

Title:

**Social Network Analysis as a methodological tool
to understand University-Industry Dynamism in
enhancing the HEI curriculum - A case of the
Nigerian Oil Industry**

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Abstract

This article applies social network analysis (SNA) as a methodological tool to investigate University–Industry (U–I) dynamism within the context of the Nigerian oil and gas industry. It examines the roles multiple stakeholders should play in enhancing an up-to-date curriculum in higher education institutions (HEIs). Based on stakeholder theory, participants were categorised into real stakeholders, stakewatchers and stakekeepers. Drawing from documentary evidence and 28 semi-structured interviews, three main themes emerged from thematic content analysis: (1) curriculum dynamism and the need for curriculum modification, (2) tutor-practitioner interaction and (3) issues surrounding U-I dynamism. Findings revealed that the present curriculum is not in tandem with current industry requirements, and the level of interactivity between the industry stakeholders and universities is low, thus having a knock-on effect on the dynamicity of the HEI curriculum. Further tests revealed that industry stakeholders occupy the position of global centrality within the network rather than government who are the regulators; a network density of 0.86 was obtained, mainly consisting of industry stakeholder groups while HEIs largely accounted for the residual unconnectedness (14%) within the network.

Keywords: university–industry dynamism; curriculum development; social network analysis; oil and gas industry, higher education institutions, Nigeria.

Introduction

In this paper, we adopt the Social Network Analysis (SNA) methodology to investigate University–Industry (U–I) dynamism¹ with respect to the roles that multiple stakeholders, including government, play in enhancing an up-to-date curriculum in Higher Education Institutions (HEIs). This research provides a novel contribution firstly by extending Fassin’s (2009) stakeholder theory beyond firm application and applying it to a network of multiple stakeholders. Multi-stakeholder networks are those in which actors from civil society, business and governmental institutions come together in order to find a common approach to an issue that affects them all (Roloff, 2008, p. 238). Secondly, in response to the call by Caniels and van den Bosch (2010), we use SNA as a methodology to examine the interaction and interrelationships that exist among academia, industry and government, from stakeholders’ points of view. Thirdly, we investigate the effects of any relationship gap that may exist among them. Given the dynamic nature of the firm (Teece and Pisano, 1994), we consider the HE curriculum as our unit of analysis, which requires a corresponding dynamism from HEIs. Our main research question is: Given the dynamic nature of industry, what are the roles of multiple stakeholders in enhancing an up-to-date curriculum?

The study was carried out within the Nigerian oil and gas industry context. The oil and gas industry provides a good fit for our research because this industry provides over 90% of the country’s revenue (CBN, 2019). Expectedly the necessary infrastructures should be in place to ensure continuous progress in the industry. Our selection is further underpinned in the literature, which suggests that key sectors of any economy play an important role in evaluating the well-being of countries (Hajkowicz *et al.*, 2011). In addition, Leal (2015) argues that the determinants of aggregate productivity in an economy are affected by the policies of their key sectors.

¹ Our concept of dynamism is drawn from the strategic management literature, which suggests that a dynamic industry is one that is changing rapidly or situations where there is rapid change in technology (Teece *et al.*, 1997)

The rest of the paper provides key discussions on University-Industry Collaboration (U-IC) and SNA. We then provide some discussion on theory and an analytical framework. Drawing from 28 interviews across seven stakeholder groups, our findings through SNA reveal the level and extent of interrelationships among these three key sectors: academia, government and industry. We conclude by discussing the theoretical contribution to Fassin's (2009) stakeholder theory and provide some key recommendations on how to further strengthen the U-I relationship, in order to enhance an up-to-date curriculum, hence providing relevance for industry.

University-Industry Collaboration (U-IC)

Extensive research has been carried out on U-IC with a focus on various aspects ranging from technology transfer (Lee, 1996; Siegel *et al.*, 2003a; Bruneel *et al.*, 2010; Fischer *et al.*, 2019), knowledge transfer (Guis-heng and Yi, 2001; Siegel *et al.*, 2003b; Bekkers and Freitas, 2008; Steinmo and Rasmussen, 2018), and social capital (Thune, 2007; Al-Tabbaa and Ankrah, 2016 and 2018) to research and development (R&D) (Barnes *et al.*, 2002; Fontana *et al.*, 2006; Abramo *et al.*, 2009; Pinheiro *et al.*, 2015) amongst others. Despite these ground-breaking studies, it appears that the fundamental underpinning for these developments has attracted little research. According to Fallows and Steven (2000), understanding academic theories has now become insufficient to enhance the prospect of employment. This is because industry has become increasingly dynamic in its capabilities (competencies and resources) (Teece, 2012), thus requiring a corresponding dynamism in the HEI curriculum. Though there is pressure on practitioners to clearly highlight their needs and provide the required feedback to academia (Santoro and Betts, 2002), universities are also encouraged to further engage with practitioners to understand theirs too and better focus their research on important issues (Gao and Rhinehart, 2004).

U-ICs have not been without barriers. According to Bruneel *et al.* (2010), two main barriers have hindered U-IC: (i) orientation-related barriers, which refer to the difference in U-I orientation; and (ii) transaction-related barriers, which stress the conflict that arises over intellectual property (IP) between university and industry. Welsh *et al.* (2008) argue