, and Salzburg is now also under increasing pressure to adjust its urban planning and city management policies to the national agendas and climate change goals. […] Tourism mobility is the neuralgic point for Salzburg's transformation towards green traffic. […] So far, the city has focused on initiatives to better manage car and bus-based touristic traffic, so we [the inhabitants of Salzburg] could better live with it. But to make urban mobility more 'green', the city's tourism-friendly management approaches won't be enough; substantial amendments to its policy frameworks and urban planning concept are necessary. The city also needs to redirect investments towards the long-overdue upgrading of the public transport system. Campaigns telling visitors to not come by car or bus, but by train or bike, are necessary, and drastic sanctions and high fees for motorised vehicles to access the city have to be enacted. […] Going green. Becoming sustainable. Creating a forward-looking city is difficult and will only work when the city is finally willing to sanction, reduce, and put these decisions in writing and integrate them into the city's constitution. (Chairperson of Mobility Forum Salzburg, 2019)

It is commonly agreed among the current actors that tourism mobility is a substantial, negative contributor towards climate change goals. However, existing climate-protection initiatives in Salzburg mainly focus on e-mobility solutions for residents (e.g. automated e-bus shuttle pilot), energy reduction strategies, and campaigns for local households, but do not address tourism mobility. Dedicated eco-friendly tourism mobility initiatives have been limited to bicycle promotion schemes from the Salzburg Tourism Office and the expansion of the bicycle paths into Salzburg's surrounding region by the federal state.

Tour bus regulations, access limits, and tourism traffic regulations were considered pressing issues and long overdue for an institutional integration. Emerging climate change agendas

were perceived as “friendly pressure which gently forces the city leaders to take the next steps and integrate concrete regulations and laws into the city constitution” (Head of Urban Planning of City of Salzburg, 2018).

Visitor-movement management as binding regulation

The city’s sensing upgrade was a key topic in the debate on the innovation of tourism mobility.

A prominent discussion among regime actors concerned the request to integrate visitor-movement management schemes into the city management concept, urban planning concept, and traffic management concept, as well as the demand to integrate visitor-movement management funds into the city’s budget to upgrade and expand city sensing, communication, and guiding systems regularly.

Data generation was perceived as the future for city management, but the generation, processing, and storing of people’s data are a highly sensitive subject that requires a critical approach and precautions.

> In terms of the ‘smart city’ or IOT applications in the city, we need to proactively develop policies, laws, and regulations to protect the users, our inhabitants, and the city. […] Data-driven management brings more possibilities but also more responsibilities. […] We need to have fixed procedures in place before we start processing user data, so we can control what is happening with data and can clearly identify foul play. (Head of Urban Planning of City of Salzburg, 2018)

Reconsidering competences

Critical voices questioned the city government’s ability to drive sustainable innovation in Salzburg. Thus, the discussion emerged to formalise development and innovation maxims for Salzburg and integrate them into the city constitution.

> The development focus, in each district, should be on the creation of a liveable, inclusive, and sustainable city and not on economic added value and the creation of a brand or image. […] We need to put that in writing in the city constitution, so our city leaders remember its citizens when they are drafting tourism plans or urban development concepts. (Chairperson of Mobility Forum Salzburg, 2019)

Although some actors perceived the institutionalisation of innovations and changes as additional pressures on Salzburg’s tourism mobility system, other actors considered institutionalised frameworks and clear regulations as a potential stabilising factor that might help to dissolve remaining entrenched political directions (e.g. dominance of market-led

strategies) and break-up path-dependent practices of city governance and management (e.g. political resistance to enact access limits).

To start a sustainable institutionalising process in Salzburg, the notion of *good governance* was suggested as a useful strategy for the development of a sustainable future for the city.

> Openness, transparency, participation, responsibility, efficiency and effectiveness, coherence, coordination conflict management, and reconciliation of interests, as well as cooperation and communication are criteria for *good governance*. Urban planners should leave their office in the city hall and start a dialogue with the citizens. Create a basis for understanding and pursue an honest, true communication process. […] This would be the right way to uphold the city's heritage of cultural exchange and dialogue and guide the city into a digital future. (Professor & Head of Transcultural Communication at Salzburg University, 2020)

The silver lining

In early 2020, the city government began to reconsider its position on the oft-discussed access limits and capacity control measures. Although no general bus or visitor access limit was enacted, the city council introduced a regulation to limit the size of tourist groups walking in the Old Town to a maximum of 25 people (Ruep, 2020).

Furthermore, in 2020, the city council agreed on a capacity control measure and set the limit to a maximum of 15,000 hotel beds in Salzburg City (Salzburger Nachrichten, 2020). Airbnb apartments and camping facilities were not included, however, and Salzburg had already reached a capacity of 14,700 hotel beds at end of 2019 (Salzburg Statistik, 2019).

An increase in the city tax for tourists was also suggested. The current tax of 1.50 euros per person should be increased by the 'cultural euro' to 2.50 euros per person. The 'cultural euro' should be dedicated to the conservation and heritage protection costs of the Old Town (ÖGZ, 2020).

Although Phase 5 is included in the MLP, the phase was in a very early stage at the time of the study, and only initial considerations for an institutionalisation of certain aspects supporting the shifting tourism mobility system were conducted.

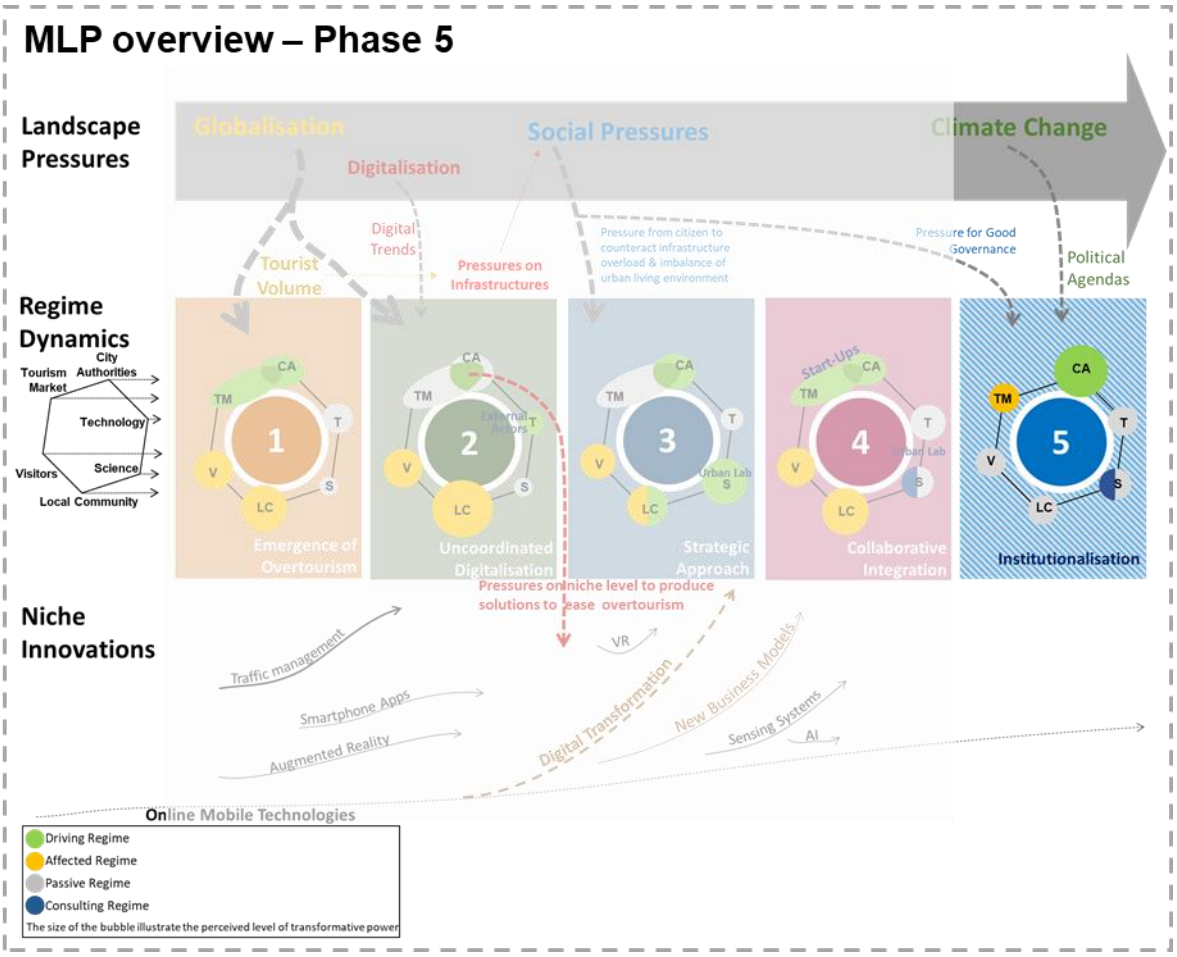

Figure 93 MLP analysis Salzburg – Phase 5 (Source: own illustration)

8.7. A Multi-Level Perspective on Salzburg's Tourism Mobility Innovation Path

The MLP on the innovation path of Salzburg's tourism mobility system provided insights into an innovating socio-technical system that was subject to severe landscape pressures and shaped by strong, interest-led innovation direction at regime level (see Figure 94).

Based on the overview of the identified innovation pathways in the literature (see Section 3.3.5), Salzburg's tourism mobility system displayed a close resemblance to the 'de-alignment and realignment' pathway (Grin, Rotmans and Schot, 2010; Geels and Schot, 2007). This pathway describes the innovation of a socio-technical system subjected to significant pressures; however, no niche innovation had matured enough to break through and foster a realignment of the de-aligned regime configuration. At the time of the study, Salzburg had not completed its innovation but had reached the realignment phase of the innovation pathway.

The de-alignment of Salzburg's tourism mobility regime was mainly triggered by pressures produced by the 'over-touristic' utilisation of the city. However, these pressures can be considered, to a certain extent, as self-induced and reflect the strong, interest-led, and market-ruled setup of regime actors (Foxon, Hammond and Pearson, 2010). This dominance of market-ruled regime actors was also identified as a key factor hindering a balanced innovation and a realignment of the regime towards a digitally transformed socio-technical system. The case study provided the first indications that a purposive and artificial steering of innovation processes could also lead to obstructing innovation.

Another key insight from the case study is that no digital tool or digitally enhanced tourism mobility system can compensate for the over-utilisation of a built environment.

Innovation Phases		Pathway	Phase Specifics
Phase 1	Emergence of 'Over-tourism'	**De-alignment and realignment** Strong landscape pressures destabilise the incumbent regime setup. Regime actors seek niche innovation to ease pressures, but no niche innovation is available for the intended purpose. Regime starts to evaluate available niche innovations for suitability and integrates relevant innovations. Regime starts to realign and continues integration of emerging, relevant niche innovations.	The self-induced 'over-touristic' utilisation of the historic city centre triggered a de-alignment of regime actors resulting in a destabilisation of the tourism mobility system. A range of urban planning measures was introduced to improve the tourism mobility management within the city. Many of these measures resulted in an ever-growing touristic utilisation of the city centre. The regime setup was increasingly tourism led.
Phase 2	Uncoordinated Digitalisation		Digital innovation was mainly driven by regime-external actors. First attempts of the market-ruled tourism mobility regime to innovate digitally resulted in the insight that expertise, know-how, and experience were lacking, and no high quality digital innovation can be generated within the system.
Phase 3	Strategic Approach		Research and science actors started to contribute actively regarding innovation. Digital expertise and experience were generated. Strong cooperation with other cities, projects, and actors was fostered to enhance know-how and exchange expertise.
Phase 4	Collaborative Integration		Current Stage Based on insights from strategic approaches, digital enhancements of tourism mobility system are pursued.

Phase 5	Institutionalisation		Current Stage Parallel to integrating digital solutions, regulatory and organisational frameworks are needed to complement the technical innovation. New ‘rules’ (see Section 3.3.2) for cooperation of regime actors must be defined to enable realignment.

Table 18 Innovation pathway – Salzburg tourism mobility system (Source: own illustration)

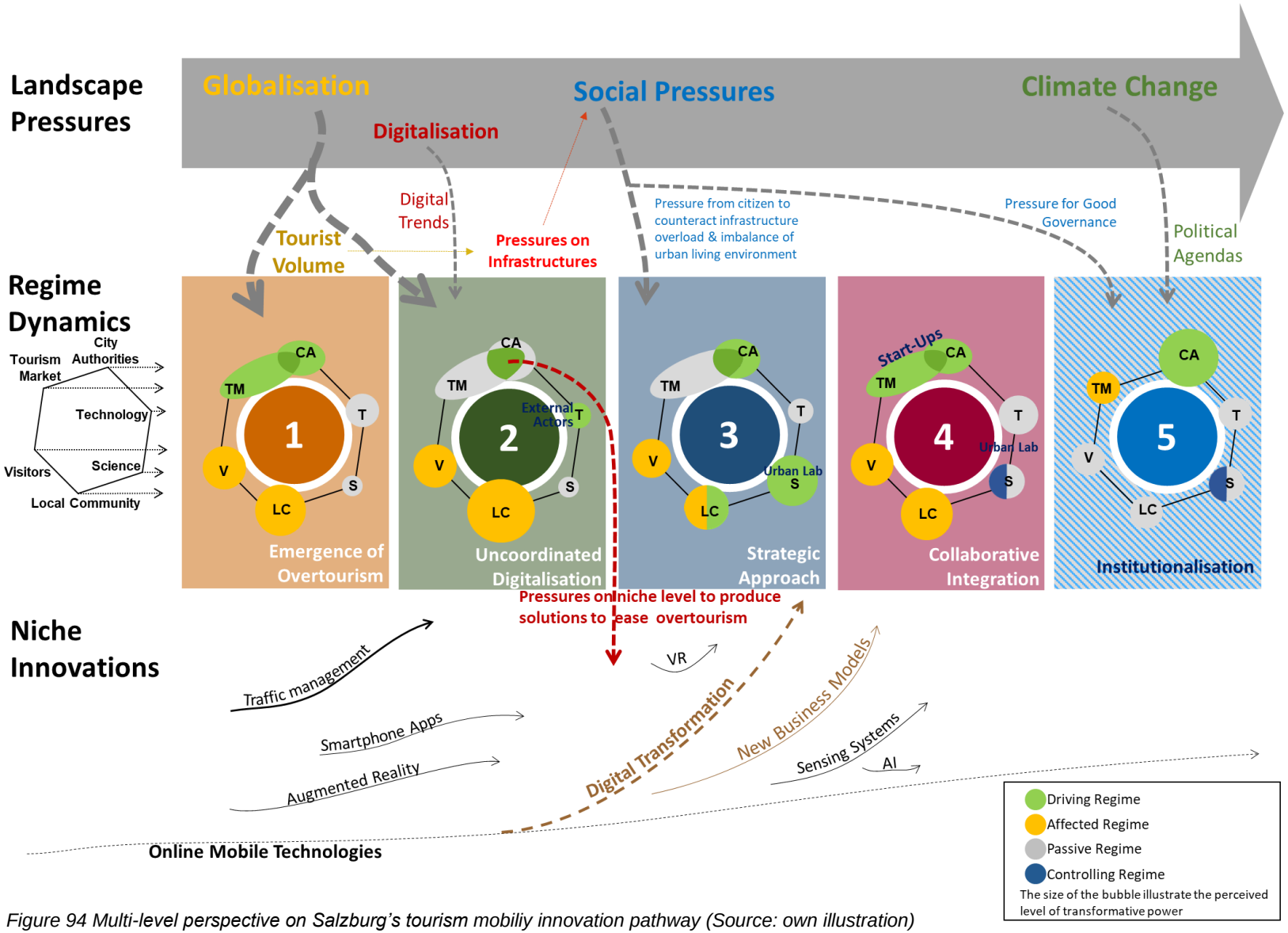

Figure 94 Multi-level perspective on Salzburg's tourism mobiliy innovation pathway (Source: own illustration)

9. Graz – Tourism Mobility as a Driver for Sustainability

In the scoping study, Graz was identified as the city subjected to the fewest touristic pressures among the Austrian case cities. The city's focus was actually to increase the touristic exploitation of the site. However, the findings of the online survey also revealed the respondents were aware of the significance of contemporary tourism mobility as a key management aspect for the sustainable touristic utilisation of the city. Therefore, the case study investigated Graz's desire to increase but maintain a sustainable touristic utilisation of the site, which was founded on strategic innovation activities of the Graz tourism mobility system.

9.1. A Contextual Overview of the Tourism Mobility System of Graz

For the contextual overview, a brief review of the long history of the UNESCO WHS of Graz's historic city is presented. The first settlements in the city area of modern Graz date to 3000 BC. In the Roman Imperial period, Grazer Field was already a densely populated agricultural area and connected to trans-regional routes of the Roman road network. The name 'Graz' originates from the Slovenian *gradec* (tranls. small castle). The name dates to the sixth century and emerged after the completion of the fortress on Castle Mountain (see Figure 95; (Brunner, 2003).

Figure 95 Fortress and Clocktower on Castle Mountain (Graz Tourism, 2020b)

From the 10th century, Graz was part of the south-eastern bulwark that stretched from Vienna to the Adriatic Sea and was meant to protect Central and Western European settlements from attacks by Eastern invaders (Brunner, 2003). In 1233, the construction of a comprehensive fortification structure around the settlement began (see Figure 96), which made Graz one of the most fortified settlements in Central Europe from the Middle Ages up to the modern period.

The heavily fortified city mountain of Graz was never conquered and presented an impregnable obstacle for Napoleon Bonaparte in the Austro-French Wars (City of Graz, 2020a).

Figure 97 City of Graz around 1626 (City of Graz, 2020a)

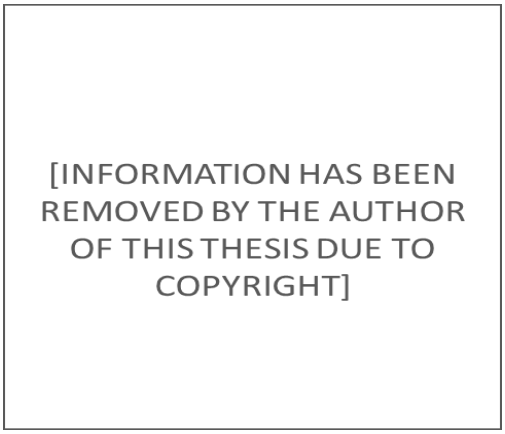

Figure 96 Graz Clock Tower (City of Graz, 2020a)

However, the fortification became a 'political sacrifice' for the peace treaty of the Austro-French Coalition War in 1809, in which the French demanded the immediate demolition of the entire fortification system of Graz. Graz's signature landmark, the Clock Tower (see Figure 97), is one of the few remnants of the former fortification on Castle Mountain and only survived demolition because the citizens of Graz bought back the Clock Tower and the bell tower for 2,987 Gulden (approx. value of 87,000 euros today) from the French occupiers (Brunner, 2003).

Following the demolition of the fortification system on Castle Mountain, the urban development of Graz continued to flourish at the foot of the mountain. The reconstruction period after the French occupation and until the First World War was the most significant for Graz's urban development. The debris on the slopes of Castle Mountain was reused for buildings in the (now) historic City of Graz around the mountain, and the cleaned-up mountain was converted into a landscape park. Urban infrastructures were upgraded and extended via a communal water supply system and canalisation. In addition, a public horse-drawn tram network was established at the end of the 19th century, which was based on the example of Vienna to establish a public transport network in Graz. At the same time, the city's connection to the national railway network was enhanced, and Graz was established as a railway hub connecting the Hungarian, Italian, Slovenian, and Austrian railway networks. Due to Graz's newfound role as a well-connected transportation hub, large industrial corporations settled in Graz, such as Andritz PLC and the Puch factories (later Steyr-Daimler-Puch PLC and Magna Steyr), turning the city into a major industrial site in Central Europe.

9.2. Diversifying Contemporary Graz for Greater Sustainability

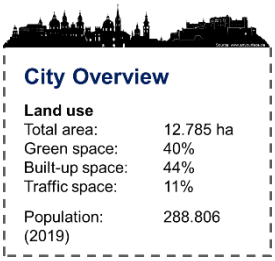

Figure 98 City figures (amended from City of Graz, 2020b)

Today, Graz is the capital of the federal state of Styria, covering an area of 12,785 ha, with 288,806 inhabitants in 2019 (see Figure 98; (City of Graz, 2020b).

Graz is the second largest city in Austria and is located around 150 km southwest of Vienna. The city is in the Graz Basin, directly at the end of the Graz Highlands. The city area covers almost the entire Graz Basin, which is enclosed on three sides by 400-metre high hills. Only on the south side do the Grazer Highlands open up and the city continues into Grazer Field. The river Mur divides the city into two, with the Old Town and Castle Mountain mainly on the east side of the river.

Graz's topographical location, in combination with a strong manufacturing industry and high levels of commuter traffic – with an average of 85,500 commuters per day in 2017 (+30% since 1991; (Addendum, 2017), meant the city continuously had the highest air pollution in Austria since the start of air quality monitoring in the 1980s (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). As a reaction to the drastically worsening air quality in the 1990s, including a peak of 166 days above EU limits for fine dust pollution (PM 10) in 1999, the city government initiated a far-reaching diversification plan for the urban utilisation of Graz, with the key purpose being to lower air pollution levels in the city.

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Figure 99 Air pollution in the Graz Basin (author, 2019)

The key focal areas of the plan included upgrading the environmental performance of manufacturing plants (e.g. air filtration systems, supply networks), the development of improved mobility management strategies, including parking management, traffic control and monitoring systems, and upgrading public transport networks.

> Since the 1990s, we have been using 'soft mobility' concepts for our city traffic politics. We were facing severe challenges and realised that drastic measures were needed to stop the rapidly increasing pollution of the city. At the end of the 1990s, we were among the top 100 most air polluted cities worldwide. This was a wakeup call. […] We started to rigorously sanction urban traffic, introduced strict regulations for the manufacturing industry, and started large campaigns to make citizens aware of the pollution levels of their homes and also introduced measures to lower these emissions […] And we also started to set a symbol for a cleaner Graz by forbidding fireworks on New Year's Eve. (Head of Urban Planning of City of Graz, 2019)

The city council also developed a comprehensive diversification programme for Graz's economic structure and urban utilisation. The touristic exploitation of Graz, based on its rich cultural heritage, was devised as a promising diversification activity and led to the application and nomination of Graz as a UNESCO WHS in 1999.

Graz's inscription as a WHS was based on its exemplary blend of architectural styles in the historic city centre, which have succeeded each other from the Middle Ages until the 18th century and embody a diversified and highly comprehensive ensemble of architectural, decorative and landscape examples, originating from the Germanic region, the Balkans, and the Mediterranean.

In 2010, the WHS status was extended to Eggenberg Castle located west of the historic city centre (see map in Appendix VI). Today, the WHS covers an area of 91 ha, of which the historic city centre takes up 72 ha and contains around 450 buildings (see map Appendix VI; (UNESCO, 2020).

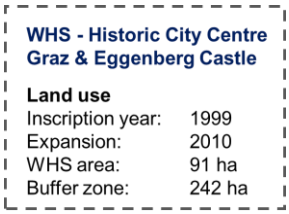

Figure 100 WHS Graz overview (Source: own illustration)

> From a touristic point of view, Graz was always underperforming and in the shadow of Salzburg and Vienna. We always needed USPs and highly visible PR to promote the destination and regain the attention of the public. […] The nomination as a World Heritage Site in 1999 helped us to improve our international and national recognition and made it easier to compete with Vienna or Salzburg. […] The expansion was a strategic move to convey to visitors that Graz is not only a filthy industrial town, and that Graz is worth visiting. (CEO of Graz Tourism, 2019)

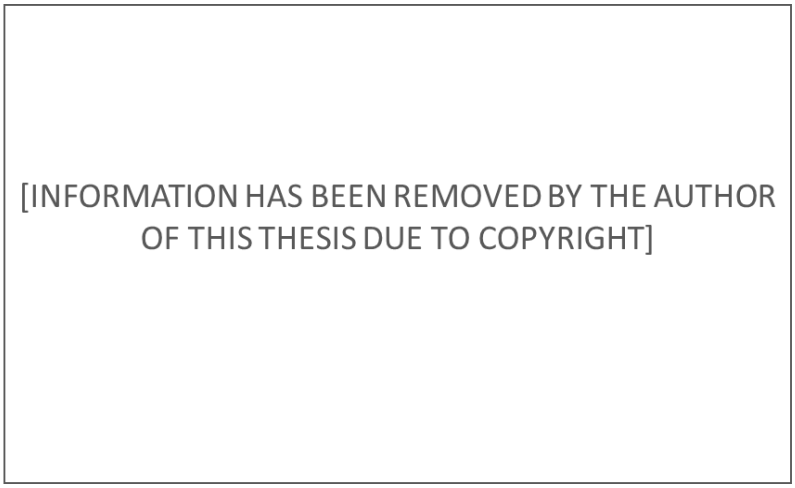

Figure 101 Graz Old Town (City of Graz, 2020a)

During the development of the diversification plans of the city, the significance of tourism mobility as a potential impact factor for air quality ratings was addressed. However, due to touristic movement being difficult to define, demarcate, and measure, as well as no data from other cities on the impact of touristic movement on air quality being available, the relevance of tourism mobility was considered minor, and the touristic diversification plans for Graz did not incorporate dedicated visitor movement in tourism mobility management schemes.

Nevertheless, the city authorities included an evaluation of potential tourism mobility impacts into the already well-designed 'air quality radar' of the city (Head of Urban Planning of City of Graz, 2019).

9.3. Creating Touristic Graz

The nomination as a UNESCO WHS boosted Graz's level of awareness among domestic and international visitors; however, the key focus of the city was on the "invention of a cultural Graz" (CEO - City Forum Graz, 2019) to compete with Vienna and Salzburg.

After the inscription as a UNESCO WHS, the nomination as Cultural Capital was Graz's next strategic approach to boost its destination attractiveness and touristic recognition and overcome the still dominant perception of Graz as a cultural and touristic 'insider tip'.

The city invested around 56 million euros into the creation and upgrading of Graz's cultural infrastructure and improvements to the touristic infrastructure.

> Without the Cultural Capital funds, Graz would have never become a significant cultural city. […] Although some say the momentum of the Cultural Capital year was quickly lost, the buildings, institutions, cultural infrastructure, and the cultural spirit still prevail in the city. […] Over the long

> run, the ‘reinvention’ of Graz03 has intrinsically altered the city and city life and made the city open for post-modernity and an innovative future. (CEO - City Forum Graz, 2019)

For the Cultural Capital year, large architectural projects were realised, such as the Art Museum (see Figure 102), which is also called the ‘kidney’ or ‘crashed alien’ by locals, and was voted as ‘winning tip’ for European modern architecture by *The Guardian* in 2019 (The Guardian, 2019). Mur Island (see Figure 103) is a floating platform on the river Mur and was meant to become the second landmark of Graz – after the Clock Tower. The ‘Shadow Object’ Clock Tower was a temporary art project by a young artist from Graz, who used the subtle intervention in urban space to highlight how perception influences our image of reality (see Figure 104).

Figure 102 Graz Art Museum (Graz 03, 2004)

Figure 104 Mur Island (Graz 03, 2004) *Figure 104 Shadow Tower of the Clock Tower (author, 2003)*

In the MLP analysis (see Figure 105), the trigger for the innovation of Graz’s tourism mobility system is evident, namely the strategic decision to diversify the city’s utilisation.

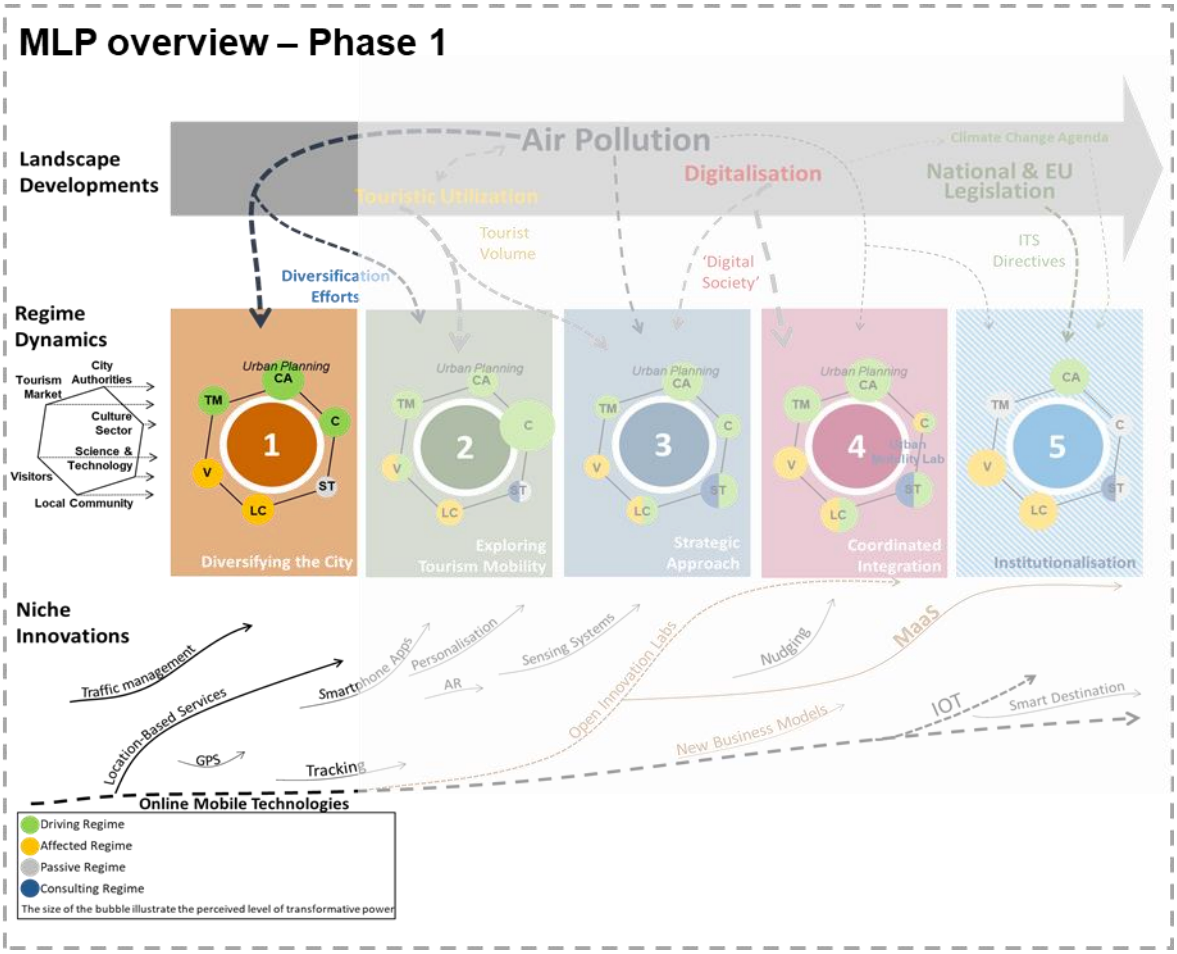

Figure 105 MLP analysis Graz – Phase 1 (Source: own illustration)

9.4. Tourism Mobility in Cultural Graz

Touristic movement was one of the leading topics in the Graz03 programme. This thematic focus emerged during the planning process for Graz03.

> We tried to take it very literally and really create a capital full of culture. However, it soon became very obvious that just building sites across the city was not doing much. But we needed to also deal with visitor movement. […] During the planning process of Graz03, we realised how important a strategy is to send or guide people across a site. And we also realised how much creative potential is hidden in this topic. So, we decided to incorporate touristic movement as a lead theme into Graz03. And we were very curious regarding the proposals of artists on how to deal with or investigate this topic. (CEO - City Forum Graz, 2019)

Selected examples

Below is a selection of the wide range of proposed art projects that addressed visitor mobility and the urban consumption projects that were installed in the city.

As part of the *Die Gespiegelte Stadt* (transl. the mirrored city) project, large-scale mirrors were installed across the Old Town to encourage a reflective experience of space and to provide the observer with new perspectives of the city (see Figure 106).

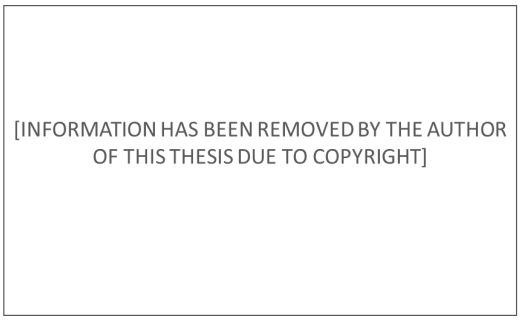

Figure 106 'Mirrored City' (Graz 03, 2004)

The participative Graz03 project *access.all.areas* was designed to explore Graz in new ways, new areas, and new stories. An open call for projects was made, inviting interested people to submit their ideas for city adventures and discoveries. Over 100 projects from citizens, students, and artists took place over the period of one year and covered thematic areas including discovering the Mur, alternative city tours, and exploring the unknown side of Graz's cultural scene.

Figure 107 'Accelerations' (Graz 03, 2004)

The permanent light installation *beschleunigen (transl. accelerate)* used side-marker lighting from road tunnels to illuminate the *Pomeranzengasse* in the Old Town, which was formerly used as a lane to bring convicts to their execution site in the main square. On some days, the installation was also supported by sound. The installation was meant to intensify the movement experience in the narrow lane for both locals and visitors (see Figure 107).

Figure 108 Art installation in front of KIOER (Cultural Styria, 2007)

For the reconstruction of the Marienplatz, which is the square in front of the Institute for Art in Public Space, a design competition was launched in 2006. The winning project used light installations on the ground as an interpretive method to convey information about the site. The light installations were designed as a timeline, guiding the visitor over the square (see Figure 108).

For Graz03, new technologies played only a minor role in the interpretation of the site or visitor guidance. Only at the end the 2000s were the first online maps and tour guide apps released. These online mobile tools were developed by external businesses that specialised in providing

online touristic aids. The local actors in charge of visitor-movement management continued to employ analogue guiding methods and interpretative material.

However, Graz`s cultural sector continued to deal with visitor movement and urban consumption

> through innovative design which helps us to better understand human behaviour in the urban context. Only this understanding allows us to use design components to actively shape and influence urban consumption, movement, and use of space. (CEO - City Forum Graz, 2019)

In 2011, Graz became a UNSECO City of Design to honour the existing design quality of the city and as encouragement to continue the implementation of design in all aspects of life.

> The award should not be seen as a label, nor to polish the image of the city, but as a clear statement about the city and its citizens to actively and consciously shape the living environment of the city. (CEO of Graz Tourism, 2019)

The Design City projects covered a wide range of topics, with several addressing urban mobility, among which a number incorporated tourism mobility perspectives. Although Segway tours through the Design City were developed, the publication of digital and analogue city maps and thematic tours for pedestrians and cyclists to explore the Design City covered the commercialising of the city's new brand, and more comprehensive projects used systematic urban interventions to change the use and perception of the urban environment. Example projects are urban furniture (see Figure 109), with a focus on 'city consumption' and "new human needs while walking in the city" (CEO - Mobility Research Graz, 2019). These were cooperative projects enabling designers and researchers to understand urban behaviour and the implications of interventions.

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Figure 109 Urban furniture projects in Graz (City of Graz, 2019)

9.4.1. The Role of Tourism Mobility in Diversified Graz

The city government's efforts to ease the air pollution problem by diversifying Graz proved effective and led to decreasing CO_2 emission levels in the 2000s and 2010s (see Figure 110).

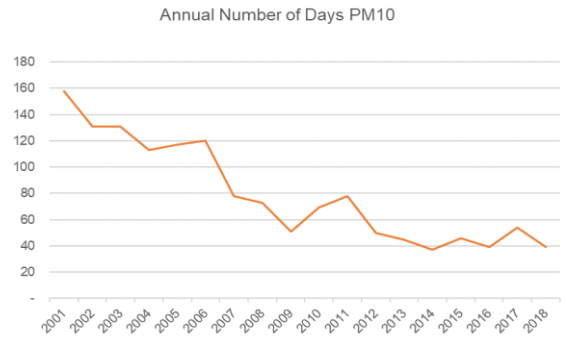

Figure 110 Air pollution level 2001–2018 in Graz (City of Graz, 2020b)

In addition to decreasing air pollution levels, the city's recognition as a touristic site increased.

Tourism statistics support the statement that

> the diversification of Graz's urban utilisation and impulses form cultural and touristic initiatives, which are clearly the right way to foster the sustainable growth of the city. […] Graz has finally found its niche to compete with Salzburg and Vienna for a share of the touristic market (CEO of Graz Tourism, 2019).

However, when correlating air pollution levels (see Figure 110) and tourist and visitor arrivals (see Figure 111), it is obvious that touristic mobility has a measurable impact on the city's air quality level. The signature events, including the years as Cultural Capital in 2003 and the UNESCO nominations as City of Design in 2011, resulted not only in an above average growth of touristic arrivals, but also in peak air pollution levels.

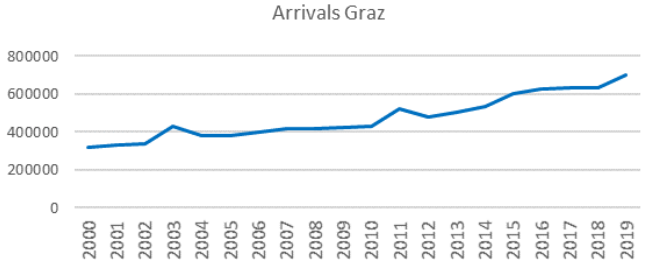

Figure 111 Arrivals Graz (Graz Tourism, 2019b)

This reflection of elevated touristic traffic in the air quality is closely related to the modality mix of arriving tourists and visitors. The geographical mix of Graz's arrivals shows that domestic tourists (44.8%) and German tourists (20.6%) dominate the tourism market (City of Graz, 2020b).

In accordance with the source markets and the short length of stay, the dominant arrival mode at the destination was the car, around 86% (Head of Urban Planning of City of Graz, 2019), followed by bus tourism. Plane and train were rather irrelevant as tourism mobility mode options for Graz visitors.

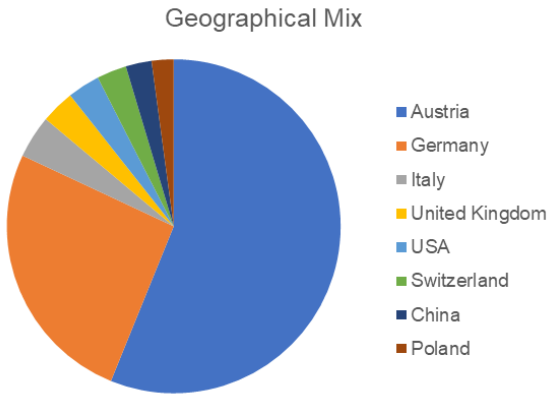

Figure 112 Geographical mix arrivals Graz 2017 (Graz Tourism, 2019b)

Although the still-moderate visitor numbers were considered manageable, urban planning authorities observed growing tourism mobility effects on the city system. In particular, the dominance of cars visiting Graz impacted the strained air quality of the city. Furthermore, on heavy tourism-days, roads and parking facilities in the inner city were already reaching their limits.

> The city, the cultural sector, and the tourism industry are putting a lot of efforts into the fast growth of Graz's tourism. We are risking that the diversification effort to ease CO_2 emissions is now shifting to become another factor causing more CO_2 emission. (Head of Urban Planning of City of Graz, 2019)

In addition to large-scale cultural events, Graz's tourism sector was also pushing to organise events in the city. One example is the annual Graz Christmas Market, which brings growing challenges for the traffic management authorities of the city.

Advent season is when the City of Graz managed its breakthrough as a pre-Christmas hotspot in Austria. From the beginning of November until the middle of December, an average of around 2.5 million visitors stream into Graz's Old Town to enjoy the Advent atmosphere. During this period, around 200 tour buses drive into the city daily. On peak days, around 120,000 people visit the Old Town (ORF, 2019a), of whom around 80% arrive by private car, 10% by tour bus, and the rest by train or plane (Graz Tourism, 2020a).

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Figure 113 Advent market Graz (Kleine Zeitung, 2019)

During this period, the touristic carrying capacity and tourism mobility infrastructures are increasingly at their limits, and touristic traffic significantly impacts the air pollution level in Graz (CEO - Mobility Research Graz, 2019).

> The Advent period can be seen as a realistic scenario of a heavily used, touristic Graz. On some days, we reach a tourist-per-visitor ratio in the Old Town of around 35, numbers which are easily comparable with Salzburg. […] We are learning a lot during this period and, of course, economically, the visitor masses seem very attractive for business, but it is clear that heavy touristic utilisation, like in Vienna or Salzburg, which are working a lot with groups and mass tourism, is no viable option for Graz. From our perspective […] [i]t is difficult to establish tourism as an additional economic pillar of a city's economic system, but at the same time keep the invasiveness and effects of tourism to a minimum. In my view, this balance can only be met if we really understand how the tourist consumption of our urban environment works and manage it from day one, as well as refrain from attracting tour groups and budget tourism. (Head of Urban Planning - City of Graz, 2019)

The MLP of this phase shows clearly the dominance of the cultural stakeholders as lead actors at regime level (see Figure 114). This approach strongly differs from the innovation approaches of Salzburg and Vienna and highlights the case-specific character of innovation. Although an innovation must be adjusted and fine-tuned to the peculiarities of the individual local socio-technical systems, the common innovation processes and tendencies of Phase 2 can be identified throughout the three case studies. In particular, the exploratory character of this phase again becomes apparent, based on trial-end-error to gain preliminary insights into and experience of novel digital tools.

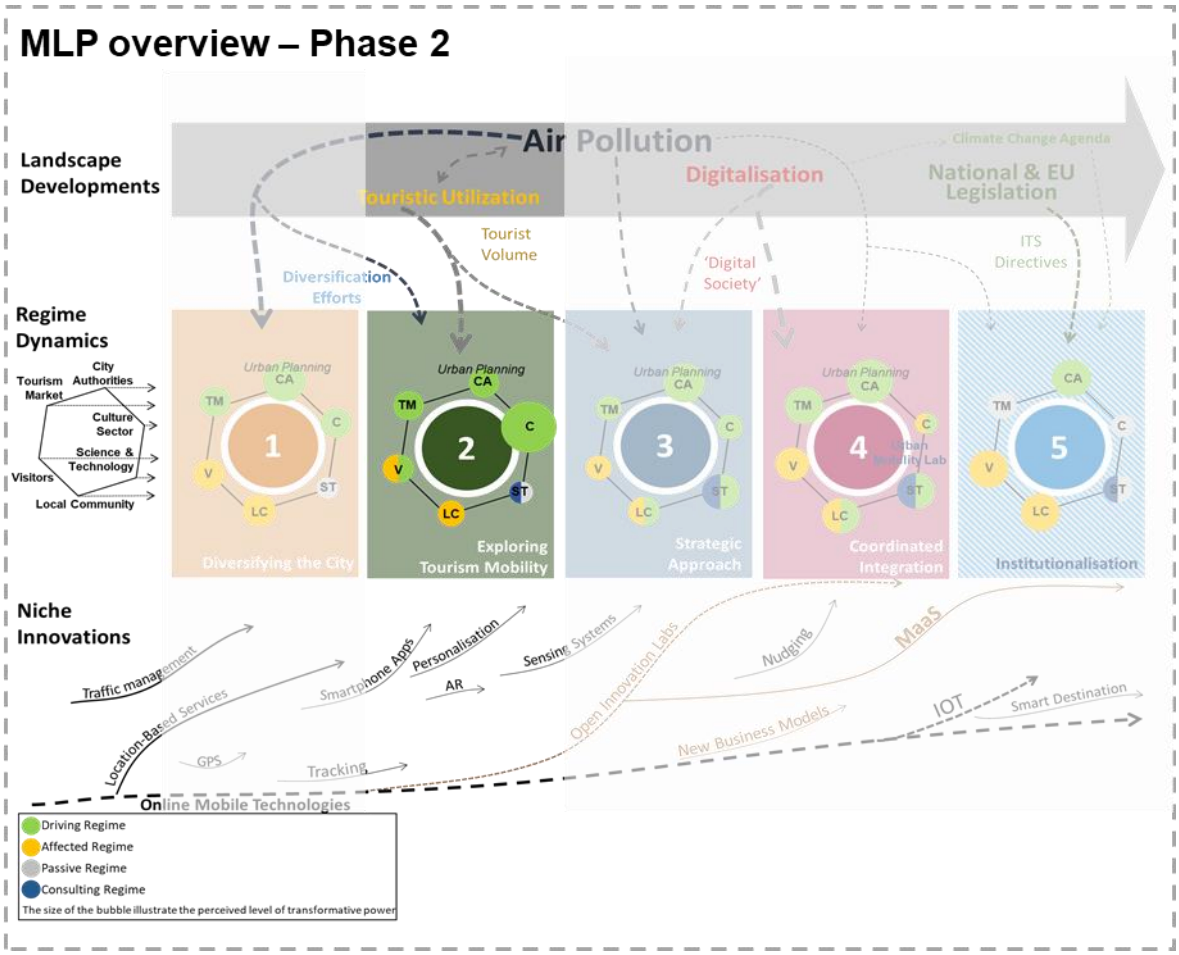

Figure 114 MLP analysis Graz – Phase 2 (Source: own illustration)

9.5. Innovating within the Sustainable Limits of Tourism Mobility

By the middle of the 2010s, the diversification efforts launched in the 1990s had substantially altered the urban utilisation of the city. Graz had developed into a recognised touristic destination. Tourism had evolved into an additional economic pillar and into a significant employment sector of Graz.

However, the environmental impacts of the 'touristification' of the city were underestimated in the original diversification plans and were also largely neglected in recent decades due to the dominant focus of the city being to create touristic Graz. Thus, the city government found itself confronted with the dilemma that the side effects of the introduced measures to ease air pollution levels of the city actually negatively affected air quality. A shift away from the touristic utilisation of the city was not feasible anymore. To enable a continuous and overall sustainable tourist utilisation of the city, the city council, led by the urban planning department, initiated a

rethinking process on the role and forms of tourism mobility. Furthermore, tourism mobility had to be integrated into the revised urban mobility management plan.

A cross-sectoral discussion group was formed with representatives from the city government, the tourism sector, the cultural sector, and sciences and research to increase networking and collaboration and to share individual experiences and data on urban mobility. A key objective of this discussion group was to pool existing know-how and information on tourism mobility in Graz to develop a clearer understanding of the scope and characteristics of touristic mobility in the city and region. During this process, it became evident that the cultural sector was the most-experienced sector with touristic movement due to the urban mobility, visitor movement, and urban consumption projects of recent decades. Although the insights from these projects provided a baseline for the conceptual discussion of tourism mobility and insights into human behaviour while exploring the city, data on mobility modes, mode mix, volumes, peaks, spatial distribution, and impacts on existing infrastructures of touristic mobility were unavailable. In addition, the roles, responsibilities, and topic leadership of tourism mobility were not clearly defined within the existing stakeholder configuration.

9.6. Tourism Mobility Stakeholder Structure

An analysis of the stakeholder structure (see Figure 115) of tourism mobility relevant actors showed that Graz's cultural sector was the most active actor group shaping touristic movement in the city. Cultural stakeholders considered touristic mobility an integral aspect of urban utilisation. The cultural discussion of touristic movement focused on exploring and 'playing with' human movement and urban consumption in the historic built environment, and thus made movement an attraction in itself. Due to a wide range of art projects, cultural stakeholders had gained comprehensive insights into the tourism mobility structure of Graz and collected valuable information on tourism mobility behaviour and on techniques to influence visitor movement in the urban environment.

The tourism sector, on the other side, displayed a relatively moderate interest in tourism mobility objectives. Unlike in many other destinations, the cultural sector in Graz was the lead actor for the provision of interpretative and guidance material for tourists and visitors, whereas the tourism sector mainly supported these activities. Interpretative efforts mainly focused on analogue communication methods and activities. With an increasing breakthrough of OMTs, the provision of digital guidance and interpretation tools was largely outsourced to external, specialised actors. The tourism sector focused on marketing activities and the expansion of touristic utilisation, and it set ambitious targets for touristic growth to reach 1.6 million

overnights stays by 2023, which would be a growth of around 500,000 overnight stays compared with 2019 (CEO of Graz Tourism, 2019).

The urban planning department was the main driver and coordinating actor within the tourism mobility system. In addition to their active duties in urban management and planning, the department also encouraged a sophisticated, cross-sectoral discussion on tourism mobility issues and a proactive appraisal of integration options of tourism mobility management schemes in the urban planning, management, and traffic concepts.

> We should never forget what Graz's actual problem is: air pollution. Tourism is a good economic utilisation for a city, but it can also be resource-draining and polluting. […] We do not have the leeway for trail-and-error with tourism; we need to exactly understand what we are doing, how far, and how much. […] It is essential that all stakeholders are strategically working together for innovation, but also that limits are accepted when necessary. (CEO - Mobility Research Graz, 2019)

To generate a clear understanding of these limits, the urban planning department worked closely with the city's IT service (ITG) to utilise new technologies across the city to generate insights into urban mobility and digitalise urban mobility management.

In addition to coordinating local activities for a strategic approach towards tourism mobility management, the city government also closely cooperated with mobility partners of the city region and federal state, such as the Federal Transport Authority of Styria (VVSt). Furthermore, the city contacted other cities (e.g. Vienna), national bodies, and supranational bodies (e.g. the EU) to collect existing know-how on strategic approaches regarding how to sustainably manage tourism mobility.

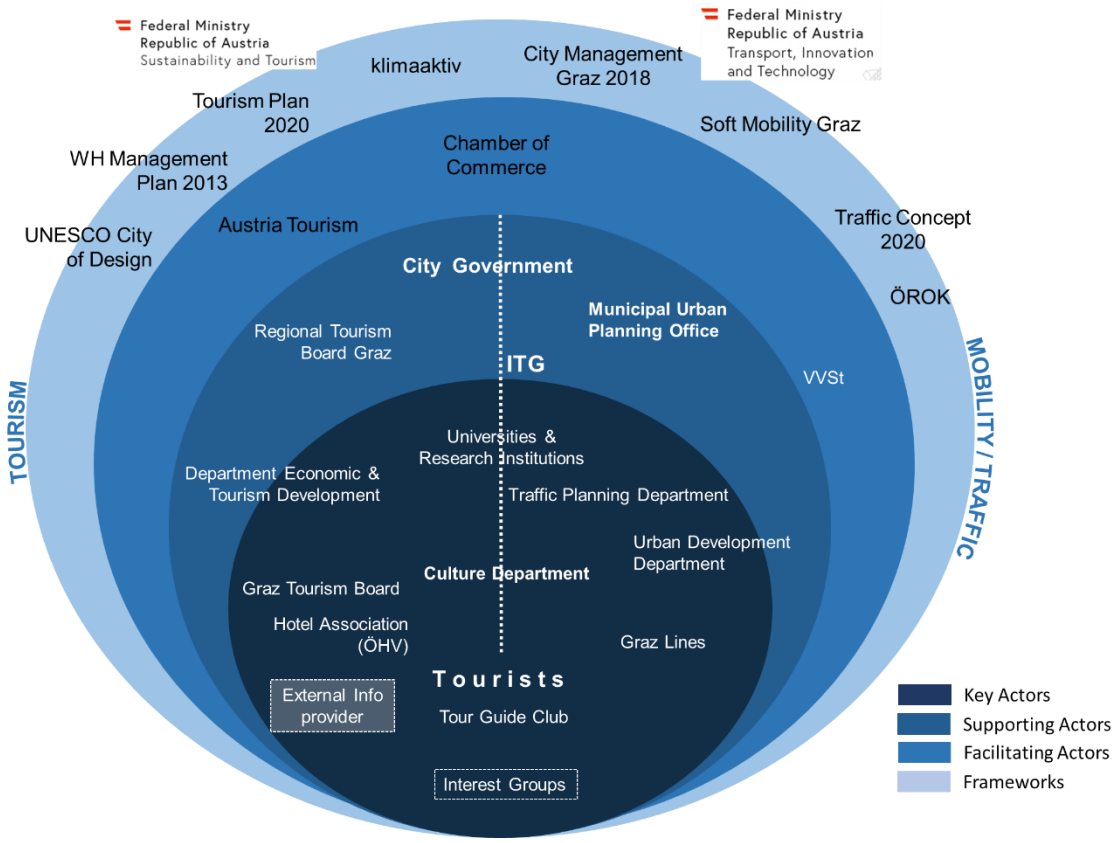

Figure 115 Tourism mobility stakeholder structure (Source: own illustration)

9.7. The 'Sensable' City

The city authorities saw great potential in new technologies to generate data on mobility, and thus obtain quantifiable insights into the urban mobility systems. Employing new technologies to create a smart urban mobility management was another possibility, with tourism mobility management as an integral part of this strategic approach.

Thus, Graz became part of the national UML scheme and launched the UML Graz in 2017 as one of five mobility labs in Austrian cities. Graz's UML focused on four objectives: (1) influencing awareness of mobility and mobility behaviour; (2) city region logistics; (3) traffic management 2.0; and (4) autonomous driving (CEO of Urban Mobility Lab Graz, 2019).

> For all four topics, tourism mobility is of relevance and is integrated as either a variable or as an objective in certain projects. (CEO of Urban Mobility Lab Graz, 2019)

The overall objective was to develop a comprehensive understanding of the urban mobility system of the city, which would provide the basis for the development of a revised and optimised urban mobility management plan. Tourism mobility was considered an integral part of these activities and the management plan. In particular, walking and arrival traffic were considered key aspects for tourism mobility in Graz. The research on walking behaviour

focused on generating a detailed understanding of urban consumption and the potential of digital tools to influence and control visitor micro-movement within the city centre. However, investigations into arrival traffic addressed car-dominated touristic traffic, which negatively impacted Graz's air quality levels.

9.7.1. Focus on Walking

The projects and research activities of the UML on walking mainly investigated micro-mobility behaviour and urban consumption and explored the potential to influence mobility behaviour.

One example was the research project Walk & Feel, which sought to generate a large dataset about Graz's walkability. The goal of the project was to improve conditions for pedestrians, and thus to improve the quality of stay in the city. To generate data on walkability conditions, a sensor network was installed that recorded and mapped the physiological reactions of pedestrians and attempted to identify the emotional responses and perceptions of the respondents. The insights generated were used to create indicators for an alternative assessment technique to evaluate the built environment and the walkability quality. The project played a valuable role in the advancement of human behaviour sensing, with several follow-up projects under development.

> The initial project was basically a proof-of-concept for our approach. We used data of pedestrians, without a detailed consideration of movement purpose. […] We are now developing follow-up projects using this methodological approach to investigate specific mobility groups, like students, moms with children, different kinds of businesspeople, and tourists. […] A detailed understanding of emotional responses to the environment would revolutionise urban development, design, and planning. It holds enormous potential to recreate space, to reshape our understanding of space, optimise utilisation of space, and so much more. […] The perceptions and emotional reactions of tourists are especially interesting due to the fact that these respondents are not acquainted with this space and show very different reactions. […] Our data holds great potential to improve the urban experience for all users: for example, (re-)excite locals about a familiar environment but also show visitors a bit of the everyday Graz. (CEO of Urban Mobility Lab Graz, 2019)

Another walking-based, open innovation project supported by the UML was the Time2Walk app, which promoted walking as an attractive mobility mode and collected opinions and suggestions from users regarding city improvements.

> With the gamified app, we tried to engage more people to walk, more often and for longer. Users could collect 'Future Tokens' – our game currency – with every step they took and buy city enhancements in the virtual city to shape the Graz of the future. […] One goal was to change the

> image of walking from a necessity to a rewarding enjoyment. Second, we got first-hand insights into how the urban structure is actually experienced by pedestrians. Third, we engaged people to actively think about the urban environment. […] We used AR technologies but also sharing platforms for users to connect and exchange experiences, and we also crowned a winner with the most achievements at the end of the pilot. (CEO of Urban Mobility Lab Graz, 2019)

Users could choose from predefined city improvements that covered the topics of safety, reachability, walking network, quality of stay, and accessibility (see example in Figure 116).

The app had a high participation rate and produced valuable data for urban planning and design. The pilot of the Time2Walk app was initially designed for locals, but the data revealed that many visitors also used the app during their stay. The touristic value of the app was a rather unexpected result. However, due to this finding, a slightly amended Time2Walk app dedicated to visitors was planned to be developed. The visitor version was adjusted to address visitor preferences and their interests and designed to fit the typically shorter duration of stay of visitors in the city. The app was proposed to generate visitor perceptions on aspects such as inner-city movement and urban consumption, but also to generate data on arriving in Graz and reaching the inner city.

Based on findings of the UML research, a revision of the urban mobility management plan began, including the integration of a visitor (mobility) management plan, and urban infrastructures were amended and expanded to improve the visitor experience and way-finding, but also to enhance the management and control of touristic movement within the city (Head of Urban Planning of City of Graz, 2019).

To enable such far-reaching changes of underlying frameworks of Graz's tourism mobility system, this strategic phase (Phase 3) within the innovation pathway was necessary (Figure 117). Further insights and experiences with novel tools were systematically generated in this phase. However unlike Phase 2, the city authorities, in particular the urban planning department, took the lead coordinating role to drive an experimental utilisation of novel technical tools, while also involving a wide range of stakeholders, and placed the findings of the utilisation efforts in the context of the mobility and city management frameworks. This systematic focus to find suitable strategies to drive the innovation of Graz's tourism mobility system enabled a smooth progression into the coordinated integration of OMTs (Phase 4).

Figure 116 Time2Walk mapped results for most popular city movement suggestions for 'Graz of the future' (amended from Time2Walk, 2020)

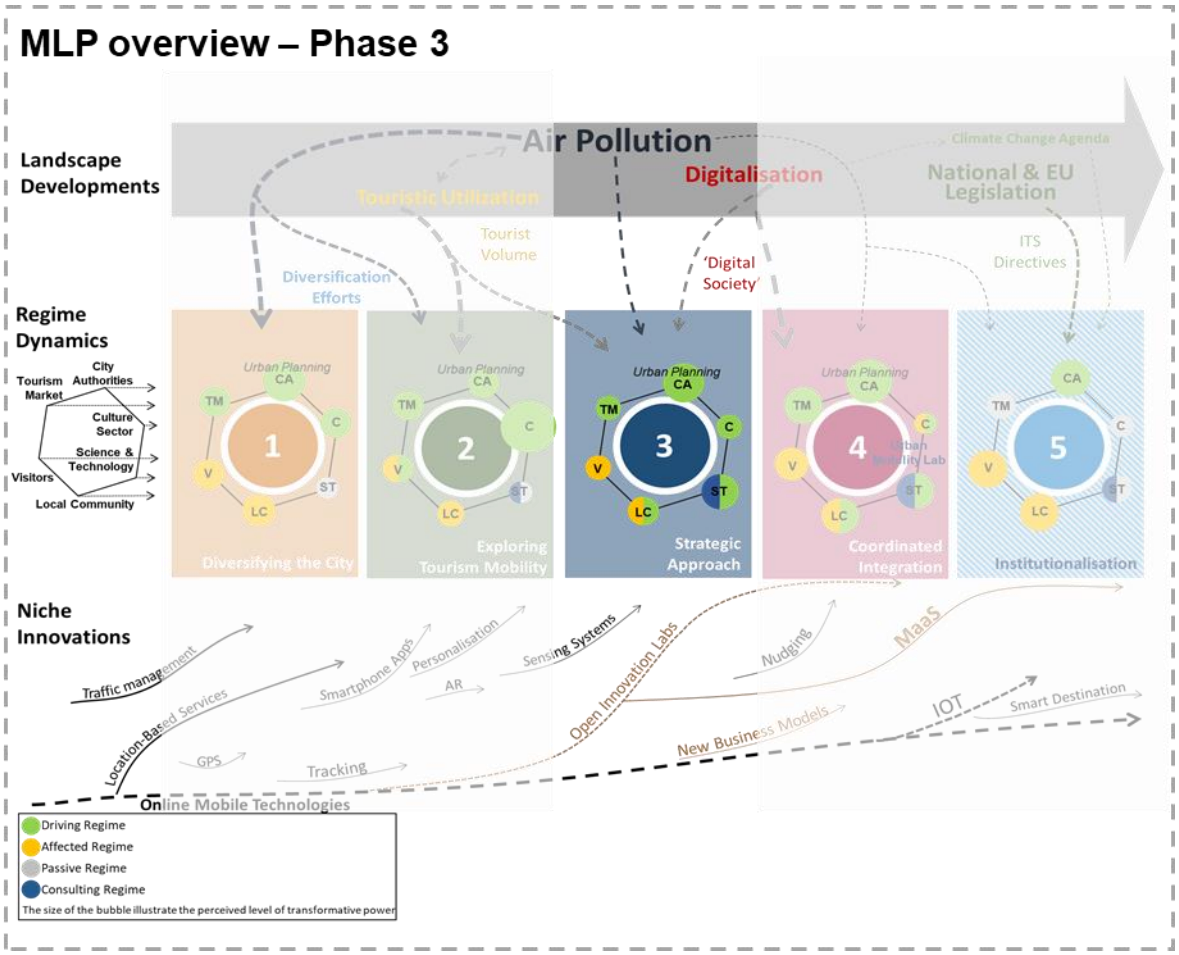

Figure 117 MLP analysis Graz – Phase 3 (Source: own illustration)

9.7.2. Integrating Findings into the Mobility Concept of the City

One of the first tourism mobility improvements of the urban infrastructure was the integration of a pedestrian guidance system launched in 2019. Discussions on the necessity of a guidance system started in 2013, but it took until 2017 for the city council to agree on the realisation of the concept. An investment of 580,000 euros (Mein Bezirk, 2018) was budgeted for the installation of information boards (see Figure 118) and signage to guide visitors and locals through the city and draw attention to important sights, as well as to convey information. The Tourism Board and the City of Graz shared the costs for

Figure 118 Information boards at the train station Graz (Mein Bezirk, 2018)

the guidance system and the upgrading of the touristic mobility infrastructure. Analogue and digital guidance tools were used, and strategically located urban furniture became an integral part of the visitor (mobility) management scheme of Graz. In addition, a roadmap for the continuous innovation of movement management was developed, including special emphasis on upgrading the sensing and tracking capabilities to enable a real-time micro-movement management system in the future (Head of Urban Planning of City of Graz, 2019).

Parallel to the launch of the guidance system, the Tourism Board also introduced an e-shuttle bus service and e-carts for guided tours. These services were inspired by the Viennese e-Old-timer tours. In addition to the e-shuttle bus, automation initiatives in the city were working on integrating automated, self-driving city shuttles planned to launch in the early 2020s.

Figure 119 E-shuttle bus in Graz (Graz Tourism, 2019a)

9.8. Touristic Traffic as a Key Challenge

Despite improvements of the micro-movement schemes for tourists within the city, Graz's overarching challenge was touristic traffic towards the city, which was still dominated by motorised individual transport and which verifiably and negatively impacted air quality.

The city government's strategic focus to lower tourism traffic impacts mainly considered gateway management, visitor parking management, and a digitally supported visitor traffic control as essential tools. These objectives were identified during the strategic discussions.

The gateway management plans for touristic traffic and the provision of visitor parking outside of the city core have only been implemented for major events and the Advent period. Based on the example of other cities, such as Salzburg, the city government started to evaluate the feasibility of a permanent, comprehensive gateway management scheme that would include the expansion of visitor parking facilities outside the city core and introducing shuttle services (such as the e-shuttle mentioned above). However, a feasibility analysis for implementing such a scheme outlined the unsuitability of this solution.

> Building these facilities is the least problem, but we need to establish a whole infrastructure around these services. […] At the moment, we are facing a conundrum. There are too many visitors with cars coming to the city centre and increasingly straining inner city road infrastructures and impacting air quality levels. But there are too few visitors coming to Graz on a daily basis to

> be able to justify large investments for gateway parking facilities and city shuttle schemes. (Head of Urban Planning - City of Graz, 2019)

Based on this reasoning, far-reaching gateway parking developments were not implemented in Graz. Instead, the city authorities revised the existing parking-management scheme and limited short-term, on-street parking possibilities for visitors even further. The focus was on directing visitor traffic towards dedicated garages in the city to control volumes of individual visitor traffic.

However, the stakeholders agreed that this intervention was not enough, and that an overall modality shift away from motorised individual transport towards an increasing use of public transport for visitors to Graz had to be the aspiration. The ‘first / last mile’ problem (EEA, 2020) was considered a key obstacle to triggering such a shift.

The first / last mile problem refers to the limited availability of mobility options offered to complete or start a journey by public transport. To address this specific issue, the urban planning department devised plans to create a multimodal transportation network within Graz. However, local actors lacked experience, and thus sought cooperation with other cities and specialised companies.

The Vienna start-up Up-stream, which had supported Graz with the development of Graz Mobile, which is based on the corresponding Vienna Mobile app, also supported Graz in the digital development and integration of a multimodal mobility platform called tim. The app provides users with information on all affiliated, available mobility services within their vicinity, including public transport, sharing, and on-demand-services (bike, scooter, e-cars, e-taxis). The app also guides the user to the next, so-called Multimodality Node (see Figure 120).

For the initial phase of the city start-up tim, the city council established three Multimodality Nodes across the city. However, unlike in other cities, such as Vienna, no commercial vehicle-sharing provider had located in Graz at this time because Graz’s multimodal and sharing market was considered too small to be lucrative. Thus, the City of Graz decided to provide

Figure 120 'Multimodal Node' Graz (KDZ, 2020)

vehicles to implement a multimodal service in the city and expanded the public transport service with an e-car fleet and bicycles meant for sharing.

The service was well adopted and had a rapidly growing usage rate. In 2020, the 10th Multimodality Node was installed, and the scheme was expanded into the region around Graz as Regio-tim. However, the business model of tim was based on a membership scheme with a one-time registration fee and different payment schemes for the usage of the services. Therefore, tim was mainly attractive for young and elderly locals without cars. The initial idea of the city government to start a cooperation with national and federal public transport providers, and thus make tim an attractive solution for visitors to Graz, was considered unfeasible at the early stage. The city's capacity to provide sharing vehicles was limited, and the membership scheme was considered a control mechanism to manage demand for multimodal services. For a large roll-out of tim, a significant scaling-up of multimodal transport facilities and vehicles was necessary. With the introduction of tim, a certain shift of urban mobility behaviour among locals and visitors was evident, which also attracted small, innovative companies and start-ups to provide sharing solutions, such as bike and scooter sharing. However, because tim was provided by the City of Graz, the technical and organisational setup was incapable of incorporating external, individual mobility, or transport providers.

> The idea to use tim for tourists was always in the room, and actually also a target when we designed tim. […] we always considered it as the solution to our 'last mile' problem, so that we can finally also trigger a modality shift among our visitors. […] But for such a large-scale introduction of a multimodal mobility system, the capacities and also the business structure of tim is not suitable. Therefore, we formed a dedicated steering group, with relevant persons from Graz Holding [as representatives of Graz Mobile], the mobility section of the federal state of Styria, the Transport Association Styria, and the regional management of the central region Graz. This committee took the decision to upgrade the existing mobility system and introduce a MaaS network in Graz. (Head of Urban Planning of City of Graz, 2019)

9.9. Mobility as a Service as Innovation Enabler

The MaaS idea was considered a promising approach to trigger a long-term mobility shift of all kinds of travellers, from individual transport to a low-emission mix of public, shared, and on-demand transport. However, to implement a functioning MaaS network, a range of innovation activities had to occur, including the setting-up of a MaaS ecosystem, which requires the introduction and implementation of technical architecture based on harmonised technical standards and interfaces to enable the technical linkage of services. Furthermore,

the development of an organisational architecture to enable the collaboration of the actors involved becomes necessary. Amendments to regulatory and policy frameworks were also considered inevitable by the stakeholders to provide a foundation for a durable and sustainable adoption of a MaaS service (Head of Urban Planning of City of Graz, 2019; CEO - Smart City Graz, 2019). In addition, the MaaS ecosystem had to be easily scalable to enable a low-threshold expansion of the MaaS network across providers, services, and borders.

Graz became involved in national and EU-funded innovation projects (Karlsson et al., 2017). In a first step, Graz's suitability to develop a MaaS service was assessed (IZT, 2018). Furthermore, the city used the national MaaS initiative 'MaaS made in Austria' (MaaS miA; (AustriaTech, 2019) and national ITS development plans (ITS Austria, 2018) as sources to obtain knowledge on the overarching conceptualisation and regulatory indications of MaaS, but also on the technical frameworks to develop a MaaS ecosystem.

At the time of this study, the city had just devised its strategic approach to implement a MaaS ecosystem (IZT, 2018). Within this strategy, the city council was considered the most suitable lead actor to coordinate the implementation of MaaS in Graz. The MaaS network was designed as a platform that integrates all necessary data on affiliated transport providers via dedicated interfaces. The existing Graz Mobile app was chosen as the front end for the MaaS service. Overall, the MaaS service has a modular structure that enabled a continuous adaptation and expansion of the scope and features of services, but also the integration of a wider range of mobility modes and a diversification of target / user groups of the service. Furthermore, the modular structure enabled the integration of 'special-purpose mobilities' into the ecosystem, such as tourism mobility modules that consist of a specially designed service and mobility feature structure (e.g. 'last mile' focus services), a dedicated tariff structure, and the potential for linkages with the services of third parties.

However, insights from the first MaaS implementation in Graz indicate the identification of a suitable business model was a key challenge due to the highly heterogenic character of collaborating businesses and organisations. The technical development of the MaaS platform also faced issues regarding data sovereignty and trust, because data had to be integrated into the MaaS platform. In addition, highly divergent data quality and data formats emerged as another key challenge for integrating the necessary transport data into the MaaS platform.

In addition, strategic considerations also highlighted the inevitability of introducing push-and-pull factors that would trigger the desired mobility mode shift of travellers. Sanctioning schemes for individual transport (e.g. cars) to drive in Graz had to be significantly enhanced, and strategic alliances with national and federal public transport providers and automobile clubs, travel agencies, and bicycle associations were considered crucial factors.

Based on these insights, the actors involved decided to launch a MaaS test-and-experimentation platform in the UML to develop and refine Graz's MaaS approach prior to large-scale implementation. The UML also joined MaaS projects, such as ULTIMO (UML, 2019), to attain more know-how on MaaS through an active experience exchange with other European cities.

In addition to R&D activities to create a functioning and user-friendly MaaS service, the city government started to promote MaaS as a mobility solution of the future to trigger a rethinking among different travellers coming to or moving within Graz.

> With MaaS, mobility modes are merging. If we do it right, we have the chance to make it attractive for people to use the lower-emission modes of the MaaS service. […] But simply introducing nice apps and fancy-looking shared bikes in the city will not do the trick. We need to engage everybody to join us on the journey towards a lifestyle shift. (CEO - Mobility Research Graz, 2019)

As summarised in the MLP analysis, the fourth phase focused on the coordinated integration of developed solutions and devised strategical approaches. Thus, the innovation process was highly focused on scaling-up and transferring innovative solutions from an experimental environment into the live city environment. The activities of this phase also clearly highlight the strong interlinkage and embeddedness of the tourism mobility system within the overall city (mobility) system (e.g. MaaS).

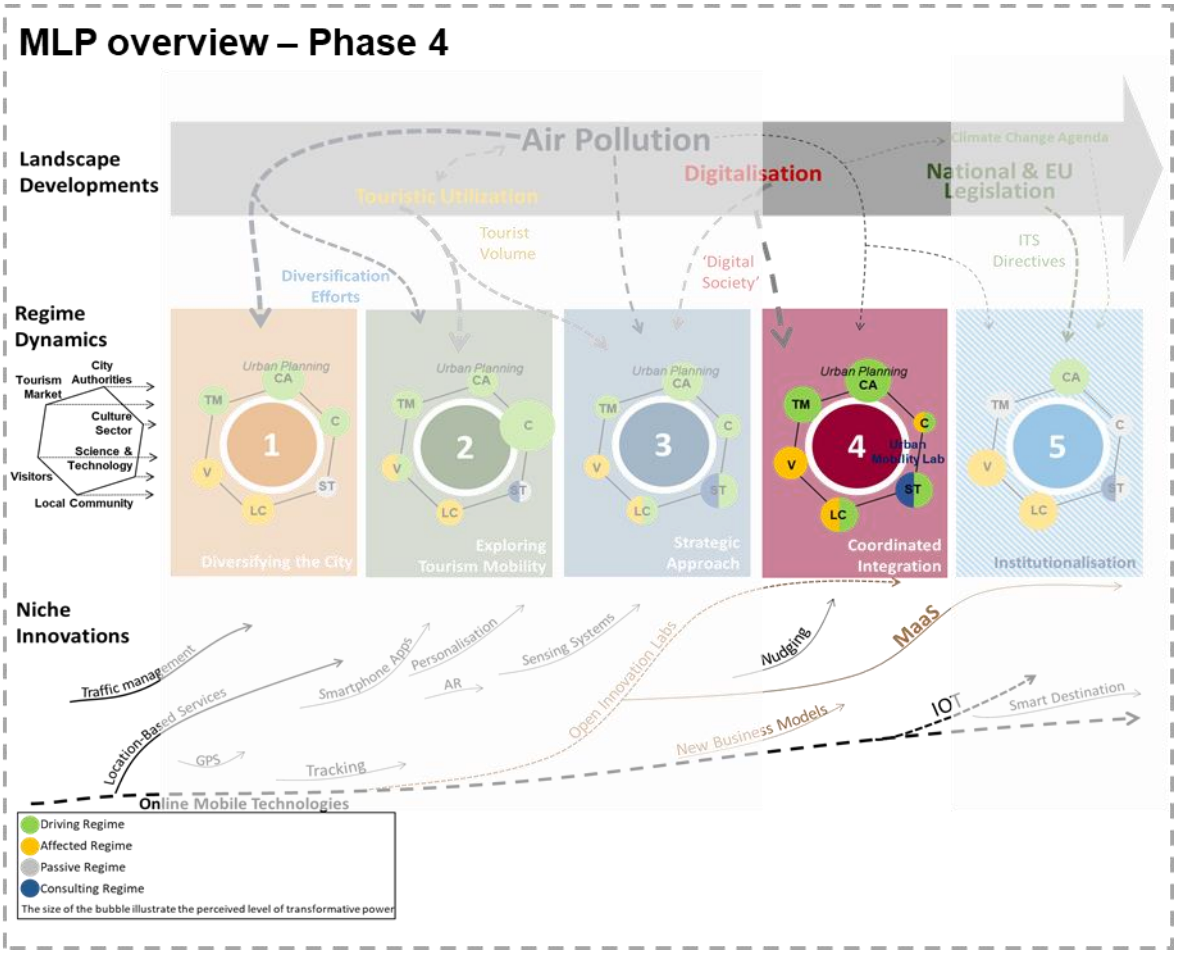

Figure 121 MLP analysis Graz – Phase 4 (Source: own illustration)

9.9.1. Mobility as a Service and Right

The vision of the MaaS developers in Graz was that, with a functioning MaaS service in place, the purpose of the journey was also losing importance: “In a MaaS world, a traveller is a traveller. And each traveller will have the same right of mobility” (Head of Urban Planning of City of Graz, 2019).

Based on this maxim, the city launched the ‘Mobility as a Right’ campaign. This campaign was meant to emphasise the city government’s awareness of its responsibility to provide a suitable mobility solution for each user of the built environment, no matter whether citizen, visitor, student, or other.

> At the moment it is only a campaign, but it is our plan to integrate the ‘Right for Mobility’ in our city constitution, as the first city in Europe. […] The essence of this ‘right’ is that Graz is working on the improvement of its mobility infrastructure to provide everybody with eco-friendly solutions for their mobility needs, without the need to own a vehicle. (Head of Urban Planning of City of Graz, 2019)

The ‘right for mobility’ was proposed as a new city vision to be integrated into the revised urban development and traffic management concepts of the city. Within the ‘right for mobility’, the provision of seamless and easily accessible touristic mobility solutions was included, with a special focus on the provision of affordable and easily accessible, multimodal public transport options for the ‘last / first mile’.

To highlight the relevance of mobility innovation in Graz, the city council proposed integrating the commitment to strive for the continuous innovation of Graz’s mobility system in its city constitution. At the time of the interviews, the city council was evaluating the feasibility of incorporating a regulatory innovation of the mobility system based on the national ITS law “for the provision of intelligent traffic systems in road traffic and for interfaces to other transport systems” (National Councial, 2010b). This regulatory commitment would cover not only the constant upgrading and innovation of the physical mobility infrastructures of the city region, but also the enhancement of digital solutions, ranging from implementing intelligent traffic management, to the provision of seamless journey planning, and the provision of a continuously evolving MaaS service.

Figure 122 summarises the activities of this phase. However, due to the very early stage of this phase at the time of the study, only the initial triggers for the institutionalisation of relevant aspects and innovation tendencies could be identified.

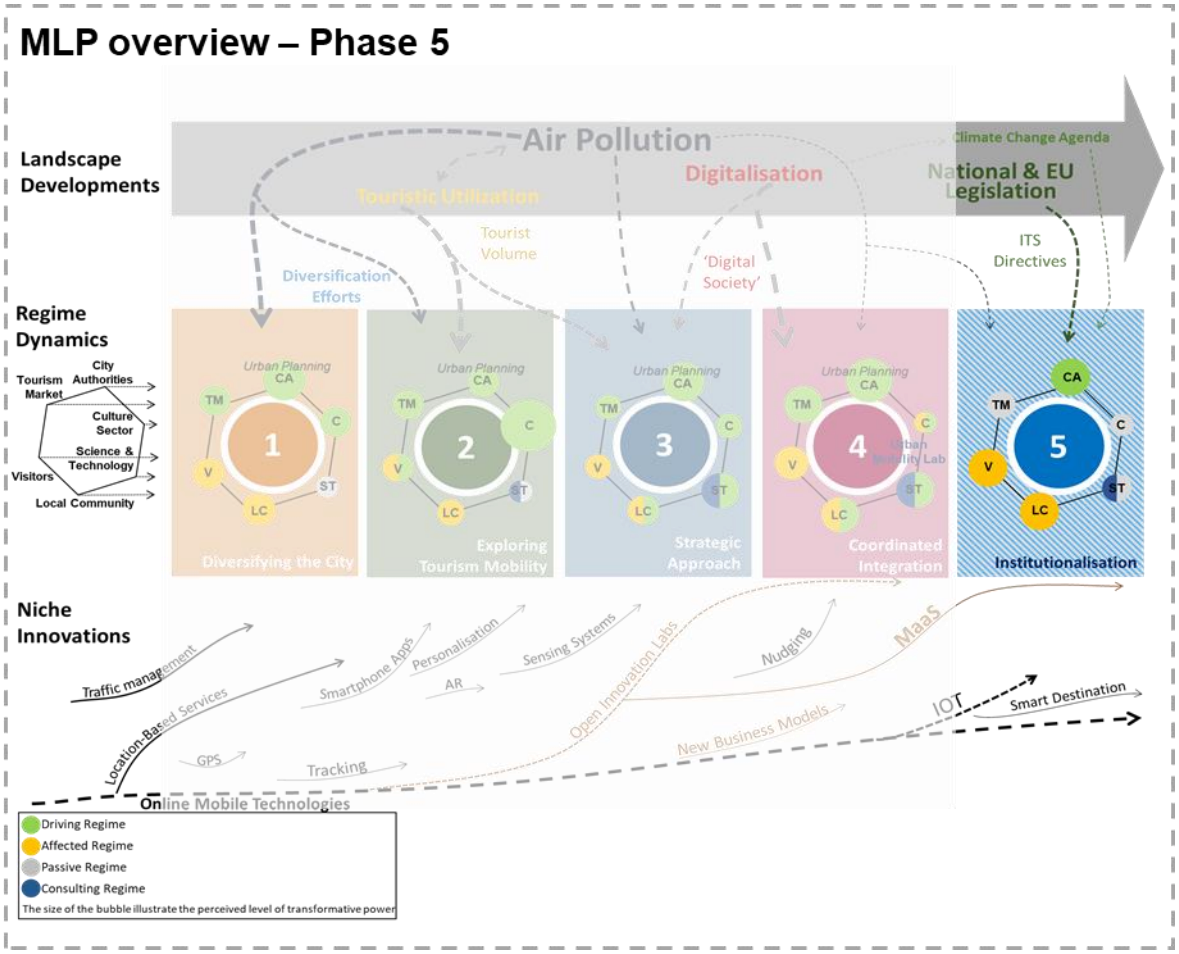

Figure 122 MLP analysis Graz – Phase 5 (Source: own illustration)

9.10. A Multi-Level Perspective on Graz's Tourism Mobility Innovation Path

The MLP of Graz's tourism mobility system innovation pathway resembles, to a certain extent, the Eco-City pathway (Marletto, 2014) in the literature (see Section 3.3.5) and describes a planned innovation pathway based on the actors' vision for change.

Graz's actors pursued a vision to establish a more eco-friendly city utilisation focused on using the city's touristic potential. This diversification of Graz was the trigger for the emergence of tourism mobility and its relevance for a sustainable city management. The impact of touristic traffic was underestimated by the incumbent actors, and thus largely neglected in the city's diversification strategy. However, due to Graz's fragile air quality levels, the significant impacts and extent of emissions produced by touristic movement became quickly apparent.

The multi-level analysis showed that actors reacted to the imminent pressures emerging from the effects of touristic traffic on the city's air quality by utilising regime-internal resources. Graz's cultural sector took the lead in the exploration phase of the innovation path and introduced a diverse range of schemes to understand and introduce touristic movement

management measures in the city. Graz's appointment as Cultural Capital and Design City provided additional resources to explore and innovate urban and touristic mobility within a cultural context.

Despite this unconventional shift of lead actors, the incumbent regime pursued a balanced and dynamically stable change process of the tourism mobility system. The key findings of the exploration phase highlighted the interwovenness of diverse mobility systems within the city and the strong linkage to external mobility systems. These findings revealed that the mere innovation of one mobility system, such as tourism mobility, were not enough to develop a low-impact mobility system in Graz.

When the science and technology regime took over the steering of the innovation activities, the direction shifted towards a holistic approach to develop a MaaS system in which all mobility forms in the city would be incorporated and attuned, and the mobility system leading to the city would also be linked.

The overall innovation path of Graz's tourism mobility system involved highly target-orientated and stable transformation dynamics. In particular, appointing a regime actor who was most suited and capable of driving the individual innovation phases ensured highly effective and stable innovation. Thus, the overall innovation path of Graz's tourism mobility system can be considered as 'Harmonised Transformation'.

It will be highly interesting to continue observing Graz's innovation path to introduce the aspired MaaS service in the city because MaaS systems are highly heterogenic and require 'out-of-the-box' approaches to find a suitable organisation architecture and business model to collaborate with.

Innovation Phases		Pathway	Phase Specifics
Phase 1	Diversifying the City	**Harmonised Transformation** Incumbent actors reacted to the emerging pressure on socio-technical systems and developed a vision for a new, innovated system setup. A vision-led innovation pathway was pursued, and regime	The diversification efforts towards a stronger touristic use of the historic city build the foundation for tourism mobility in Graz.
Phase 2	Exploring Tourism Mobility		The negative impact of tourism mobility became measurable. The cultural sector had sufficient funds to explore touristic movement and mobility, and thus took the lead.
Phase 3	Strategic Approach		A science and technology regime took the lead to explore the capabilities of OMTs to enhance mobility management. The need to innovate

		actors reacted to emerging deviations or obstacles via a harmonised shift of the most capable lead regime actors to ensure continuous innovation progress.	the holistic mobility system to ensure low environment impacts was established.
Phase 4	Coordinated Integration		OMT-enhanced mobility management solutions were introduced, and the first version of a digitally enhanced, linked-mobility service was established
Phase 5	Institutionalisation		Based on this initial, linked-mobility service and influenced by EU and national regulations, the development of a multimodal, linked MaaS service began to be developed.

Table 19 Innovation pathway – Graz tourism mobility system (Source: own illustration)

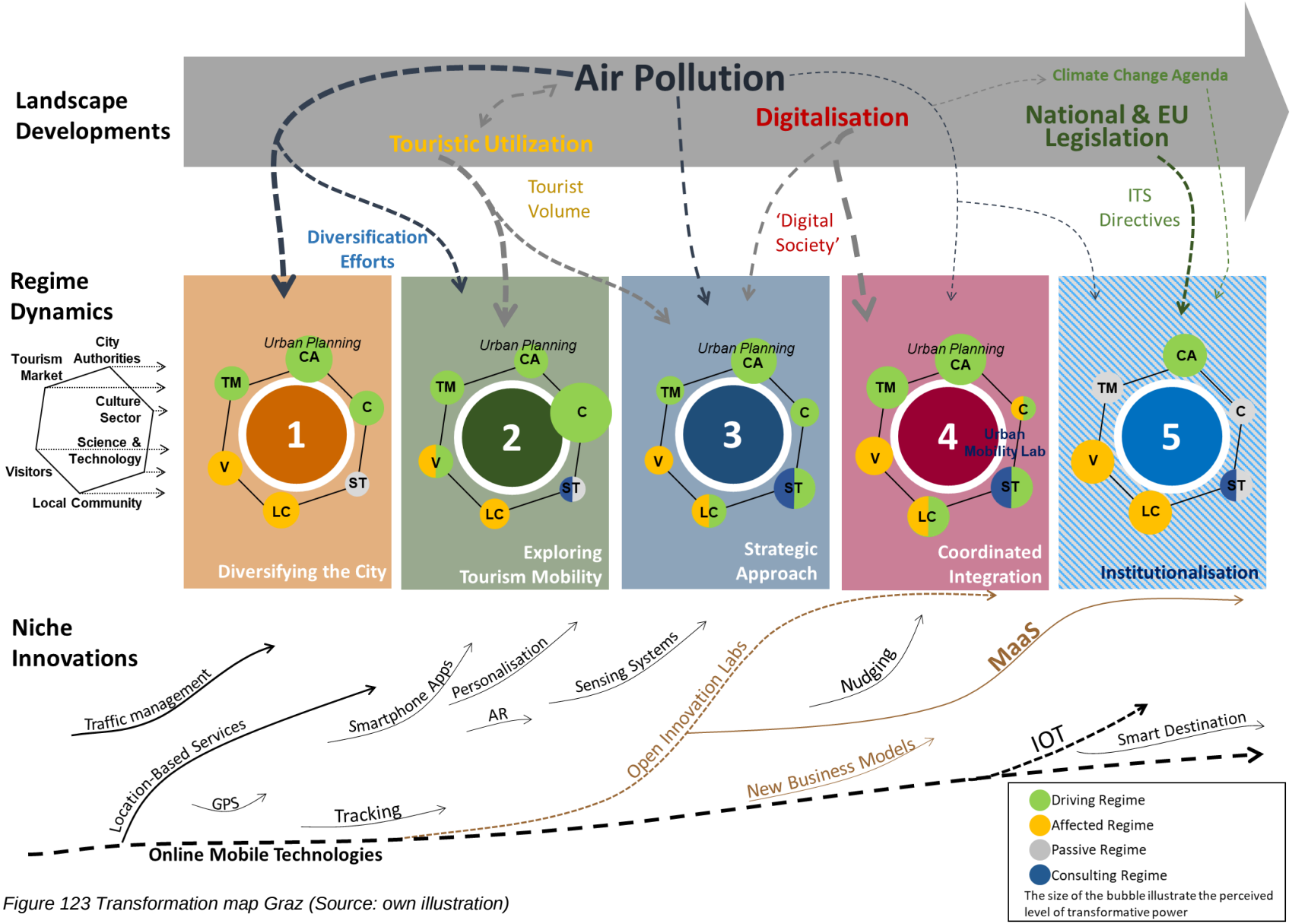

Figure 123 Transformation map Graz (Source: own illustration)

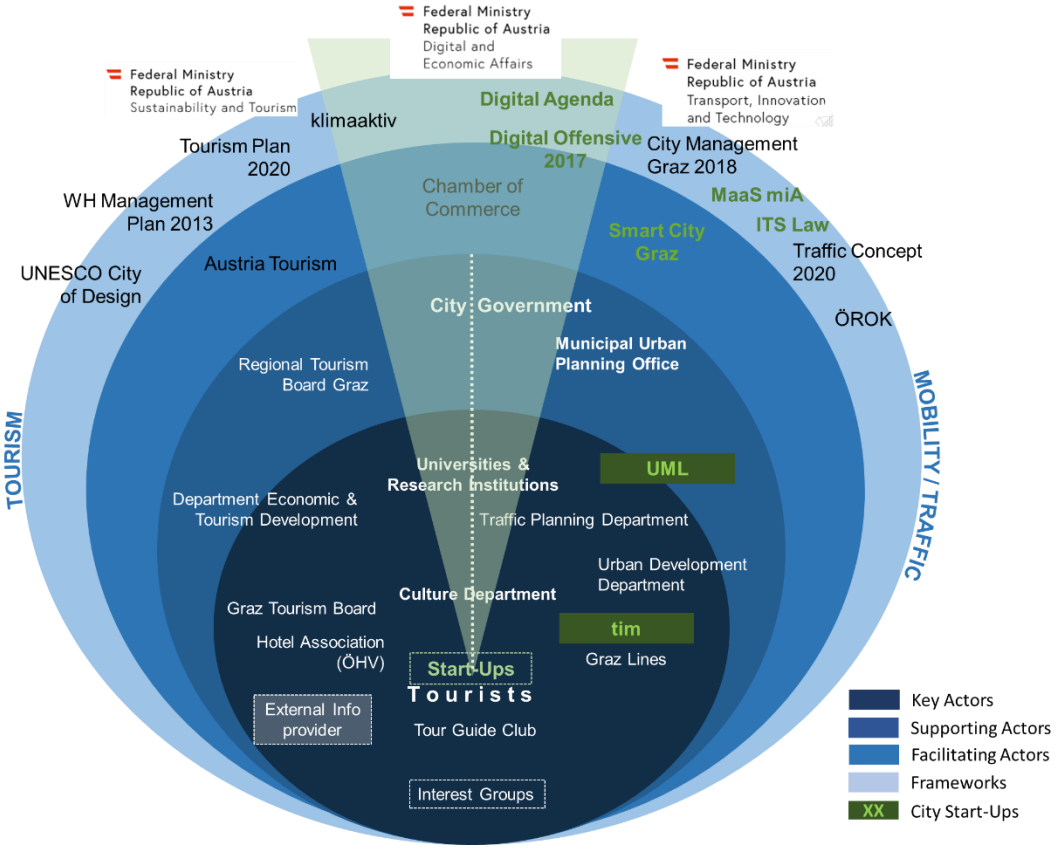

Figure 124 Innovated tourism mobility stakeholder structure Graz (Source: own illustration)

10. The Innovation Path of Tourism Mobility Systems

The above case studies and the scoping study on the current state of tourism mobility systems in European UNESCO World Heritage Cities revealed that tourism mobility systems are an essential socio-technical sub-system within contemporary destination systems. Tourism mobility systems are shaped by, and strongly shape, local environments, but also innovation processes in tourist-historic cities.

The MLP analyses proved to be a valuable tool to not only gain an initial understanding of the stakeholder setup for tourism mobility systems, but also provided an overview of the external factors shaping the configuration and the innovation of contemporary tourism mobility systems. This holistic and heuristic approach to analysing tourism mobility systems in increasingly digitalising tourist-historic cities enabled the identification of general innovation processes and dynamics. The case cities were a heterogenic set of tourism mobility systems in Austria but still displayed comparable and reoccurring innovation phases that match the initial findings of the scoping study. This finding took the discussion of innovation phases and their dynamics within tourism mobility systems in tourist-historic cities to a more general level.

In this chapter, this general discussion regarding overarching innovation phases of tourism mobility systems in European historic cities is conducted and the key output of this thesis, namely an innovation phase model (IPM) of tourism mobility systems (see Figure 126), is provided. For a detailed understanding of the individual, generalised innovation phases, identified key characteristics of each phase are analysed (see Section 10.4). This general innovation phase model is designed to be transferred to other destinations to better understand local tourism mobility systems, their innovation status as well as innovation processes.

Prior to the discussion of the IPM, a conceptual discussion and paradigmatic viewpoints on tourism mobility are provided (see Section 10.1) which constitute the theoretical foundation for the innovation phase model. Furthermore, a generalised perspective on the system actor configuration and stakeholder setup of tourism mobility systems is outlined (see Section 10.2). The system actor configuration provides an overview of all identified actors involved in tourism mobility systems and thus, illustrates the highly cross-sectoral character of tourism mobility. It is essential to first comprehend the actor structure of tourism mobility systems, before discussing innovation processes of tourism mobility.

10.1. Conceptualising Tourism Mobility

One of the fundamental contributions of this study is the discourse on the relevance of tourism mobility as a form of mobility (Coles, Hall and Duval, 2005). The findings highlight the significance of tourism mobility within a destination's mobility system, but also illustrate the shifting role and character of tourism mobility in the age of digital transformation. Sheller and Urry's (2006, p. 212) paradigmatic perception of mobility, which describes it as being shaped by "immobile infrastructures that organise the intermittent flow of people, information, and image as well as the borders or 'gates' that limit change and regulate movement or anticipate movement", was also clearly confirmed for tourism mobility. In particular, the relevance of immobile infrastructures and the role of gateways as a key tool for enabling, limiting, or steering touristic movement within historic cites became apparent. In addition, the conveyance of information was repeatedly confirmed as a core aspect, interlinking tangible and intangible elements of the tourism mobility systems.

However, the insights from this study also provided novel perspectives on the effects of the increasing digitalisation of touristic mobility. In particular, OMTs and the possibilities to communicate ubiquitously with 'connected' visitors raise the significance and potential of information from a mere regulating tool to a novel form of infrastructure that shapes and organises movement. These changes were especially reflected in the need for local stakeholders to create digital infrastructures that comprise not only computation and data transmission capabilities and facilities, but also require local actors to develop novel skillsets to provide and make use of digital infrastructures, as well as to find suitable collaboration structures.

In the literature review, the isolated character of tourism and mobility was thematised (see Section 2.2). It was argued that the tourism sector perceives transport as a logical prerequisite rather than an integral part of the touristic utilisation of a destination which needs to be carefully planed and continuously upgraded (Scuttari, Lucia and Martini, 2013b), whereas the transport sector commonly neglects touristic movement in local mobility plans or strategies (Lew and McKercher, 2006). In the scoping study (see Chapter 5) and the case studies of the Austrian cities (see Chapters 7, 8, and 9), these statements were confirmed. Furthermore, in the early stages of the digital transformation of the case cities, the lack of cooperation and coordination of activities between the individual sectors largely dominated the innovation processes. However, the findings demonstrated that, with increasing digitalisation, a cross-sectoral and harmonised collaboration became necessary to allow innovation to continue.

Overall, the cross-sectoral character of tourism mobility is a key obstacle for a structured integration of tourism mobility into existing city and mobility systems. Even in cities such as

Salzburg, which displayed a highly unstructured and ‘unbalanced’ innovation path, the emergence of joint tourism mobility structures could be identified. Throughout, the findings of the study support Sheller and Urry’s (2016) argument that with the growing digitalisation of all aspects of our world, the strict delimitations among systems, sectors, and their responsibilities are blurring, and cross-sectoral objectives, such as tourism mobility, have a chance to break through and (re)position themselves within shifting mobility systems.

In addition to this paradigmatic window of opportunity for tourism mobility, digitalisation developments are another factor facilitating the breakthrough of tourism mobility within management and planning frameworks, as well as at policy level. In particular, the unprecedented and rapidly evolving technical capabilities to capture not only the macro-movement, but also the micro-movement of individuals on-the-go in built environments, is considered key for introducing an effective and fine-tuned tourism mobility management capable of easing the growing touristic pressures on the sites. However, the findings of this study also revealed that the digitalisation and digital transformation of tourism mobility systems were nascent, and tourist-historic towns displayed very different levels of innovation (see Section 10.3).

10.2. Tourism Mobility System Actor Configuration

Based on socio-technical system theory (Geels, 2002) (see Section 3.2) and the findings of the scoping study and case studies, the structure and setup of tourism mobility systems were analysed. Figure 125 illustrates the production and consumption elements (Geels, 2002) identified as comprising the socio-technical system of tourism mobility. Elements that evolved due to digitalisation developments are marked in green. Due to the cross-sectoral character of tourism mobility, the production side has a highly heterogenic character. Digitalisation dynamics shape not only the mobility and tourism elements of the socio-technical system, but the novel digital elements are also continuously integrated into the system. Management and governance elements dominate the steering of the innovation of the system. However, the case studies highlighted that the balance and harmonisation among all the elements involved are crucial for a functioning operation and innovation.

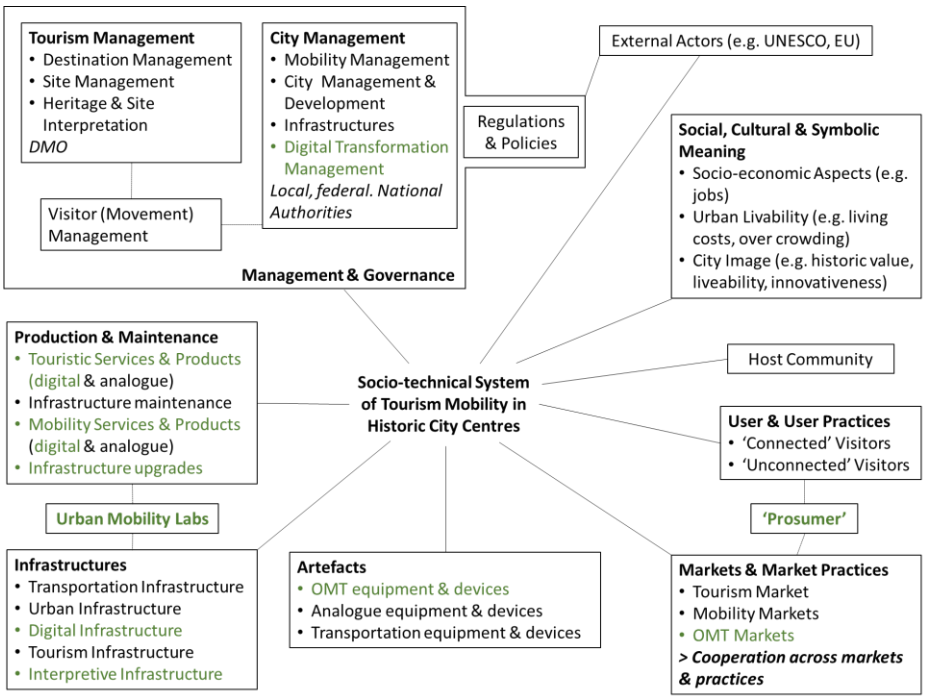

Figure 125 Socio-technical system of tourism mobility (Source: own illustration)

Specific elements of digitalisation complement the existing socio-technical system but also create new 'test spaces', such as urban labs. These test spaces are necessary to compensate for the lack of experience and know-how and enable experimentation to find or integrate niche innovations in a protected yet real-life environment. On the consumption side, the provision of digital spaces for 'prosumers' follows a similar approach, namely, to generate real-life comments on novel solutions from users and reserve the possibility to adapt solutions and co-create optimised solutions with input from customers.

The multidimensional (tourism, mobility, digitalisation) character of this socio-technical system makes innovation processes highly heterogenic. However, the case studies revealed that, despite very different starting situations and touristic utilisation in the case cities, similar innovation phases could be identified.

10.3. A Multi-Level Perspective on the Innovation of Tourism Mobility

In the first empirical part of the thesis, which analysed the European tourist-historic cities (see Chapter 5), the overall status of contemporary tourism mobility systems was established for this sample. The analysis provided valuable insights and highlighted that existing tourism mobility systems are subject to enormous change dynamics and often lack viable approaches to accommodate these emerging, pressure-induced changes.

As outlined in the literature review, globalisation, digitalisation, and sustainability issues are considered key pressures that trigger change in touristic movement (see Section 2.11.2). The case studies confirmed these initial findings and highlighted such pressures were not only the key triggers for changes, but also strongly shaped innovation processes, directions, and dynamics among system actors at regime level. This 'power' of pressures to create, shape, and steer innovation (see Section 10.3.1) has been little investigated in the literature. In addition, the study found that pressures had the potential to influence developments directly at niche level, and thus shape innovation from two levels – the landscape and the niche.

10.3.1. The 'Power' of Pressures

The analytical parts of the scoping study and the case studies indicated that contemporary tourism mobility systems within European historic cities are subject to a range of similar pressures. However, each case city also faced very site-specific challenges that impacted the innovation of the local tourism mobility system. In the following paragraphs, the key challenges identified are summarised.

(Over)Touristic utilisation

The majority of interviewees considered the number of tourists and visitors arriving at and exploring a site to be the most direct and significant factor creating pressures on local environments. Although the discussion regarding carrying capacity is not new (Price, 1999; Straaten, Borg and Trumbic, 2001), this study discussed carrying capacity issues under the lens of the 'moving masses'. In particular, the case of Salzburg illustrated severe impacts of touristic movement on the urban living environment, infrastructure, traffic, public transport, and inner-city walking areas. The cases demonstrated that sanctioning the mobility or number of moving tourists was considered the most effective way to ease the pressures triggered by the touristic 'over-use' of a site. Although no 'over-touristic' situation was identified in Vienna and Graz, insights from local stakeholders revealed that considerations regarding acceptable levels of touristic utilisation were omnipresent, and the fine line between touristic utilisation being sustainable or harmful to the built and living environment were well recognised. The role of tourism mobility within this debate was generally limited to tourism mobility management as a tool to limit or (re)direct moving visitors, with the main focus being to allow the maximum touristic utilisation of a site while minimising the impacts from tourism. However, the findings also suggest that the mere utilisation of digital innovations, such as tour guide apps, only has a small effect once the 'over-touristic' utilisation of a site prevails.

Digitalisation of the system

Digitalisation was also identified as a further landscape pressure in all the case cities and in the scoping study. Digitalisation-induced pressures commonly concerned the perceived (or actual) need of a destination to upgrade digitally its interpretation and guiding features of the site to stay attractive, and thus competitive, for the rapidly growing number of 'connected' visitors. Throughout the literature, the inevitability digitalising (eventually) the destination's interpretation and communication channels with visitors is evident (see Section 2.10.2). The findings of the scoping and case studies support the literature and the drivers behind these digitalisation developments, which mainly refer to the 'spill-over' effects of an increasingly digitalised society (Mackay and Vogt, 2012). However, the findings also found that the pressure to digitalise the local tourism mobility system is strongly interlinked with the pressure discussed above – over-tourism. The higher the pressures from the touristic utilisation of a site, the more local actors commonly perceive the pressure to drive the digitalisation of the local system. Thus, the perceived need to digitalise local tourism mobility systems is founded on the actors' focus to keep the site attractive and competitive, but also to utilise novel technologies to ease the effects of other pressures on the local system.

Both these pressures commonly emerged at an early stage in the innovation path of tourism mobility systems. At this stage, system actors commonly lacked experience and know-how regarding these novel, digital tools, and thus pursued a relatively uncoordinated trial-and-error approach to utilise these tools in the existing systems. Although the importance of skills and knowledge of how to digitalise an existing system is well known in the literature (see Section 2.10.4), the findings of both the scoping and the case studies revealed that local actors considered the acquisition of these 'resources' as the most challenging aspect. Each case city experienced this phase of uncoordinated utilisation of new digital tools to gain experience and a deeper understanding of them. Further research is necessary to understand the reasons impeding the transfer of know-how and skills to digitalise tourism mobility systems between cities or sites. Although in the case of Graz, some transfer of know-how from Vienna was identified, this was only utilised because the same system actor was involved in the innovation processes of both cities. Transferring know-how and experience exchange between actor groups could not be identified in the other case studies.

Volatile visitors

However, when a tourism mobility system was at a more advanced innovation stage and had introduced a range of digitally enhanced guiding and interpretation tools, another type of digitalisation effort became apparent. Once 'connected' visitors had ubiquitous access to a wide range of digital information while exploring the site, they started to display highly volatile, ad-hoc decision-making and movement behaviour (e.g. see Vienna in Section 7.8.1).

Digitally induced volatile behaviour of 'connected' visitors is well discussed in the literature (Paulson, 2017; Dickinson et al., 2012) and is often related to the 'spill-over' effects of digitalisation (see Section 2.10.2). However, in the context of this study, the severity and extent of such ad-hoc decision-making and volatile movement behaviour within tourism mobility systems became even more apparent. The findings indicate these effects placed significant pressures on local actors and the existing visitor management and control mechanisms of the tourism mobility system. In some cases, digitally enhanced communication methods were even perceived to create 'unmanageable' visitors, and thus made existing visitor-management strategies largely obsolete.

Although these effects did not directly emerge at landscape level, but stemmed from within the innovation process, they significantly challenged the overall innovation pathway of tourism mobility systems. At the time of the study, no effective approach to deal with this significant side-pressure of digitalisation developments could be identified within the case cities. This is ascribed to the market-driven nature of information provision to 'connected' visitors, which was not attuned with local management strategies. The lack of technical capabilities to generate, analyse, and strategically use sufficient data from moving visitors onsite also hindered the enhancement of local micro-mobility management strategies.

In the literature although, methods to track, trace, or sense moving visitors at sites (see Section 2.10.1) are discussed, in practice the 'unmeasurability' of tourism mobility and touristic micro-movement still prevails (see also Section 2.10.2). The findings revealed that the inability to put a figure on touristic movement also slowed the innovation of the overall tourism mobility systems.

Environmental impacts of touristic mobility

The case study of Graz identified not only another landscape pressure shaping the innovation pathway of the local tourism mobility system, namely the environmental pressures caused by excessive CO_2 emission levels, but it also addressed the challenge of measuring and illustrating the impact of touristic mobility and traffic.

Due to the fragile air quality situation in Graz, only small deviations in pollution caused noticeable changes to Graz's air quality. This circumstance made it possible to put a figure on local touristic traffic in the city region and enabled the identification of the severe cumulative impact of individual, touristic traffic (see Section 9.2) on the local air quality environment.

Based on this tangible measure of touristic mobility, increasing policy-led pressures to integrate eco-friendly and low-carbon objectives into innovation efforts of tourism mobility systems emerged. In Graz, these pressures were considered 'positive' pressures to develop a sustainable city system. Nevertheless, for the actors involved, the increasing pressures from national and supranational authorities to create low-carbon (e.g. Climate-Change Agenda) and intelligent transport and traffic systems (e.g. ITS law) presented a resource-intensive challenge.

In this study, policy-led pressures only emerged at a late stage of the innovation process. This late appearance was usually not caused by system-internal innovation processes, but predominantly had external roots because both the climate-change agendas and ITS objectives only became relevant for the local and regional levels at the end of the 2010s to early 2020s. Therefore, tourism mobility systems, which began their innovation process in the 2020s, were very likely to face policy pressure at a much earlier innovation stage. As outlined in the literature review (see Section 2.10.4), academic discussions on governance and policy-related issues relevant for the innovation processes of (tourism) mobility systems are scarce. This study provides the first insights into this theme and identified that policy-related aspects constitute a landscape pressure with the potential to shape the innovation process of tourism mobility systems. However, the findings also reveal that regime-internal pressures emerged that required existing policies and governance structures to be adapted. Policy innovation act as pressures for changing the system, but a continuous adaptation of internal system policies and their supporting structures is required to maintain change and enable innovation.

In Table 20, the pressures identified above and their perceived intensity regarding the innovation pathways of the individual case cities are summarised.

	Pressure	Intensity	Site
General Pressures	Number of tourists	Medium ↗	Vienna
		Strong ↗	Salzburg
		Medium ↗	Graz
	Digitalisation to stay competitive	Medium →	Vienna
		Medium →	Salzburg
		Low ↗	Graz
	Digitalisation-induced change of visitor (mobility) behaviour	Strong ↗	Vienna
		Strong →	Salzburg
		Medium ↗	Graz
		Medium ↗	Vienna

	Pressures from policy level – Climate-change agendas	Low	Salzburg
		Strong →	Graz
	Pressures from policy level to innovate mobility system	Strong →	Vienna
		Low →	Salzburg
		Strong ↗	Graz
Site-specific Pressures	Urbanisation	Low →	Vienna
	Social pressures caused by over-tourism	Strong ↗	Salzburg
	Air pollution	Strong →	Graz

Table 20 Summary of pressures in case cities (Source: own illustration)

As discussed in the previous section, pressures not only impact and shape the innovation directions and dynamics at regime level, but also possess the 'power' to influence developments at niche level (Geels and Schot, 2007).

When social pressures in Salzburg regarding easing the 'over-touristic' situation within the city became too much to resist, the actors involved transferred these pressures to the niche level and pushed niche actors to find digital solutions to allow for touristic exploitation but ease the impacts of touristic movement. As the case study showed, this transfer of pressures was unsuccessful, and considered by some to be an "unsustainable evasion manoeuvre of responsible actors to make tough decisions" (City Forum Graz, 2019). Nevertheless, this transfer of pressures impacted the niche level and fostered the creation of an incubator for start-ups and new business ideas to mature.

10.3.2. The 'Power' of Niche Innovations

In addition to this very specific niche development of Salzburg, common trends were also evident at niche level. Overall, the emergence of perceived 'game-changer' technologies (Sheller and Urry, 2006; Dickinson et al., 2012) dominated the initial innovation phases of tourism mobility systems. The exploitation of novel digital OMT solutions to increase the touristic utilisation of sites was predominant. These niche innovations mainly focused on the digital enhancement of guidance and site interpretation, as well as on the personalisation and provision of ubiquitous information for walking visitors, and mainly concerned the increasing utilisation of smartphones. These efforts were predominantly market orientated, and no coordination with management organisations or local authorities was pursued. Thus, no significant benefits of novel technical innovations for tourism mobility management evolved.

A much smaller share of developments at niche level focused on enhancing the generation and analysis of location-sensitive data from OMTs. As also outlined in the literature (see

Section 2.10.4), technical solutions to generate data on touristic movement also evolved at niche level; however, only a few of these solutions were used by the regime level. The science and research sector mainly tested the usability of some novel solutions for tourism mobility purposes (Ratti et al., 2007; Girardin et al., 2008). Although it is widely accepted in the literature and in practice (see Section 2.10) that new technical solutions to comprehensively track and sense micro-mobility patterns of visitors in the destinations are crucial for the enhancement of mobility management (Scuttari, 2019; Albrecht, 2017), few developments with this focus could be identified at niche level in the case studies. The findings of the study indicate that developments at niche level are very much market orientated (regime level) and influenced by landscape pressures.

The case studies also revealed that many novel applications and tools commonly evolved in an isolated and uncoordinated manner at niche level. Furthermore, after their breakthrough into the regime level, hardly any linkages between the individual innovations were created. However, digitalisation effects on societies created 'connected' visitors who were increasingly requesting a 'one-stop shop' and easy access to multi-app services. To close these gaps, business models and organisational approaches started to develop also at niche level. These developments were, however, very new and in a relatively immature state at the time of the study; thus, no breakthrough of functioning linked services approaches could be identified. Graz and Vienna were the case cities that were most advanced regarding finding linked service solutions. Although Graz tapped into national and EU resources to create a MaaS service, Vienna had enough resources to create MaaS competencies internally.

Another key finding of the case analysis is the significance of UMLs as incubation spaces (similar to the niche level, see Section 3.3.3) to develop, test, and refine novel solutions. While initial urban labs focused very much on technical tools, second-generation urban labs also pursued work on organisational architectures, business models, and the integration of local participation methods to create holistic, long-term, and sustainable innovations of highly heterogenetic and complex systems, such as tourism mobility.

The findings of this study suggest that niche innovations not only have to happen at niche level (such as incubation spaces), but also can occur in artificially developed incubation spaces at regime level. Furthermore, innovations that evolve at niche level need not be mere technical solutions but can also comprise novel collaboration structures (e.g. business models).

In the scoping study, the constraint of financial but mainly human resources regarding innovating existing tourism mobility systems was a key finding. However, the case studies showed that resource availability was mainly an issue for the early stages of innovation. In

addition, each case city had a relatively strong financial background and had access to many university graduates from relevant study programmes (IT, ITS, e-commerce, etc.). Although these factors had a definite positive impact on the case cities' innovation progress, it became apparent that the collaboration and cooperation of actors, across providers, sectors, policy levels, and countries, plays an increasingly crucial role, not only for the innovation of the tourism mobility systems, but also for developments at niche level.

10.4. The Innovation Phases and their Dynamics of Tourism Mobility Systems

In the empirical parts of this thesis (the scoping study [see Chapter 5] and the case studies [see Chapters 7, 8, and 9]), reoccurring innovation patterns were identified. These common innovation patterns seemed connected to a set of corresponding pressures that triggered change, niche innovations that enabled change, and innovation dynamics among regime actors to realign and ensure a continuous functioning of the changing socio-technical system. Although the case studies indicated that each tourism mobility system had very distinct actor setups, were subjected to a wide range of different pressures, had access to different levels of resources and tools to innovate, and thus pursued case-specific innovation pathways, nevertheless common innovation phases were identified (see Table 21). In the first analytical section (the scoping study, Chapter 5), a phase-wise innovation path was identified, which was confirmed and refined in the case studies of the second analytical section (see Chapters 7, 8, and 9).

Five sequential phases were identified (see Figure 126) that revealed distinct characteristics, triggers, and challenges in all the case cities. In addition to the contribution to research, the summary of the identified five phases of innovation is also an analytical framework for the innovation process of tourism mobility systems. This framework can be used by management organisations, authorities, and agencies responsible for the operation and innovation of tourism mobility systems to conduct a self-assessment of their innovation status and use the insights into the characteristics, pressures, and triggers to move to the next innovation phase as a basis for innovation plans. Table 21 discusses the individual innovation phases in detail and highlights the characteristics of the phases, key challenges, and drivers that lead to progression in the innovation pathway.

In the five-phase framework, the first phase of innovation addresses the emergence of tourism mobility as a relevant (notable) aspect within the existing destination / city system (Phase 1). Once tourism mobility is established as a relevant factor local actors explore and utilise methods and tools to enhance the tourism mobility system in situ. These explorations are often

relatively uncoordinated and scattered across the actor groups of the tourism mobility system (Phase 2). Due to the uncoordinated approach the expected added value or benefits of the digitally enhanced tourism mobility system fail to materialise, and the need to develop a strategic and refined approach to ensure an effective innovation of the systems becomes apparent (Phase 3). Once the strategic alignment of all actor groups and innovation activities is developed, a coordinated integration of digital enhancements and of suitable organisational and collaboration structures that support the evolving system configuration is pursued to progress the innovation of the system (Phase 4). The substantial changes arising from the previous innovation phases, are necessary to enable a functioning and resilient innovated tourism mobility system, and also require amendments to the existing underlying regulative and policy frameworks of the destination system. These changes trigger an institutionalisation of relevant components of the system (Phase 5) to enable a (re)alignment and stabilisation of the innovated tourism mobility system.

Figure 126 Innovation phases of tourism mobility systems in digitalising historic cities (Source: own illustration)

Innovation Phase		Phase Characteristics	Key Challenges	Triggers to Move On
Level 1	**Emergence of tourism mobility as a relevant factor within the city system**	Establishment of tourism mobility as a relevant element of mobility / destination system (commonly triggered by impacts of touristic movement on urban environment, which increase pressures on mobility / destination system) Tourism and mobility actors pursue isolated, sector-centric approaches to address tourism mobility A joint, cross-sectoral tourism mobility approach is largely missing due to a clear division of the tourism and mobility sectors within the city system setup First approaches to addressing tourism mobility show that experience and know-how regarding tourism mobility are largely missing ➢ The need to understand touristic mobility better becomes apparent	Establishment of tourism mobility as a joint, cross-sectoral objective Predominating isolation of tourism, mobility (and digitalisation sector) within city, and mobility system ➢ Challenges to develop joint and synchronised approach of all actors to manage tourism mobility	Increasing pressures on tourism mobility system, which make the innovation of the existing system necessary (e.g. 'over-touristic' use, pressures to digitalise, increase environmental sustainability, lower impact of touristic traffic) In addition, the emerging need to understand tourism mobility better urges actors to engage in tourism mobility activities to gain experience
Level 2	**(Uncoordinated) Scattered utilisation**	The existing tourism mobility system is enhanced with available analogue and digital tools relevant for touristic movement management Upgrade and innovation activities are not coordinated among actors and occur in a largely isolated manner Strong involvement of external actors for the provision of relevant digital tools due to incumbent actors still lacking experience, know-how, and resources. Key foci are primarily on the improvement of the visitor experience and site consumption Only peripheral focus on the use of new technical solutions to enable touristic mobility management	Due to lack of coordination and exchange of actors, the introduced and utilised applications and tools are not coordinated, linked, or attuned ➢ Low added-value of utilised tools for a citywide, strategic touristic movement management	External pressures on system are increasing Due to missing coordination of innovation activities, no added-value or positive impact on system (to ease pressures) are noted by actors ➢ Need to coordinate innovation activities across sectors and providers is recognised Experience exchange among actors considered as added-value No clear strategy regarding how to synergise tourism and mobility sectors to develop joint objective
Level 3	**Strategic alignment to innovate tourism mobility**	Strategic alignment of actor collaboration to understand better the prevailing tourism mobility system and attune the innovation activities of the tourism and mobility sectors Distribution of roles and responsibilities of incumbent actors within a joint tourism mobility system Coordinated assessment and decision-making for joint activities to progress the innovation of tourism mobility • (often) Cross-sectoral working groups formed to develop holistic development plan and roadmaps jointly • (often) Alignment of planned efforts with external resources for innovation (e.g. EU project participations, funded, national initiatives, regional cooperation) • (often) Test environments enable testing of developed tools and assessment of strategic approaches (e.g. Urban Labs)	(Re)Distribution of roles and responsibilities of incumbent actors within a joint tourism mobility system ➢ Involvement of all actors is crucial ➢ (Ideal approach) Neutral actor leads the strategic alignment phase ➢ Identification of new actors to close emerging gaps / shortcomings in the realigning regime setup (e.g. start-ups) Joint agreement on strategic innovation vision, plans, and activities Joint allocation and mobilisation of funds and resources ➢ (if necessary) Cooperation with national and supranational actors ➢ Strategic collaboration of linked services to create tourism mobility ecosystem (such as MaaS approach)	Once strategic (re)alignment of actors is done and plans for next innovation steps are decided, there is a need to move on and implement / integrate efforts regarding plans A continuous feedback loop to assess the impact and effects of implementation activities and fine-tune strategic approach and implementation activities to optimise tourism mobility innovation is considered an important, reoccurring step ➢ Continuous feedback loop between Phases 3, 4, and 5 ensures the balanced, stable, and dynamic innovation of tourism mobility systems and is necessary to refine and extend innovation efforts External pressures are still impacting the tourism mobility system and the destination system

Innovation Phase		Phase Characteristics	Key Challenges	Triggers to Move On
Level 4	**Coordinated integration of innovated aspects**	Based on the strategic considerations, innovation efforts and activities are implemented and integrated into the existing tourism mobility system Realignment of incumbent regime actors and integration of new actors is in full progress Phase is still dominated by the implementation / integration of technology-focused innovations ➢ The need to complement the technologically enhanced system with organisational and regulative aspects becomes more apparent ➢ Organisational architectures and frameworks are gradually introduced into the digitalised tourism mobility system	To maintain close collaboration and aligned implementation activities among all actors To adhere to the jointly agreed innovation plans and continuously renegotiate, refine, and adjust those plans ➢ Continuous Feedback loop (Phases 3, 4, & 5) Strive for a holistic innovation to create a durable and resilient digitalised tourism mobility ecosystem ➢ Identify suitable organisational framework for the digitalised tourism mobility system ➢ Develop organisational processes to make the linked tourism mobility system work	The integration of technical innovations into the system has reached a certain maturity The need to complement technical architectures with organisational and regulative structures has been recognised, and the first approaches show that ➢ Limits of existing organisational frameworks for highly heterogenic set of actors become apparent ➢ Novel approaches to collaborate become necessary The emerging tourism mobility ecosystem makes it necessary to adjust / develop regulative frameworks to regulate this novel setup and collaboration (e.g. data standards, data protection) 'Innovation policies' are increasingly emerging (climate-changes laws, ITS laws)
Level 5	**Institutionalisation**	Growing recognition of tourism mobility as a joint topic / objective leads to the integration of tourism mobility in governance apparatus ➢ Establishment of regular exchange between policymakers and tourism mobility system actors Organisation architectures for tourism mobility systems show a strong tendency to introduce platform concepts as a collaborative approach to interlink the heterogenic set of services ➢ Boundaries between the individual components of the systems increasingly blur Unsuitability and shortcomings of existing regulative frameworks to cover merging, digitalised tourism mobility systems become more obvious Maxim shift of policymakers towards climate-protection agendas with a strong focus on inducing a shift of mobility behaviour of population 'Right of Mobility' initiatives emerge, which also consider tourism mobility as a basic right for citizens. This new conceptualisation of mobility requires an adapted approach towards mobilities	Suitable organisational architectures are still in a trial-and-error stage Pressures from the policy level to enhance the climate-friendly-ness of tourism mobility highlight again the ➢ Missing solutions for the first / last mile problem ➢ Missing solutions to measure touristic mobility and impacts, and thus to prepare fact-based strategic approaches to reduce impacts of touristic movement To go beyond the mere provision of the local tourism mobility system and interlink with adjacent systems (geographical and thematic) to enhance usability and create cross-border, cross-provider, multimodal tourism networks of tourism mobility systems. Only then can large-scale travel behaviour shifts be considered possible To enable cross-border tourism mobility systems > need to adjust EU and national legislation	

Table 21 Innovation phases of digitally enhanced tourism mobility systems (Source: own illustration)

This chapter provided the key contribution of the thesis by outlining a generalised stakeholder configuration of tourism mobility systems as well as by developing the innovation phase model (IPM) of tourism mobility systems in touristic historic cities. In the following conclusion of the thesis the overall contribution of the study as well as the research aims are revisited and discussed.

11. Conclusion

This thesis set out to unravel tourism mobility, which is a complex 'system of systems' subject to significant innovation. A detailed understanding of the configuration and dynamics of tourism mobility is essential to enable a more sustainable touristic utilisation of built environments. However, the ongoing digital transformation of societies and environments is also continuously affecting tourism mobility. To illuminate both the status quo and changes to tourism mobility, this study 'zoomed-in' from a Europe-wide perspective of the state of tourism mobility systems in historic cities to a detailed analysis of the innovation pathways of three case cities: Vienna, Salzburg and Graz. From this focus, a generalised model of the innovation phases and pathways of contemporary tourism mobility systems was created.

This chapter concludes the thesis by revisiting the research aims and placing them in context with the findings of the study. The methodological and conceptual contributions of the study are summarised, and the key findings of the case studies are outlined.

11.1. Research Findings

In accordance with the research aims and objectives, the scoping study provided an overview of the current state of tourism mobility systems in contemporary, digitalising historic cities in Europe (RO1, see Section 5.2). These findings provided a basis for a detailed discussion of external drivers for change in the three Austrian case cities, in the form of pressures and niche innovations (RO2A; see Sections 10.3.1 and 10.3.2) as well as for the analysis of change dynamics at the regime level (RO2B) in the context of the overall system innovation processes and pathways (RO3; see Section 10.4).

Each objective contributes to the overall research aims of this thesis, namely the analytical discussion regarding the innovation phases of tourism mobility systems in the digital age (RA1) and the conceptual input on tourism mobility (RA2), as summarised above.

A key output of this thesis is the analytical five-phase innovation model of tourism mobility systems in tourist-historic cities (see Figure 126 and Table 21). The model is described in Section 10.3. The model provides a summary of the innovation processes and dynamics linked to the pressures on contemporary tourism mobility systems and niche innovations seeking to break through at the regime level. In principle, the five-phase model is transferable to tourism mobility systems outside

Austria and can be used as a self-assessment tool to establish the current innovation status of a local tourism mobility system, as well as the readiness of the local system to innovate (further).

This study highlights the importance of strategic and state-of-the-art tourism mobility management to ensure the sustainability and economic viability of a destination. However, with increasing digitalisation developments, local actors are often overburdened by the digital upgrading of tourism mobility systems, a task that is not only highly complex, but also unprecedented. Thus, stakeholders lack experience regarding innovating their systems.

The five-phase model provides an orientation for organisations and the people in charge of the management and innovation of tourism mobility systems. The model offers a guideline throughout the innovation process, as the common triggers, challenges and characteristics of phases are outlined.

The generalised five-phase innovation model builds on the findings of the two empirical sections of the thesis, which were designed to provide (1) an overview of the current state of tourism mobility systems in European UNESCO WHS-listed historic cities and (2) insights into the tourism mobility system and its evolution and innovation within the three case cities in Austria.

11.1.1. The Current State of Tourism Mobility Systems

The scoping study was initially employed to develop a basic understanding of the current situation of tourism mobility systems in European cities and to gain insights into the key aspects and issues associated with these contemporary systems. However, the insights of this first empirical study provided more than just benchmarks to be used as a starting point for the in-depth investigation of the Austrian case cities.

The findings of this study reveal that tourism mobility systems in Europe are under increasing touristic pressure due to the growing and changing touristic mobility and the lack of capability of local actors to adapt local systems to these changes.

Local tourism mobility systems have a highly heterogenic composition that is mainly reflected in the very different levels of touristic exploitation of a site and approaches regarding how to incorporate and deal with tourism mobility. Overall, tourism mobility is still not only under-researched by academia, but also relatively unrecognised as a key factor for city / destination management. This study suggests it is crucial to elevate the priority and importance of tourism mobility within local management strategies to ensure that the peculiarities of touristic mobility

and volumes of touristic traffic are incorporated into citywide mobility and traffic management schemes for historic-tourist cities.

The thesis also highlights the relevance of public transport for tourism mobility. A mere digital innovation of information services on public transport is not enough. The case studies highlight that a continuous innovation and upgrade of public transport infrastructures as well as affordable pricing is essential to enhance the attractivity, hence, the actual use of public transport by visitors. The study also showed that in innovated tourism mobility systems, public transport in combination with intelligent multimodal mobility services (e.g. MaaS)holds a great potential to aid to persistent problems such as the last/first mile issue of tourism mobility, the dominance of individual traffic for rural tourism, as well as long distance journeys across countries with public transport.

However, for a successful establishment of public transport as relevant mobility mode in tourism mobility system significant and substantial behavioural changes of travellers are required. These changes are closely interlinked and can only be triggered with the development of easily accessible, sustainable, smart and affordable mobility infrastructures at destinations.

The findings also highlight that novel digital tools are often perceived as a remedy to ease increasing touristic pressures on sites. However, digitalisation developments pose an additional pressure on local systems. The digitalisation of tourism mobility systems is inevitable and a highly complex, resource intensive, and challenging endeavour for all actors involved. Thus, it is crucial for local actors to be fully aware of the setup of the local tourism mobility system, to stay up to date with digitalisation trends relevant for the local system, and to set them in context of the available resources.

This study found that all the investigated destinations lacked the resources to (1) understand tourism mobility and (2) to innovate digitally the tourism mobility system, and these had to be added over time. In particular, knowledge and experience exchange proved to be valuable tools to understand tourism mobility systems better, as well as innovation processes and activities.

However, the cross-sectoral character of tourism mobility is often a key obstacle to pursuing a proactive and structured engagement to drive the establishment of a functioning and well-balanced tourism mobility system, as well as to drive its innovation. Thus, it is crucial to break-up entrenched stakeholder structures when necessary, and to define, both proactively and regularly,

actor setups and their corresponding responsibilities and integrate novel actors to enable change processes to occur and innovation to thrive.

Another challenge regarding tourism mobility systems at a more advanced innovation phase is finding suitable governance, collaboration structures, and business models for the increasingly heterogenic set of actors. The consolidation of long-established actors, such as local authorities and DMOs, with novel actors (mainly emerging from digitalisation developments) that display an agile and dynamic business approach, was identified as one of the most pressing issues currently slowing the innovation of tourism mobility systems.

Although a high willingness to collaborate and develop strategic partnerships to innovate tourism mobility systems was identified among actors, the absence of suitable governance and collaboration approaches is a key reason for tourism mobility not being clearly assigned to an industry sector or authority but remaining as an objective between relevant actors.

Overall, this study provides only a snapshot of rapidly evolving socio-technical systems. However, it became apparent that the majority of contemporary tourism mobility systems are at an innovation stage in which technical solutions have been developed and are ready to be used. What are lacking are governance structures that allow technically innovated systems to stabilise and evolve into resilient and holistically innovated socio-technical systems.

Due to the ongoing character of the innovation of tourism mobility, the five-phase model constitutes a preliminary exposition based on findings of this study. However, with progressing innovation, this model must also be revisited.

11.2. Methodological Contribution

The literature review identified not only significant changes to tourism mobility systems over time, but also a certain evolution pathway for research on tourism mobility (see Section 2.10).

The multi-level perspective as an analytical tool

The MLP was applied throughout the thesis and proved a useful analytical tool for exploring the innovation pathway of tourism mobility in the case cities.

Regarding the analysis of the online survey data, in the scoping study, the MLP framework was employed (see Section 5.2). To date, the analytical basis of the MLP has focused primarily on qualitative data and secondary sources (e.g. Geels, 2006; Weber and Rohracher, 2012; Förster, 2020). Therefore, the approach in this thesis regarding analysing the quantitative survey data within the MLP framework is relatively new. The results from the survey analysis were substantiated by the findings of the in-depth interviews in the case cities and provided a solid foundation for the research design of the second empirical part of the study.

In addition, this research responds to the critique of the MLP regarding spatio-specific considerations (see Section 3.3.6). Spatial dimensions proved crucial for the analysis of local innovation processes in the case cities and for developing the overall five-phase innovation model. In particular, the case studies demonstrate that location-sensitive and location-dependant innovation processes and innovation developments can be analysed within the MLP framework. For example, the innovation of Graz's tourism mobility is strongly driven by the desire to improve air quality levels, which are strongly interlinked with the city's geographical location. Furthermore, Salzburg is seeking innovative tourism mobility solutions to ease the pressures on the built and living environments of the city.

These findings also contribute to the discussion on the ambiguous role and influence of the 'city' within the MLP framework (Hodson and Marvin, 2009; see critique in Section 3.3.6). The thesis demonstrates that, prior to conducting an MLP analysis of innovating socio-technical systems in a 'city' context, it is crucial to develop a detailed understanding of the actor groups at the regime level, as well as the relevant actors at the landscape and niche levels. Insights from the actors and stakeholders also set the role and relevance of the 'city' within the context of innovation, as well as delimitating the decentralised influence of the 'city' from the influence of the regional and national context.

Furthermore, regarding the functioning of the MLP as an analytical tool, the case study findings highlight a very strong interdependency between the three levels of the MLP, blurring the demarcations between the regime, landscape and niche levels (see discussions in Section 10.3.1). This aspect is not as apparent in previous MLP discussions regarding innovation processes (Geels, 2005a; Whitmarsh, 2012; Moradi and Vagnoni, 2018). However, this thesis's findings indicate the use of levels within the MLP allows enough flexibility to identify cross-level dynamics within the innovation process of socio-technical systems.

The case studies also revealed that regimes should not be considered homogeneous structures per se within the MLP (Truffer and Coenen, 2012; see critique in Section 3.3.6) but comprise a heterogenic and dynamic set of actor groups that are constantly changing and adjusting to local variations.

To substantiate these indications, further research and case discussions using the MLP and considering these viewpoints are necessary.

However, this study revealed that the innovation of socio-technical systems subjected to unprecedented phenomena (such as digitalisation) can be understood only when the historical evolution of a system is considered, all the actors involved in the system are recognised as equally important agents, and all the holistic system's interconnections to other systems and external components are incorporated. Thus, the MLP can be considered a highly effective tool for analysing this and similar research areas.

11.3. Conceptual Contribution

'Spatialities' of innovated tourism mobility

This study supports the indications of Urry and Sheller (2006) that the internet or (in more contemporary terms) digitalisation holds substantial challenges and potential for radical changes in mobility systems. The findings of the thesis highlight the increasing 'placelessness' (Hannam, Sheller and Urry, 2006) of mobilities, which is accelerated by digitalisation developments. The discussion also extends to 'spatialities' (Duarte, 2017). Although tourism mobility still happens predominantly in physical spaces, exploring and experiencing space has become hybrid. Corporeal and immaterial methods to consume space are increasingly synergised and lead to a blurring of 'spatialities'. In the study, it became apparent that tourism mobility no longer only happens in the physical space, but also in virtual and mental spaces (see for example Section 2.1 and 7.5). Based on the insights of this study, touristic movement appears a purposive, omni-modal movement with an intrinsic focus on exploring and experiencing tangible and intangible (digital, mental) places and spaces. This increasing detachment of touristic movement from physical spaces is accelerated by the increasing digitalisation of the individual, societies, and environments.

In the same manner, the role and relevance of the 'destination' as enabling, mobilised place (Sheller and Urry, 2016) is scrutinized. Lew and McKercher (2006) emphasis that destination

characteristics as well as visitor characteristics are the key influence factors shaping decision-making and mobility behaviour in space and time. However, this study highlights the changing role and objectivity of the 'destination'. OMT supported interpretation adds a digital/virtual layer (e.g. AR, VR) to the physical space that makes up the destination. Virtual tours of a site even enable mere virtual touristic mobility to a digital destination, without the need for a physical movement component. Aside from this extreme form of virtual tourism, to date, most touristic mobility still incorporates physical movement. But also in the context of contemporary tourism mobility supported by OMTs, the objectivity and image of the destination are shifting. Not so much the built fabric but information on the historic sites is shaping the experience, place consumption and image visitors form on the destination. While local actors, such as DMOs, were the main information provider before, in ages of the 'sharing society' prosumers and their 'raw', unfiltered information increasingly shape the story and image of a destination.

In addition to the growing significance of the digital, the study also identified a prevailing resilience of the 'not-digitalised' (analogue) elements in (tourism) mobility systems (e.g. analogue interpretation methods) and the essential role of corporeal components and infrastructures to enable innovation towards a more digital mobility system.

For the future conceptualisation of innovated tourism mobility systems, the discussion on the role of corporeal and immaterial components within the systems is the most interesting and essential. At the time of the study, this discussion was just starting, and the actors were only gaining their first experiences with hybrid systems. Therefore, this thesis can raise the issue but cannot provide any substantial conceptual explanations.

In addition, the institutionalisation of shifting systems (aspects) was identified as having considerable relevance for developing sustainable and durable systems. However, in discussions in academic literature regarding 'new mobilities', this aspect was hardly considered. Although this study does not provide deep insights into institutionalisation processes of innovating mobility systems, the clear relevance of this aspect was repeatedly highlighted and provides basic insights into the underlying dynamics relevant for future research.

Tourism mobility as entity or objective

This study highlighted again the dichotomous character of tourism mobility and the fundamental issues that emerged out of the cross-sectoral and still largely atomistic approaches used to

address tourism mobility in urban environments. This characteristic is essential for the conceptualisation of tourism mobility. However, the findings showed that, with the progressing innovation of the system, a joint perspective and approach towards tourism mobility was also evolving. These co-evolutionary dynamics were still ongoing at the time of the study, but two dominant approaches to developing a joint tourism mobility understanding at destinations were identified. One approach took an organisational focus and established dedicated tourism mobility departments or multi-stakeholder committees, and thus embedded tourism mobility as a thematic entity in the organisational structure of the city or destination. The alternative approach involved the formulation of tourism mobility as a joint objective for the management, planning, and the development of the city, destination, and mobility system.

Due to the ongoing character of the innovation of tourism mobility systems under investigation, no definite outcome or stabilised and completely realigned socio-technical tourism mobility system could be analysed. Thus, no definite conceptual perspective on tourism mobility can be derived from this thesis. However, this thesis provides insights into the dynamics that triggered the synergy of two very isolated systems that were also subjected to strong lobbying activities and were highly market driven. The transferability of these findings to other, similar cross-sectoral system structures requires further research.

The stakeholder setup

Closely related to the cross-sectoral character of tourism mobility is the configuration of stakeholders. The key findings concerned an ongoing change in the actor setup at regime level, but also their changing roles and responsibilities within the tourism mobility system. In addition, the setup of stakeholders and their roles within the innovating systems proved highly case specific. For example, in Graz, the cultural sector took over as lead actor in one innovation phase. The only system actor that displayed comparable activities in all the case studies were city administrations. Overall, city administrations held a supra-sectoral role, so they focused throughout on the coordination of activities of incumbent actors of all the involved sectors, as well as being responsible for the steering of the innovation direction. Thus, city administrations were the pivotal actor with the decisive role within tourism mobility systems to pursue a dynamic, stabile innovation or to destabilise the system due to an unbalanced innovation progress.

In addition to the identified shifts of ‘producing’ actors at regime level, the study also highlighted changes to the consumption aspect of the system, namely of visitors and tourists. The findings

support the discussion regarding the ‘changing user’ in the literature review (see Section 2.10.1) and add novel insights into the changing mobility and place consumption behaviour of ‘connected’ visitors. For example, the findings suggest that the ‘unconnected’ experience of a site is not only relevant for ‘unconnected’ visitors, but also that ‘connected’ visitors generally seek a balanced offer of analogue and digital solutions. Furthermore, the findings indicate that digitally enhanced site interpretation is not only relevant for visitors, but also that it increasingly engages locals to re-experience their well-known space. These findings contribute to the discussion on the ‘post-tourist’ (Sharpley, 2018) and add a novel ‘flavour’ to the nature of tourism mobility, especially with a focus on defining the demarcations of adjacent socio-technical systems and highlighting that the roles of the involved actors are blurring.

11.4. Insights From the Case Cities

The developed five-phase model consolidates the findings of the three case cities and clearly shows that despite the heterogenic tourism mobility setup and tourist utilisation of the three cities, basic similarities in the underlying innovation processes were evident.

The case studies found that Vienna can be considered a best practice example, pursuing a proactive and agile innovation of its tourism mobility system. In Vienna, tourism mobility has been recognised as a tool to enhance the exploration of the site for its visitors and as an essential management tool to ensure a sustainable touristic exploitation of the built environment. Vienna is the case city most advanced in its innovation of the local tourism mobility systems, and local actors have also started to transfer know-how to other cities in Austria, such as Graz.

When analysing Vienna’s tourism mobility system through the lens of the five-phase model, the pressing challenge of innovating tourism mobility systems is evident. Vienna has reached an innovation status in which the technical capabilities to drive innovation are available and largely used by the local systems. However, holistic collaboration and governance structures to integrate these technical solutions are still missing. The city compensated for the lack of suitable governance structures by introducing city-owned start-ups. However, with progressing innovation, the necessity to provide collaboration frameworks that enable the linkage of individual start-ups and close the gap between private and public entities is becoming more obvious. A stronger integration of the current tourism mobility system, with its tourism mobility actors and objectives, into the established Smart City framework of Vienna would provide a good basis for tourism

mobility to become more relevant and to become part of a citywide framework that operates on a more solid governance framework.

Salzburg exemplifies a tourism mobility system that is highly market driven and prioritises the economic exploitation of its touristic potential over the sustainable utilisation of the historic city. The case provides deep insights into the dynamics that emerge when the actor groups at regime level are unaligned and imbalanced. These regime dynamics lead to an exploitation and overstraining of the built and living environment of Salzburg, which result in the deceleration of the innovation of the local tourism mobility system. Despite this highly constrained innovation path, a key finding of this case study is that even this imbalanced innovation had similar phases to the more balanced approach of Vienna. However, the case also highlights that the digitalisation and innovation of a system is only effective and progressing well when the socio-technical system is stable at the beginning of the innovation. Introducing novel solutions into an unstable system with the expectation that innovation will lead to the stabilisation of the system is a mistake.

According to the five-phase model, Salzburg is still searching for strategic alignment. Although the system has tried to move onto the next phase, innovation proved only to work sustainably once each innovation phase had been successfully mastered. For Salzburg, it is essential to reconsider its traffic management strategy and significantly restrict daily numbers of individuals and bus traffic to the city. Furthermore, it is necessary to seek a more inclusive decision-making approach among regime actors to decide on the next strategic steps for the innovation of the local system.

In contrast to Salzburg, Graz started with a strategic approach to introduce tourism to city utilisation. Therefore, tourism mobility was recognised as a relevant factor for the touristic exploitation and for the mobility system of Graz from the earliest stages. In contrast to the other case studies, the cultural sector drove the first innovation phases of the system, and thus an alternative perspective on innovation strategies was identified in Graz. The case also addressed the ‘unmeasurability’ of tourism mobility by using air quality levels as indicators to establish the extent of touristic individual traffic to and in the city.

Graz will continue to face an issue with air quality levels; thus, it is crucial for the city to continue the innovation of its (tourism) mobility system towards low-emission mobility solutions. MaaS frameworks are a promising solution to provide sufficient mobility for travellers to reach Graz and explore it but produce lower emissions. However, for the local MaaS system to become really effective and sustainable, the local system must be connected to the regional and national public

transport system (or even better, the national MaaS system once established). Thus, the innovation efforts of Graz must aim to provide a highly attractive MaaS service for its visitors, making travelling to and exploring Graz by using multimodal, public transport more attractive than using individual transport.

The MLP analysis of the three case cities highlights the similarities in innovation and discussed the different approaches, providing insights into alternative innovation approaches and pathways of tourism mobility. It is crucial to continue to follow the innovation progress of the three case cities to develop or amend the established innovation model. Even more important is applying the five-phase model to other case cities to validate or scrutinise the model and ideally enhance its applicability and transferability.

11.5. Positionality

One of the epistemological assumptions of the social constructivist paradigm is that there is not one reality but many realities "that can be articulated based on the values, standpoints, and positions of the author" (Daly, 2007, p. 33). When I started the research process for my dissertation, I was a full-time student with prior, professional experience in project management of property and city developments. In the course of my PHD, I started a position as Expert at a government-related agency in Austria that focusses on techno-political measures to ensure a constant innovation and upgrade of transportation and mobility infrastructures of Austria. This changing role from a mere observer of the mobility system (as PHD Researcher) to an involved actor who is actively shaping the Austrian mobility system impacted on the data generation as well as analysis of research findings. As part of the Austrian mobility network, I gained more insights into the local stakeholder configuration as well as a broader understanding of underlying policy and legal frameworks, the relevance of delegate acts of the EC as well as the functioning of the government apparatus in terms of transport infrastructures and its innovation.

From my standpoint I am reassured that the pursuit of this thesis to better understand tourism mobility and its innovation processes is of high relevance to local, regional and national management and development plans and aids to a more strategic and sustainable utilization of touristic places. However, I also have to note that, for the here developed Innovation Phase Model to become a comprehensive guiding tool for the innovation for touristic places, it is necessary to conduct further research on the scalability (up and down) as well as the transferability of the Innovation Phase Model but also the methodological approach.

For this research the methodological approach proved to be very suitable because, first, a MLP on socio-technical systems allows to identify and illustrate a detailed actor structure of the socio-technical system as well as provides the flexibility to also amend the actor structure with changing innovation developments. Second, the MLP does not take an actor-centric approach (e.g. ANT) towards investigating innovation but focuses on innovation processes and dynamics of the socio-technical system in the course of time. Thus, allows to draw a timeline of innovation developments. And third, the MLP provides the possibility to zoom out on far-reaching landscape issues as well as niche innovations that penetrate and shape innovation of the system and at the same time zoom in on regime level to understand in detail the course of innovation.

11.6. Limitations and Critique

This study produced only a snapshot of tourism mobility systems in a state of flux. Therefore, the findings only reflect the situations at the participating destinations at the time of the study.

The limitations of the MLP as an analytical tool (as outlined in Section 3.3.6) were considered in the empirical design of the study. This study enabled a discussion of several of the outlined criticisms of the MLP (see Section 11.2). Berkhout's (2004) argument, namely that the perspective and starting point of observation of changing systems shape the results of the study, remain valid and limit this study.

During the methodological design process, the execution of focus groups as an alternative to the semi-structured interviews was considered. Since the research concerned inter-stakeholder dynamics that may lead or hinder change within the socio-technical system, the focus group approach could have been appropriate. However, feasibility issues, such as the limited time budget and the conflicting schedules of the participants, made focus groups unworkable. Therefore, semi-structured interviews were chosen to enable the individual exploration of the respondents' views.

The online survey of the scoping study was sent to people involved in the management of each destination. The responses and statements received were of a subjective nature and based on the experiences, subjective perceptions, knowledge, hierarchical insights, training and specific responsibilities of each respondent. The questions were designed to provide insights into the overall situation at the destination, and an aggregation of the overall sample size enabled an identification of trends among UNESCO-affiliated historic cities in Europe. However, the survey

findings added mainly to the institutional and organisational regime insights (market regime, policy regime) and provided a substantiated but subjective view regarding user-regime tendencies (based on the market research practices of DMOs) and technology regimes. Socio-cultural and science regimes were only peripherally considered in the survey. Science regimes, with a focus on socio-cultural and science aspects, were investigated in detail through secondary research.

The five innovation phases describe the generalised innovation of tourism mobility systems. In both the online survey with 81 respondents and in the in-depth investigations of the three case cities, comparable innovation phases were identified that the individual tourism mobility system must undergo. Although the sample volume is small, the consistent reoccurrence of a similar innovation sequence enabled the identification and summaries of the innovation phases and the elaboration of the first draft of a generalised description of the five innovation phases of sample tourism mobility systems. However, it is essential to conduct further research to validate, refute or adjust the initially identified five phases of innovation. Ideally, the phases should also be tested in different settings, countries and cultural environments.

The starting point of this study was a relatively unipolar, Western-centric perspective of technology use and mobility behaviour. The digital divide, digital inequalities and mobility poverty are of global significance and are highly relevant to tourism mobility research. However, this study is restricted to highly developed touristic destinations in countries offering at least a basic national digital infrastructure and mobility infrastructure (e.g. public transport). Furthermore, this study largely disregarded the ‘deliberate unconnected’ tourist within the actor setup and their role within the innovation processes.

The data generation was concluded only a few months before the COV19 pandemic started. Due to this fact, COV19-reated effects, which might also continue to shape tourism mobility systems after the pandemic, were not considered.

11.7. Outlook and Future Research

The study of current and ongoing innovation processes is a highly agile and open endeavour. Therefore, throughout the study, indications were made of areas that require further research, either to prove or refute a point or simply to understand better a certain point or aspect of the innovation of tourism mobility systems. In this section, only the key objectives that should be considered for future research are summarised.

This study produced only a snapshot of tourism mobility systems in a very particular setting. To obtain an in-depth understanding of the tourism mobility status quo and innovation processes, more research on tourism mobility systems in different environments is required, and the findings must be compared.

Due to the ongoing character of the innovation of mobility systems, this study can only be a starting point; the investigation of innovation pathways must continue. In particular, recent developments at policy level highlight the necessity of acting and making tourism mobility more climate-friendly to push the innovation of tourism mobility further.

One finding of this study is that an ability to measure the volume of touristic movement is lacking. This issue is one of the most significant insights. This study clearly reveals that the lack of figures on touristic movement makes it exceedingly difficult to conduct representative impact assessments, and it weakens arguments for addressing the carrying capacity limits of destinations via visitor-movement management or even gateway management to sanction access. In the case studies, Graz exemplified a solution for indirectly measuring the impacts of touristic movement. However, in Salzburg, it became apparent that lacking facts on tourism mobility was a significant hinderance to introducing management measures to safeguard the sustainability of a destination. It is essential to drive the development and integration of measuring techniques for touristic movements at all scales. Although OMTs may increasingly provide technical capabilities to measure touristic mobility, it is essential also to harmonise the definition of what tourism mobility covers and to adjust policies, regulative frameworks, and management concepts to enable the measuring of movement. In addition, data protection regulations must be drawn up.

This study also highlights the necessity to develop cross-border, cross-provider, and multimodal services to achieve mainstream usage. Therefore, a harmonisation of data standards and interfaces and a novel collaboration model are necessary. To date, these areas are relatively new and under-researched but would provide essential insights to operationalise these services.

Due to the fact, that COV19-related effects on tourism mobility systems were not considered, it is necessary to conduct a detailed analysis on short and long-lasting effects of measures introduced during the pandemic.

11.8. Chapter Conclusion

Tourism mobility is the basic prerequisite for the touristic utilisation of sites and destinations. This study highlighted the potential of tourism mobility as a regulating and control mechanism to enable an economically optimised but sustainable touristic exploitation of destinations in the three Austrian case cities. However, the case studies also highlighted that touristic mobility could cause significant pressures and challenges for destinations and local environments.

Tourism mobility is the key enabling factor for tourism, but it is also the greatest threat regarding tourism becoming an unsustainable and harmful utilisation of places. These two fundamental characteristics of tourism mobility make it a powerful component within tourism and the mobility systems of cities, regions and even countries. For many regions, tourism is an essential economic pillar that creates jobs and has multiple benefits for local communities.

Therefore, it is crucial to comprehend this cross-sectoral topic and understand its composition, evolution and innovation within a rapidly changing world. In particular, given the growth of global digitalisation, which impacts all aspects of our lives and sets our world in a constant state of flux, it is essential to engage proactively in a dynamic discussion of tourism mobility that highlights the effects of digitalisation on tourism mobility and all relevant connected socio-technical systems.

This thesis is the first step in the investigation of innovating tourism mobility systems. This study sought to provide conceptual and ontological insights into tourism mobility systems from a socio-technical systems-thinking perspective. However, this research mainly investigated the current state of tourism mobility in European cities and provided a readiness framework that analysed the individual phases of innovation of contemporary tourism mobility systems.

As a basis for this heuristic discussion of contemporary tourism mobility systems, the case studies of three Austrian tourist-historic cities provided detailed insights into the evolution of tourism mobility at these locations.

Based on the findings of this study, the highly complex innovation process of tourism mobility systems in historic European cities was revealed, and individual innovation phases were identified. This novel approach provided a clear understanding of the individual innovation stages touristic destinations must undergo as part of digitalisation developments. Insights from this study can act as a guide for research and for touristic destinations to identify their innovation stage within the digitalisation processes, as well as a reference to drive or shape the innovation of their local tourism mobility system.

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Appendix I – Questionnaire of the online survey

The current state of visitor management in the 'digitalising' historic city

I consent to take part in the study

Respondents and Organisation Profile

What is your age group?

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65 and older
- ☐ Prefer not to say

What is your gender?

- ☐ Female
- ☐ Male
- ☐ 35-44
- ☐ Prefer not to say

What is your highest education?

- ☐ High School
- ☐ Associate
- ☐ Bachelor
- ☐ Master
- ☐ Professional Degree
- ☐ Doctorate
- ☐ Prefer not to say

What is your decision-making level for managing the destination?

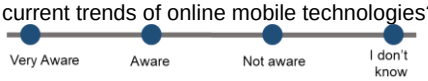
- ☐ No, not involved in decision making process
- ☐ Yes, jointly as member of the local management team
- ☐ Yes, I have full decision-making powers
- ☐ Prefer not to say

Please indicate your professional key responsibilities.

What is the company type of your organisation?

Technology awareness & acceptance

How aware do you consider yourself to be about current trends of online mobile technologies?



I find it difficult to keep up to date with the speed, new mobile technologies are changing.

I find it difficult to get information on new trends and new online mobile applications.

Do you seek information on trends of online mobile technologies?

- ☐ Yes, regularly
- ☐ Yes, from time to time
- ☐ Not deliberately
- ☐ No, I am not interested
- ☐ I prefer not to say

What describes your attitude towards the use of mobile technologies best?

- [ ] Yes, regularly
- [ ] Yes, from time to time
- [ ] Not deliberately
- [ ] No, I am not interested
- [ ] I prefer not to say

Is it crucial for your professional performance to be aware of current trends of online mobile technologies?

The utilization of new technologies adds value to the organisation

I possess the theoretical knowledge to use online mobile technologies for visitor management at the destination.

I possess the practical knowledge to use online mobile technologies for visitor management at the destination.

I perceive the attitude of my organisation towards the use of online mobile technologies as … (please briefly describe)

Does your organisation offer trainings related to job-relevant new technologies?

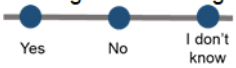
Does your organisation encourage you to visit conferences, trade shows, talks or courses on job-relevant new technologies?

Destination Overview

Do you perceive the touristic pressure on your destination is growing?

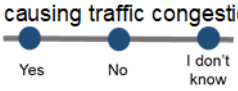
What is the dominating arrival mode of visitors to the destination?

Is the touristic utilization of the destination causing overcrowding in the destination?



If yes, which areas of the destination are most overcrowded?

Is the touristic utilization of the destination causing traffic congestions?



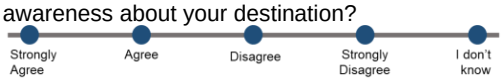
If yes. Whom do you perceived to be the key producer of touristic traffic congestions?

UNESCO Cooperation

Do you consider the UNESCO a crucial partner for the management of your site?

- [ ] To a certain extent
- [ ] Yes
- [ ] No
- [ ] Prefer not to say
- [ ] Other

Did the UNESCO listing of your site increase the awareness about your destination?



The UNESCO suggested to integrate online mobile technologies for destination management.

How regularly are you communicating with representatives of the UNESCO?
Please briefly describe your experience with the UNESCO affiliation.

- [ ] Monthly or more frequent
- [ ] Quarterly
- [ ] Once every half year
- [ ] Once a year
- [ ] No, there is no regular communication

Destination Innovation

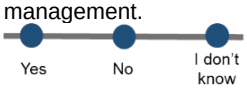
How high would you consider the innovation level of your destination?

Which stakeholder is the lead innovator at your destination?

The use of online mobile technologies at the destination conveys an image of innovativeness of the destination.

Destinations using interpretive online mobile technologies have a better reputation.

The destination has the financial resources to use online mobile technologies for visitor management.



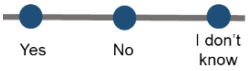
To be able to use online mobile technologies for visitor management at my destination external expertise has to be hired.

The integration of online mobile technologies for visitor management at my destination would be too expensive.

Current state of Tourism Mobility

Visitor management and policy integration

Do visitor management policies exist in your destination?



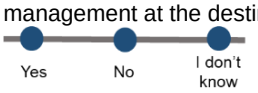
When were the policies last updated?

- ☐ Less than 1 year ago
- ☐ Less then 2 years ago
- ☐ Less than 5 years ago
- ☐ More than 5 years ago
- ☐ Never

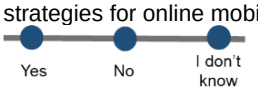
Is visitor movement management applied at the destination?

Do the visitor management policies include movement management strategies?

Are online mobile technologies used for visitor management at the destinations?



Do the visitor management policies include strategies for online mobile technologies use?

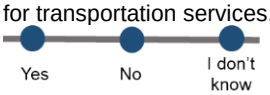


The integration of online mobile technologies into the policies structure is a precondition or successful use of online mobile technologies for visitor management.

In your opinion what is the unique advantage of online mobile technologies for destination management?

Utilization of online mobile technologies at the destination

At the destination we offer real-time information for transportation services.



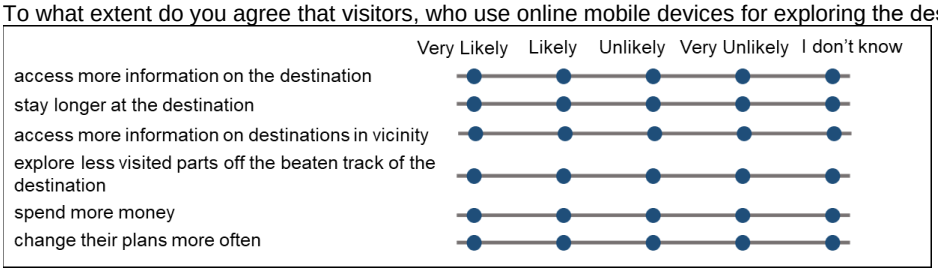
Please indicate which of the following technologies are you already using or planning to use at the destination?

- ☐ Free Wi-Fi at destination
- ☐ Augmented reality
- ☐ Virtual reality
- ☐ Near-field technologies
- ☐ Free tour guide apps
- ☐ Sharing platform for visitors
- ☐ Sharing platform for stakeholders
- ☐ Destination-run online booking platform
- ☐ GPS tracking of visitor movement

Please briefly describe key challenges for the use of online mobile technologies for visitor management at the destination.

Effects of online mobile technologies on visitors

To what extent do you agree that visitors, who use online mobile devices for exploring the destination, …



The use of online mobile devices by the visitor increases the effectiveness of exploring the destination.

Online mobile technologies offer the potential to better manage visitor behaviour at the destination.

Online mobile technology apps are effective tools for visitor movement management.

Please indicate your level of agreement. Visitor using apps for exploring the destination change their plans more often.

In my view, mobile technology enables visitors in the destination to get more relevant information.

Interpretation & Guidance

What is the dominating interpretive method used at the destination?

What is the preferred navigation device of visitors?

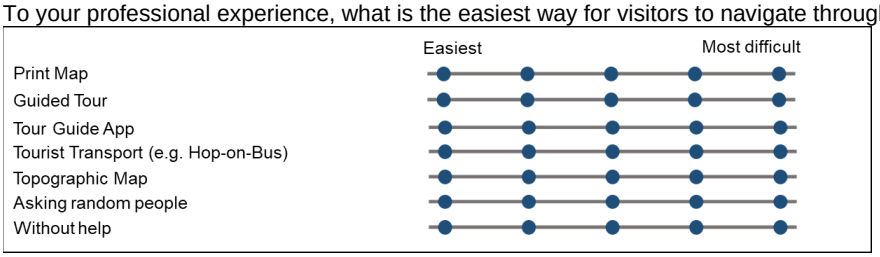
The quality of the digital interpretative solutions at the destination are...

Interpretive online mobile technology makes classis interpretation (e.g. tour guides, signages, guidebooks) less relevant.

Do you collect data on the preferred mobility choice of visitors in your destination?

Interpretive smartphone apps allow a qualitative higher communication with visitors at the destination.

To your professional experience, what is the easiest way for visitors to navigate through the destination?



Destinations that are not providing online mobile services are losing out on business.

Which stakeholder is in charge for the maintenance of the tourism mobility infrastructure?

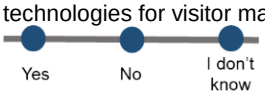
Which interpretive services for tourism mobility do you produce in-house?

Digital tools provide better services for exploring the destination than with non-digital tools.

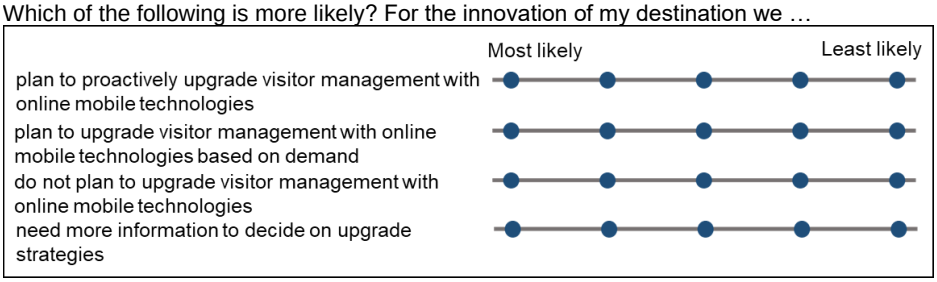
Innovation Plans of Tourism Mobility

Please briefly describe which online mobile technologies are you planning to integrate.

Are you planning to use online mobile technologies for visitor management?



Which of the following is more likely? For the innovation of my destination we …



Under which circumstances do you consider the use of online mobile technologies for visitor management inevitable?

Thank you for participating in this study!

What do you consider most problematic when integrating online mobile technologies for visitor management at the destination?

Efforts to integrate online mobile technologies into visitor management outweighs benefits.

Appendix II – Detailed results of the online survey

1. Sample overview

1.1. Destinations overview

City	WHS	Country	Destination size (km2)	Inhabitants	Inhabitants Density (pop/km2)	Inscription year	WHS Area		WHS Buffer		WHS area /city
							in ha	in km2	in ha	in km2	
-	UNESCO Commision Germany	National	-	-	-	-	-	-	-	-	-
Salzburg	Historic Centre of the City of Salzburg	Austria	65.68	146,631	22.3	1996	236.00	2.3600	467.00	4.6700	3.59%
Vienna	Historic Centre of Vienna	Austria	414.60	1,888,776	45.6	2001	371.00	3.7100	462.00	4.6200	0.89%
Graz	City of Graz – Historic Centre and Schloss Eggenberg	Austria	127.60	269,997	21.2	1999	71.97	0.7197	17.13	0.1713	0.56%
Baku	Walled City of Baku with the Shirvanshah's Palace and Maiden	Azerbaijan	2,130.00	2,236,000	10.5	2000	21.50	0.2150	12.00	0.1200	0.01%
Brugge	Historic Centre of Brugge	Belgium	138.40	117,260	8.5	2000	410.00	4.1000	168.00	1.6800	2.96%
Mostar	Old Bridge Area of the Old City of Mostar	BIH	1,175.00	113,169	1.0	1993	7.60	0.0760	47.60	0.4760	0.01%
Nessebar	Ancient City of Nessebar	Bulgaria	31.85	13,347	4.2	1983	27.10	0.2710	1,245.60	12.4560	0.85%
Split	Historical Complex of Split with the Palace of Diocletian	Croatia	79.38	178,102	22.4	1979	20.80	0.2080			0.26%
Dubrovnik	Old City of Dubrovnik	Croatia	21.35	43,697	20.5	1979	96.70	0.9670	1,188.60	11.8860	4.53%
Paphos	Paphos	Cyprus	400.00	35,961	0.9	1980	162.02	1.6202			0.41%
Český Krumlov	Historic Centre of Český Krumlov	CZ	22.16	13,141	5.9	1992	51.91	0.5191	1,073.31	10.7331	2.34%
Kutná Hora	Kutná Hora: Historical Town Centre with the Church of St Barbara	CZ	33.05	20,405	6.2	1995	62.44	0.6244	649.90	6.4990	1.89%
Telč	Historic Centre of Telč	CZ	24.86	5,410	2.2	1992	36.00	0.3600	296.50	2.9650	1.45%
Třebíč	Jewish Quarter and St Procopius' Basilica in Třebíč	CZ	57.60	36,330	6.3	2003	6.55	0.0655	136.89	1.3689	0.11%
Tallinn	Historic Centre (Old Town) of Tallinn	Estonia	159.30	413,782	26.0	1997	113.00	1.1300	2,253.00	22.5300	0.71%
Rauma	Old Rauma	Finland	1,110.00	39,828	0.4	1991	29.00	0.2900	142.00	1.4200	0.03%
Paris	Paris, Banks of the Seine	France	105.40	2,200,000	208.7	1991	365.00	3.6500			3.46%
Lyon	Historic Site of Lyon	France	47.90	484,344	101.1		427.00	4.2700	323.00	3.2300	8.91%
Le Havre	Le Havre, the City Rebuilt by Auguste Perret	France	46.95	172,807	36.8	2005	133.00	1.3300	114.00	1.1400	2.83%
Carcassonne	Historic Fortified City of Carcassonne	France	65.08	45,941	7.1	1997	11.00	0.1100	1,358.00	13.5800	0.17%
Provins	Provins, Town of Medieval Fairs	France	14.72	11,736	8.0	2001	108.00	1.0800	1,365.00	13.6500	7.34%
Strasbourg	Strasbourg – Grande île	France	78.26	491,409	62.8	1988	183.00	1.8300	708.00	7.0800	2.34%
Berlin	Berlin	Germany	891.80	3,575,000	40.1		2,160.70	21.6070	281.00	2.8100	2.42%
Lübeck	Hanseatic City of Lübeck	Germany	214.10	214,420	10.0	1987	81.00	0.8100	693.80	6.9380	0.38%
Regensburg	Old town of Regensburg with Stadtamhof	Germany	80.76	145,465	18.0	2006	182.00	1.8200	775.60	7.7560	2.25%
Goslar	Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System	Germany	163.70	41,785	2.6	1992	363.00	3.6300	376.10	3.7610	2.22%
Bamberg	Town of Bamberg	Germany	54.62	75,743	13.9	1993	142.00	1.4200	444.00	4.4400	2.60%
Quedlinburg	Collegiate Church, Castle and Old Town of Quedlinburg	Germany	120.40	21,500	1.8	1994	90.00	0.9000	270.00	2.7000	0.75%
Weimar	Classical Weimar	Germany	84.26	65,542	7.8	1998					0.00%
Wismar	Historic Centres of Stralsund and Wismar	Germany	41.36	44,730	10.8	2002	168.00	1.6800	448.00	4.4800	4.06%

City	WHS	Country	Destination size (km2)	Inhabitants	Inhabitants Density (pop/km2)	Inscription year	WHS Area		WHS Buffer		WHS area /city
							in ha	in km2	in ha	in km2	
Rhodes	Medieval City of Rhodes	Greece	1,408.00	90,000	0.6	1988	65.85	0.6585			0.05%
Chora	The Historic Centre (Chorá) with the Monastery of Saint-John the Theologian and the Cave of the Apocalypse on the Island of Pátmos	Greece	27.34	1,754	0.6	1999	259.38	2.5938	3,041.08	30.4108	9.49%
Budapest	Budapest, including the Banks of the Danube, the Buda Castle	Hungary	525.20	1,759,000	33.5	1987	473.00	4.7300	493.80	4.9380	0.90%
Tel-Aviv	White City of Tel-Aviv -the Modern Movement	Israel	52.00	429,515	82.6	2003	140.40	1.4040	197.00	1.9700	2.70%
Rome	Historic City Centre of Rome	Italy	1,285.00	2,868,000	22.3	1980	1,430.00	14.3000	0.00	0.0000	1.11%
Florence	Historic Centre of Florence	Italy	102.40	382,258	37.3	1982	505.00	5.0500	10,480.00	104.8000	4.93%
Venice	Venice and its Lagoon	Italy	414.60	261,905	6.3	1987					0.00%
San Gimignano	Historic Centre of San Gimignano	Italy	138.00	7,780	0.6	1990	13.88	0.1388			0.10%
Val di Noto	Late Baroque Towns of the Val di Noto	Italy	550.86	24,048	0.4	2002	112.79	1.1279	305.80	3.0580	0.20%
Siena	Historic Centre of Siena	Italy	118.00	53,772	4.6	1995	170.00	1.7000	9.91	0.0991	1.44%
Ferrara	Ferrara, City of the Renaissance, and its Po Delta	Italy	405.20	132,009	3.3	1995	46.71	0.4671	117.65	1.1765	0.12%
Cinque Terre	Portovenere, Cinque Terre, and the Islands (Palmaria, Tino and Tinetto)	Italy	45.12	1,615,441	358.1	1997	4,689.25	46.8925			103.94%
Vincenza	City of Vicenza and the Palladian Villas of the Veneto	Italy	80.00	112,198	14.0	1994	333.87	3.3387			4.17%
Amalfitana	Costiera Amalfitana	Italy	112.31	5,589	0.5	1997	11,231.00	112.3100			100.00%
Sabbioneta	Mantua and Sabbioneta	Italy	37.00	4,216	1.1	2008	235.00	2.3500	2,330.00	23.3000	6.35%
Pienza	Historic Centre of the City of Pienza	Italy	123.00	2,086	0.2	1996	4.41	0.0441			0.04%
Luxembourg	City of Luxembourg: its Old Quarters and Fortifications	Lux	51.47	590,667	114.8	1994	29.94	0.2994	108.73	1.0873	0.58%
Valletta	City of Valletta	Malta	0.80	5,730	71.6	1980	55.50	0.5550			69.38%
Beemster (Amsterdam)	Droogmakerij de Beemster (Beemster Polder)	Netherla	72.07	9,386	1.3	1999	7,208.00	72.0800			100.01%
Bryggen	Bryggen	Norway	445.40	271,949	6.1	1979	1.20	0.0120			0.00%
Røros	Røros Mining Town and the Circumference	Norway	1,956.00	5,583	0.0	1980	16,510.00	165.1000	481,240.00	4812.4000	8.44%
Warsaw	Historic Centre of Warsaw	Poland	517.20	1,745,000	33.7	1980	25.93	0.2593	666.78	6.6678	0.05%
Kraków	Historic Centre of Kraków	Poland	327.00	765,320	23.4	1978	149.65	1.4965	907.35	9.0735	0.46%
Toruń	Medieval Town of Toruń	Poland	115.70	199,469	17.2	1997	48.00	0.4800	300.00	3.0000	0.41%
Évora	Historic Centre of Évora	Portugal	1,307.00	56,596	0.4	1986					0.00%
Guimarães	Historic Centre of Guimarães	Portugal	241.30	158,124	6.6	2001	19.45	0.1945	99.23	0.9923	0.08%
Yaroslavl	Historical Centre of the City of Yaroslavl	Russian	205.00	597,161	29.1	2005	110.00	1.1000	580.00	5.8000	0.54%
San Marino	San Marino Historic Centre and Mount Titano	San Mari	9.76	33,400	34.2	2008	55.00	0.5500	167.00	1.6700	5.63%
Banská Štiavnica	Historic Town of Banská Štiavnica and the Technical Monuments in its Vicinity	Slovakia	205.00	10,228	0.5	1993	20,632.00	206.3200	62,128.00	621.2800	100.64%
Cordoba	Historic Centre of Cordoba	Spain	1,253.00	326,609	2.6	1984	80.28	0.8028	0.00		0.06%
Granada	Alhambra, Generalife and Albayzín, Granada	Spain	88.02	234,758	26.7	1984	450.00	4.5000	67.00	0.6700	5.11%

City	WHS	Country	Destination size (km2)	Inhabitants	Inhabitants Density (pop/km2)	Inscription year	WHS Area		WHS Buffer		WHS area /city
							in ha	in km2	in ha	in km2	
San Cristóbal	San Cristóbal de La Laguna	Spain	484.00	185,917	3.8	1999	60.38	0.6038	23.71	0.2371	0.12%
Cuenca	Historic Walled Town of Cuenca	Spain	72.00	331,888	46.1	1996	22.79	0.2279	170.49	1.7049	0.32%
Ávila	Old Town of Ávila with its Extra-Muros Churches	Spain	231.90	58,083	2.5	1985	36.40	0.3640			0.16%
Aranjuez	Aranjuez Cultural Landscape	Spain	201.10	57,932	2.9	2001	2,047.56	20.4756	16,604.56	166.0456	10.18%
Santiago de Compostela	Santiago de Compostela (Old Town)	Spain	220.00	95,966	4.4	1985	107.59	1.0759	216.88	2.1688	0.49%
Karlskrona	Naval Port of Karlskrona	Sweden	21.72	35,212	16.2	1998	320.42	3.2042	1,105.08	11.0508	14.75%
Visby	Hanseatic Town of Visby	Sweden	12.44	24,330	19.6	1995	77.00	0.7700	29.00	0.2900	6.19%
Bern	Old City of Berne	Switzerl	51.60	130,015	25.2	1983	84.00	0.8400			1.63%
La Chaux-de-Fonds	La Chaux-de-Fonds / Le Locle, Watchmaking Town Planning	Switzerl	55.66	38,625	6.9	2009	213.70	2.1370	2,867.50	28.6750	3.84%
Liverpool	Liverpool – Maritime Mercantile City	UK	111.80	552,267	49.4	2004	136.00	1.3600	750.50	7.5050	1.22%
Total / Average		**-**	**305.37**	**386,366.82**	**25.98**	**-**	**1,105.86**	**11.06**	**11,318.04**	**115.36**	**8.89%**

Remarks:

- Vienna and Liverpool are label in red to highlight their status as WHS ‘in danger’
- Collected data on destination size and number of inhabitants was requested by the relevant city authorities, data on WHS relevant parameters was generated from the UNESCO WHS website (https://whc.unesco.org/en/list/, accessed between the 12.07.2016 and the 14.07.2016)

1.2. Tourism indicators

Destination	WHS	Country	Day-Visitors	Arrivals	Overnight Stays	Visitors	Length of Stay	Arrivals/ Inhabitant	Day-Visitors / Inhabitant	Arrivals per km2	Day-Visitors per city area km2	Day-Visitors per WHSkm2	Arrivals per WHSkm2
Graz	City of Graz – Historic Centre and Schloss Eggenberg	Austria	n.a.	624,180.00	1,157,110.00	624,180.00	n.a.	2.3	n.a.	48.9	n.a.	n.a.	86.7
Salzburg	Historic Centre of the City of Salzburg	Austria	6,500,000.00	1,758,056.00	3,043,552.00	1,758,056.00	1.7	12.0	44.3	267.7	989.6	27,542.4	74.5
Vienna	Historic Centre of Vienna	Austria	22,000,000.00	7,099,233.00	15,512,730.00	7,099,233.00	3.2	3.8	11.6	171.2	530.6	n.a.	191.4
Baku	Palace and Maiden Tower	Azerbaijan	399,392.00	13,455.00	63,423.00	399,392.00	2.6	0.0	0.2	0.1	1.9	18,576.4	6.3
Brugge	Historic Centre of Brugge	Belgium	5,270,000.00	1,270,000.00	2,200,000.00	5,270,000.00	1.75	10.8	44.9	91.8	380.8	12,853.7	31.0
Mostar	Old Bridge Area of the Old City of Mostar	BIH	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nessebar	Ancient City of Nessebar	Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dubrovnik	Old City of Dubrovnik	Croatia	n.a.	1,174,878.00	1,190,000.00	1,174,878.00	1.8	26.9	n.a.	550.3	n.a.	n.a.	121.5
Split	Historical Complex of Split with the Palace of Diocletian	Croatia	n.a.	720,325.00	1,235,000.00	720,325.00	3.4	4.0	n.a.	90.7	n.a.	n.a.	346.3
Paphos	Paphos	Cyprus	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Český Krumlov	Historic Centre of Český Krumlov	CZ	466,429.00	n.a.	n.a.	466,429.00	n.a.	n.a.	35.5	n.a.	210.5	8,985.3	n.a.
Kutná Hora	Church of St Barbara and the Cathedral of Our	CZ	376,700.00	n.a.	n.a.	376,700.00	n.a.	n.a.	18.5	n.a.	114.0	6,033.3	n.a.
Telč	Historic Centre of Telč	CZ	109,425.00	n.a.	n.a.	109,425.00	n.a.	n.a.	20.2	n.a.	44.0	3,039.6	n.a.
Třebíč	Jewish Quarter and St Procopius' Basilica in Třebíč	CZ	46,400.00	n.a.	n.a.	46,400.00	n.a.	n.a.	1.3	n.a.	8.1	7,084.0	n.a.
Tallinn	Historic Centre (Old Town) of Tallinn	Estonia		1,728,429.00	3099102	1,728,429.00	2.8	4.2	0.0	108.5	0.0	n.a.	153.0
Rauma	Old Rauma	Finland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Provins	Provins, Town of Medieval Fairs	France	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Strasbourg	Strasbourg – Grande île	France	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Carcassonne	Historic Fortified City of Carcassonne	France	1,700,000.00	n.a.	n.a.	1,700,000.00	n.a.	n.a.	37.0	n.a.	261.2	154,545.5	n.a.
Le Havre	Le Havre, the City Rebuilt by Auguste Perret	France	2,000,000.00	n.a.	n.a.	2,000,000.00	n.a.	n.a.	11.6	n.a.	426.0	15,037.6	n.a.
Lyon	Historic Site of Lyon	France	6,000,000.00	n.a.	n.a.	6,000,000.00	n.a.	n.a.	12.4	n.a.	1,252.6	14,051.5	n.a.
Paris	Paris, Banks of the Seine	France	40,000,000.00	33,900,000.00	35,600,000.00	40,000,000.00	2.5	15.4	18.2	3,216.3	3,795.1	109,589.0	928.8
Berlin	Berlin	Germany	n.a.	12,970,000.00	31,140,000.00	12,970,000.00	2.4	3.6	n.a.	145.4	n.a.	n.a.	60.0
Weimar	Classical Weimar	Germany	n.a.	715,437.00	379554	715,437.00	1.9	10.9	n.a.	84.9	n.a.	n.a.	
Lübeck	Hanseatic City of Lübeck	Germany	n.a.	713,331.00	1,684,397.00	713,331.00	2.36	3.3	n.a.	33.3	n.a.	n.a.	88.1
Regensburg	Old town of Regensburg with Stadtamhof	Germany	n.a.	615,000.00	1,064,094.00	615,000.00	1,1	4.2	n.a.	76.2	n.a.	n.a.	33.8
Bamberg	Town of Bamberg	Germany	n.a.	307,160.00	684,500.00	307,160.00	2.6	4.1	n.a.	56.2	n.a.	n.a.	21.6
Goslar	Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System	Germany	n.a.	283,478.00	716,518.00	283,478.00	2.5	6.8	n.a.	17.3	n.a.	n.a.	7.8
Wismar	Historic Centres of Stralsund and Wismar	Germany	n.a.	39,346.00	92,807.00	39,346.00	n.a.	0.9	n.a.	9.5	n.a.	n.a.	2.3
Quedlinburg	Collegiate Church, Castle and Old Town of Quedlinburg	Germany	n.a.		462,007.00	300,000.00	2.4	0.0	n.a.	n.a.	n.a.	n.a.	
Chora	Monastery of Saint-John the Theologian and the Cave of the Apocalypse on the Island of	Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rhodes	Medieval City of Rhodes	Greece	1,400,000.00			1,400,000.00			15.6	0.0	9.9	21,260.4	n.a.
Budapest	the Buda Castle Quarter and Andrássy Avenue	Hungary	n.a.	4,085,178.00	1,500,000.00	4,085,178.00	1.5	2.3	n.a.	77.8	n.a.	n.a.	86.4
Tel-Aviv	White City of Tel-Aviv -the Modern Movement	Israel	n.a.	3,600,000.00	22,400,000.00	3,600,000.00	8.2	8.4	n.a.	692.3	n.a.	n.a.	256.4

Destination	WHS	Country	Day-Visitors	Arrivals	Overnight Stays	Visitors	Length of Stay	Arrivals/ Inhabitant	Day-Visitors / Inhabitant	Arrivals per km2	Day-Visitors per city area km2	Day-Visitors per WHSkm2	Arrivals per WHSkm2
Pienza	Historic Centre of the City of Pienza	Italy	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Amalfitana	Costiera Amalfitana	Italy	114,000.00	n.a.	n.a.	114,000.00	n.a.	n.a.	20.4	n.a.	10.2	10.2	n.a.
Cinque Terre	Portovenere, Cinque Terre, and the Islands (Palmaria, Tino and Tinetto)	Italy	397,000.00	n.a.	n.a.	397,000.00	4.3	n.a.	0.2	n.a.	88.0	84.7	n.a.
Ferrara	Ferrara, City of the Renaissance, and its Po Delta	Italy	400,000.00	n.a.	n.a.	400,000.00	n.a.	n.a.	3.0	n.a.	9.9	8,563.1	n.a.
Florence	Historic Centre of Florence	Italy	10,200,000.00	n.a.	n.a.	10,200,000.00	3.4	n.a.	26.7	n.a.	996.1	20,198.0	n.a.
Rome	Historic City Centre of Rome	Italy	21,000,000.00	14,694,364.00	29,290,000.00	21,000,000.00	3.63	5.1	7.3	114.4	163.4	14,685.3	n.a.
Sabbioneta	Mantua and Sabbioneta	Italy	70,000.00	n.a.	n.a.	70,000.00	n.a.	n.a.	16.6	n.a.	18.9	297.9	n.a.
San Gimignano	Historic Centre of San Gimignano	Italy	4,000,000.00	n.a.	n.a.	4,000,000.00	n.a.	n.a.	514.1	n.a.	289.9	288,184.4	n.a.
Siena	Historic Centre of Siena	Italy	636,000.00	348,000.00		636,000.00	n.a.	6.5	11.8	29.5	53.9	3,741.2	20.5
Val di Noto	Late Baroque Towns of the Val di Noto	Italy	867,833.00	n.a.	n.a.	867,833.00	n.a.	n.a.	36.1	n.a.	15.8	7,694.2	n.a.
Venice	Venice and its Lagoon	Italy	4,400,000.00	n.a.	n.a.	4,400,000.00	2.4	n.a.	16.8	n.a.	106.1	n.a.	
Vincenza	City of Vicenza and the Palladian Villas of the Veneto	Italy	260,000.00	n.a.	n.a.	260,000.00	n.a.	n.a.	2.3	n.a.	32.5	778.7	n.a.
Luxembourg	City of Luxembourg: its Old Quarters and Fortifications	Lux	n.a.	1,156,000.00	n.a.	1,156,000.00	1.9	2.0	n.a.	224.6	n.a.	n.a.	386.1
Valletta	City of Valletta	Malta	n.a.	2,000,000.00	n.a.	2,000,000.00	n.a.	349.0	n.a.	25,000.0	n.a.	n.a.	360.4
Beemster (Amsterdam)	Droogmakerij de Beemster (Beemster Polder)	Netherlands	5,300,000.00	n.a.	n.a.	5,300,000.00	1.9	n.a.	564.7	n.a.	735.4	735.3	n.a.
Bryggen	Bryggen	Norway	1,700,000.00	n.a.	n.a.	1,700,000.00	2.3	n.a.	6.3	n.a.	38.2	1,421,404.7	n.a.
Røros	Røros Mining Town and the Circumference	Norway	50,000.00	n.a.	107,000.00	50,000.00		n.a.	9.0	n.a.	0.3	3.0	n.a.
Kraków	Historic Centre of Kraków	Poland	9,100,000.00	n.a.	n.a.	9,100,000.00	2.2	n.a.	11.9	n.a.	278.3	60,808.6	n.a.
Toruń	Medieval Town of Toruń	Poland	1,500,000.00	n.a.	n.a.	1,500,000.00	n.a.	n.a.	7.5	n.a.	129.6	31,250.0	n.a.
Warsaw	Historic Centre of Warsaw	Poland	9,600,000.00	n.a.	n.a.	9,600,000.00	2.2	n.a.	5.5	n.a.	185.6	370,227.5	n.a.
Évora	Historic Centre of Évora	Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Guimarães	Historic Centre of Guimarães	Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Yaroslavl	Historical Centre of the City of Yaroslavl	Russian	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
San Marino	San Marino Historic Centre and Mount Titano	San Mari	n.a.	78,000.00	n.a.	78,000.00	1.3	2.3	n.a.	79.9	n.a.	n.a.	14.2
Banská Štiavnica	Historic Town of Banská Štiavnica and the Technical Monuments in its Vicinity	Slovakia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Santiago de Compostela	Santiago de Compostela (Old Town)	Spain	n.a.	2,600,000.00	1,500,000.00	2,600,000.00	1.7	27.1	n.a.	118.2	n.a.	n.a.	241.7
Aranjuez	Aranjuez Cultural Landscape	Spain	293,287.00	n.a.	n.a.	293,287.00	n.a.	n.a.	5.1	n.a.	14.6	143.2	n.a.
Ávila	Old Town of Ávila with its Extra-Muros Churches	Spain	301,359.00	n.a.	n.a.	301,359.00	n.a.	n.a.	5.2	n.a.	13.0	8,279.1	n.a.
Cordoba	Historic Centre of Cordoba	Spain	3,300,000.00	n.a.	n.a.	3,300,000.00	n.a.	n.a.	10.1	n.a.	26.3	41,106.1	n.a.
Cuenca	Historic Walled Town of Cuenca	Spain	980,321.00	n.a.	n.a.	980,321.00	n.a.	n.a.	3.0	n.a.	136.2	43,015.4	n.a.
Granada	Alhambra, Generalife and Albayzín, Granada	Spain	2,900,000.00	n.a.	6,000,000.00	2,900,000.00	n.a.	n.a.	12.4	n.a.	329.5	6,444.4	n.a.
San Cristóbal	San Cristóbal de La Laguna	Spain	1,180,000.00	n.a.	55,421.00	1,180,000.00	n.a.	n.a.	6.3	n.a.	24.4	19,542.9	n.a.
Karlskrona	Naval Port of Karlskrona	Sweden	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Visby	Hanseatic Town of Visby	Sweden	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
La Chaux-de-Fonds	La Chaux-de-Fonds / Le Locle, Watchmaking Town Planning	Switzerl	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Bern	Old City of Berne	Switzerl	n.a.	432,055.00	n.a.	432,055.00	2	3.3	n.a.	83.7	n.a.	n.a.	51.4
Liverpool	Liverpool – Maritime Mercantile City	UK	n.a.	839,000.00	n.a.	839,000.00	3.8	1.5	n.a.	75.0	n.a.	n.a.	61.7
Average		-	**4,578,281.83**	**3,606,342.50**	**6,674,050.63**	**3,217,093.43**	**2.6**	**19.29**	**42.53**	**1,165.3**	**316.8**	**80,758.7**	**154.1**

Table 3 Tourism indicators - part 2

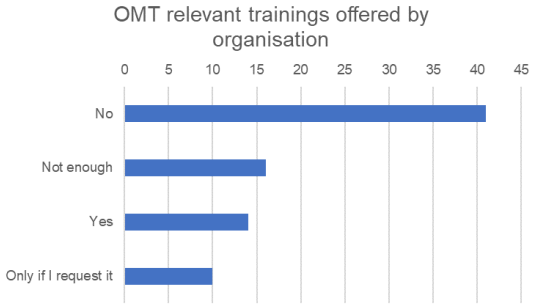
Remarks:

Data on touristic figures was generated from published tourism reports of the destinations or via personal communications with destination management personal

2. Organisational attitude towards OMT use

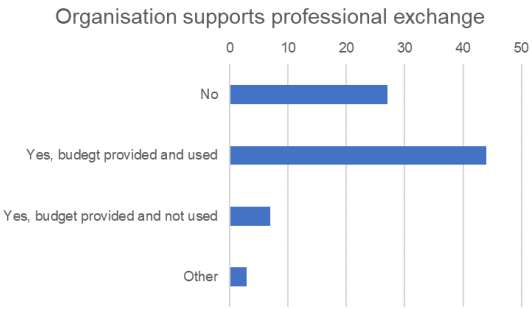
2.1. Relevant trainings offered by the organisation

		OMT relevant trainings offered by organisation		
		Frequency	Percent	Valid Percent
Valid	No	41	50.6	50.6
	Not enough	16	19.8	19.8
	Yes	14	17.3	17.3
	Only if I request it	10	12.3	12.3
	Total	81	100	100



2.2. Professional exchange supported by organisation

		Organisation supports professional exchange		
		Frequency	Percent	Valid Percent
Valid	No	27	33.3	33.3
	Yes, budegt provided and used	44	54.3	54.3
	Yes, budget provided and not used	7	8.6	8.6
	Other	3	3.7	3.7
	Total	81	100	100



2.2.1. Correlations Professional exchange – perceived quality of solutions

		Perceived quality of digital interpretive solutions	Organisation supports Professional Exchange
Perceived quality of digital interpretive solutions	Pearson Correlation	1	.522**
	Sig. (2-tailed)		.000
	N	65	65
Organisation supports Professional Exchange	Pearson Correlation	.522**	1
	Sig. (2-tailed)	.000	
	N	65	81

** Correlation is significant at the 0.01 level (2-tailed).

Note:

Data of the online survey used within this thesis only summarise the most crucial findings relevant for the analysis. More data was collected as part of the online survey which was not included. The complete set of data is available upon request by the author.

Appendix III – National strategies relevant for tourism mobility

This section provides a chronological overview of national strategies relevant for tourism mobility and highlights key foci as well as summaries suggestions for an effective establishment of tourism mobility.

In March 2019 the latest tourism mobility guidelines were released as joint project of the Federal Ministry for Sustainability and Tourism (BMNT) and the Federal Ministry of Transport, Innovation and Technology (BMVIT) and focusses on the provision of 'soft' mobility. The guidelines are called 'How to make my destination sustainably mobile?" and were designed to educate practitioners and people in charge for the management for touristic destination in terms of tourism mobility matters as well as support them to optimise, upgrade and adjust tourism mobility structures on-site.

Key suggestions comprise:

- The establishment of 'mobility as service' which describes a more customer oriented and user-friendly mobility provision
- Luggage logistics services
- Improvement of multi-modal mobility services, to increase interactivity to use and user-friendliness
- Focus on intra-destination mobility with emphasis on adequate signages and information on-site as well as attuned intra-destination transportation services
- Improvement of online information and development of a sophisticated, ubiquitous information and communication structure which accompanies the visitor throughout the stay

Federal Ministry for Sustainability and Tourism (BMNT) released the 'Plan T' in 2019. The federal tourism masterplan emphasis on the importance of tourism for Austria (BMNT, 2019). It integrates and orients on the Sustainability Goals of the UN Agenda 2030. The plan acknowledges tourism mobility (TM) as relevant factor for sustainable development and highlights the share of tourism mobility on the production of overall CO2 emissions as well as identifies tourism mobility among tourism chain elements with the most severe impact on environments.

Suggestions comprise:

- Emphasis on environmentally friendly solutions for reaching and leaving the destination

- Sustainability of mobility at destination needs to be improved > special focus on added values & integration of host-community in TM schemes
- Focus on development of integrative mobility schemes by combining mobility modes for tourists
- Emphasis to increase cooperation between tourism and mobility sector
- Consideration of TM in overall traffic concepts

In 2015 the Federal Ministry for Sustainability and Tourism (BMNT) and the Federal Ministry of Science, Research and Economy (BMWFW) published first ‘guidelines’ which focussed on touristic mobility. Overall, the publication could be considered more of an explanatory paper which covered an introduction to the topic, explaining the interdependencies of tourism and mobility to raise awareness on tourism mobility issues. Furthermore, different mobility modes and their relevance for tourism were outlined and examples on tourism mobility management and activities from the international down to the local level were given. Although, the ‘Sustainable Mobility in Tourism’ guidelines had largely a descriptive character, the significant impacts of touristic mobility on the sustainability of environments and climate change was emphasised as well as the role of the largely neglected day-visitors as key producer of tourism mobility effects was highlighted.

For the first time, the paper also discussed the administrative and political structure relevant for tourism mobility, including a discussion of responsible and involved bodies and organisations as well as of relevant plans, concepts and strategies which provide the fundamental framework and shape tourism mobility in Austria.

In 2010 the economics ministry released the concept ‘Neue Wege im Tourismus’ (New Ways for Tourism) which depicts a comprehensive tourism strategy for Austria. Although, the concept is market focused, it was one of the first

It highlights that tourism needs to be established as integrative aspect in urban planning and traffic politics.

Suggestions comprise:

- Expansion of bicycle-networks
- Expansion of actions against traffic aggravation (e.g. increase of fees for short-term parking)

- Improvement of available online information on mobility network and option (including multiple languages)
- Guest cards which entitle visitor to complimentary use of public transportation (costs covered by guest tax)
- More advertisement on available public transportation services
- Establishment of luggage logistics

Furthermore, the Austria Tourism Agency has released a Digitalisation Strategy for Tourism in 2017. In this paper mobility aspects are omitted but digital transformation is highlighted as one of the biggest challenges for tourism and supporting sectors. As well as the provision of an area-wide coverage of online connection is emphasised due to increasing OMT-usage of tourists.

In addition to the strategic papers on Tourism Mobility, an annual meeting, the 'Tourism Mobility Days', was established and launched on 2014 to connect key stakeholders and discuss best practice examples.

The Federal Ministry of Transport, Innovation and Technology (BMVIT) realised the Traffic and Transport Plan for Austria in 2012, with the focus on more efficient traffic systems. It also integrates the UN Agenda 2030 goals. The plan emphasises on the integration and consideration of tourism and tourism mobility in transport politics.

Further suggestions comprise:

- Emphasis on the development of a sustainable, multi-modal transportation network for tourists
- Improving efficiency of existing transportation network also for tourism

Another relevant national concept is the Spatial Development Concept released by the Society for Spatial Planning (ÖREK) in 2011. It also integrates the UN Agenda 2030 goals. The concept takes as holistic approach towards tourism and highlights the interdependency for regions, landscape, environments, society, economies and tourism. Tourism depends on intact spatial, cultural and natural landscapes, it markets the uniqueness of places and heritage, thus, a central focus of tourism is the safeguarding and protection of these assets to maintain economic resilience. The main goals of the concept are to safeguard and reinforce the raison d'être of

peripheral regions (which are often used for touristic purposes) in order to ensure the availability of needed financial support to continuously provide mobility services in these areas.

Suggestions comprise:

- Urgent need for spatial planning and touristic development to continuously reconciliation and coordinate
- To consider the tourism as competitive factor for a region (with potential to support structurally weak areas) and integrate these considerations into spatial planning and development
- Considerations on effects of touristic developments on the local social and cultural environmental and structure
- Impact on touristic developments on traffic system
- Need to consider tourism not as spatial use confined to a certain area in the destination but affecting the whole destination (tourists tend to roam around)

Appendix IV – Selected research projects on tourism mobility

Name	Description	Year(s)
CIVITAS DESTINATIONS	The project builds up an integrated approach to address mobility and tourism, testing balanced strategies to face the rising challenges of these two growing sectors and to achieve sustainable development and a better quality of life in touristic utilized cities. The project develops a set of innovative solutions for the implementation of sustainable mobility measures to offer intelligent sustainable transport solutions for tourists and residents. A cooperative approach is taken, which integrates all major stakeholders of six participating European sites, in the development process of the innovation solutions. The solutions aim to improve urban accessibility, the cost effectiveness and integration of transport services and to reduce emissions and energy consumption. (Civitas, 2020) Preliminary solutions cover: • sustainable urban mobility planning for residents and visitors • safe, attractive, and accessible public spaces for all generations • shared mobility and e-infrastructures towards zero emissions transport • smart and clean urban freight logistics at tourist destinations • mobility management and awareness for sustainable mobility • attractive, clean, accessible, and efficient public transport	2016-2020
DESTI-SMART Delivering Efficient Sustainable Tourism with low-carbon transport Innovations:	The project addresses challenges to deliver efficient sustainable tourism. Key focus is to promote sustainable mobility and accessibility with low-carbon transport in tourism destinations. (DESTI-SMART, 2020)	2014-2020

Name	Description	Year(s)
Sustainable Mobility, Accessibility and Responsible Travel	Addressed issues are: • considerations on investments necessary for the shift to low-carbon travel solutions and e-mobility • improvements of inter-modality facilities and multi-modality solutions for visitors • accessibility for visitor with mobility difficulties • integration of cycling and walking concepts into tourism mobility strategies	
STARTER Sustainable Transport for Areas with Tourism through Energy Reduction	The overall aim was to promote energy efficient and sustainable mobility. The concept of 'Local Travel Plan Networks (LTPN)' was applied in 5 sites) to engage stakeholders in the adoption of a common strategy to shift tourists from private cars to more sustainable mobility options. (Jorna, 2014) Key findings: • implementation of soft measures (on-line information; policy and promotion measures; fleet-related measures and promotion of public transport) significantly influenced visitor travel behaviour towards sustainable transport modes • the motivation of local stakeholders to participation was largely possible after ID of concrete issues • touristic traffic peaks depicted a great challenge and needed to be considered for planning and when implementing mobility measures	2012-2014

Name	Description	Year(s)
K2K - Consortium development zero-emission tourism mobility	A cooperation project between Austria and the Netherlands, to evaluate the use of electric vehicles for the utilization at touristic destination to lower CO2-footprint (Netherlands Enterprise Agency, 2018). Key finding: • the use of electric vehicles for tourism under-researched • limited battery range is key concern for tourists • stakeholders are very slow in adapting and promoting e-mobility solutions for tourism • good available of charging infrastructure • limited availability of e-rentals	2017 - 2019
MOVELETUR	The project aimed to promote a sustainable and clean tourism model for visitors of bordering natural spaces and the creation of an e-vehicle network (e.g. e-bikes) and 'green' tourist itineraries that connect points of natural and cultural value. Strong focus on management and governance aspects as well as on necessary upgrades of infrastructure. Preliminary key findings describe mainly challenges for infrastructure upgrades, stakeholder engagement and amendments of policy structures, but also included best practice examples (FEDARENE, 2020b).	2017-2020
LOCATIONS Low carbon transport in cruise destination cities	The project perceived cruise ship tourism as economic added value for coastal cities and aims to support local public administrations in drafting Low-Carbon Transport and mobility Plans (LCTPs) with measures dedicated to cruise-related passengers and	2014-2020

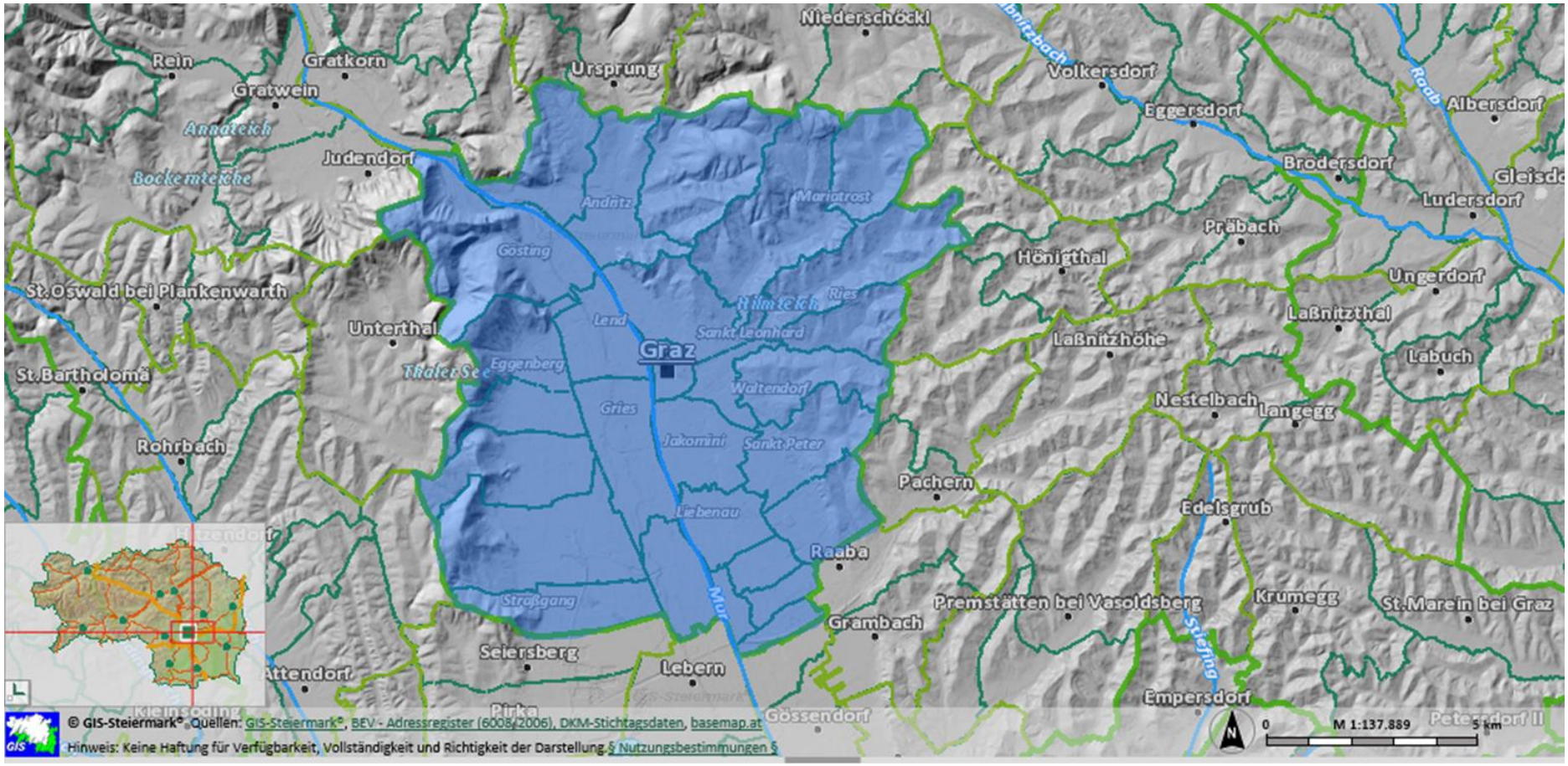
Name	Description	Year(s)
	freight flows, contributing to decongest the city traffic and to lower the production of greenhouse gases. Preliminary progress: LCTPs were used to assess nine project partner cities, findings were used to develop a risk-management-based modular catalogue which is meant to be used for replication and transfer of the LOCATIONS approach at other coastal destinations (FEDARENE, 2020a).	
MOBILITAS Mobility for nearly-zero CO2 in Mediterranean urban tourism destinations	The project aimed to reduce negative impacts caused by tourism flows on environments, host community and infrastructures and enhance the overall sustainability by promoting low carbon mobility models in Mediterranean tourist areas for visitor and residents (ENERGIES2050, 2020). Key solutions: • elaboration of mobility scenarios for urban planning and city management interventions • using IT tools to enhance communication with visitors • introducing electrical and sharing mobility solutions • publication of sustainable tourism mobility handbook	2014-2020
SEEMORE	The project focused on introducing energy-efficient transport solutions for visitors in 8 coastal tourist regions of Europe. The project took a participative approach to establish	2012-2015

Name	Description	Year(s)
	a strong stakeholder structure and cross-sectoral cooperation networks (CINESI, 2015). Final outputs of the project: • Mobility information packages for tourists • Communication and awareness raising campaigns • Improved sustainable mobility options • Integrated products for leisure and mobility • Integrated planning processes taking the needs of tourists into account	
CIVITAS SUMPs-Up Sustainable Urban Mobility Planning	The project seeks to enable mobility planning authorities across Europe to adopt Sustainable Urban Mobility Plans (SUMPs). Key focus is to lower the barriers to the implementation of more energy-efficient and sustainable urban mobility planning. (SUMPs-Up, 2020).	2016-2020
TRACE	The project assessed the potential of movement tracking services to enhance planning and promote walking and cycling in cities. The project produced three different tracking tools which are meant to promote walking and cycling. The apps used gamifications **a**nd incentive scheme to enhance walking and bike usage.	2015-2018

Appendix V – Case Study – Vienna

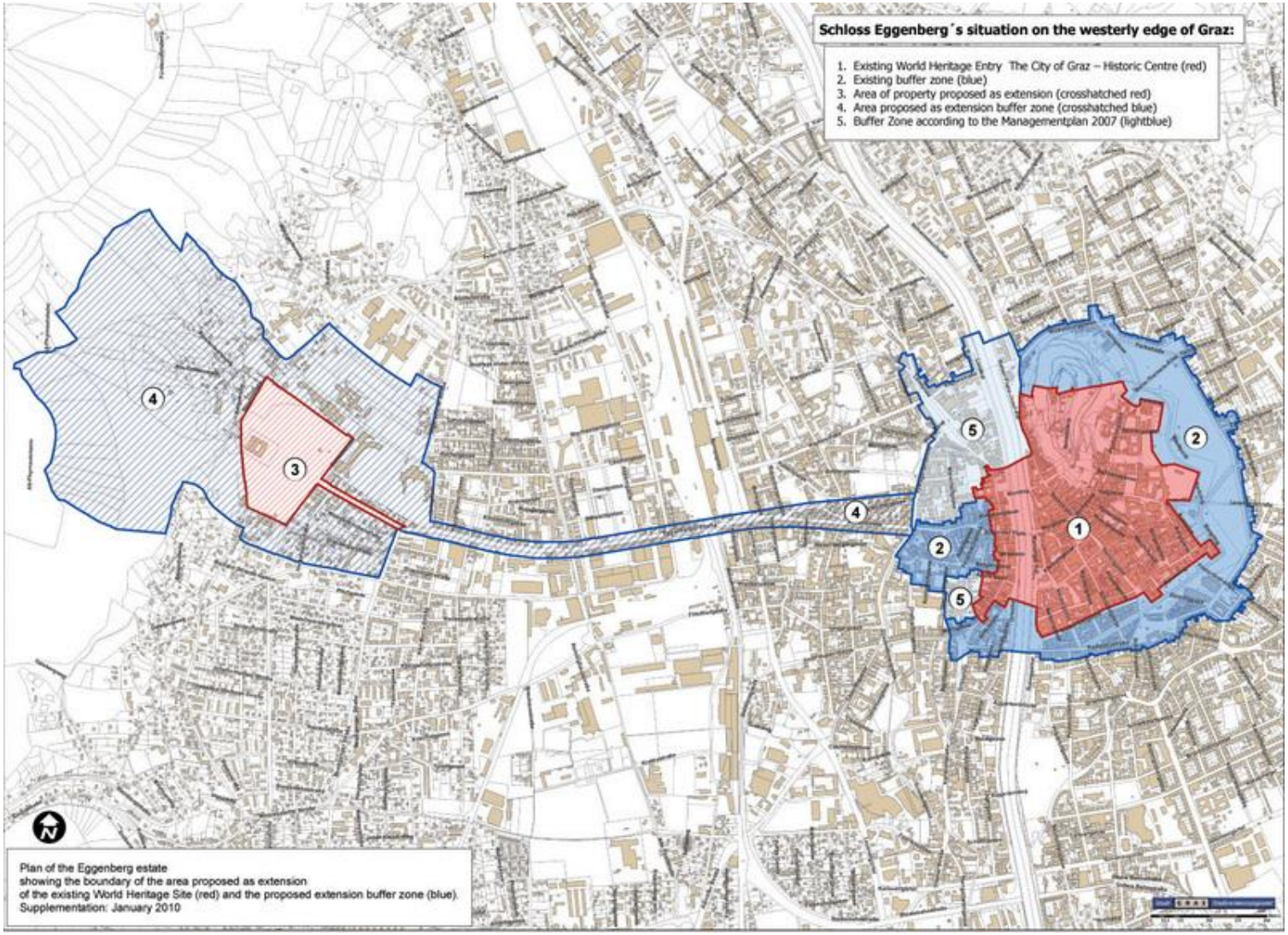
UNESCO WHS area maps

Appendix VI – Case Study – Graz



Shaded map of City area of Graz (Federal State Steiermark, 2020)

UNESCO WHS map of Graz



UNSEC WHS areas in Graz (UNESCO, 2020)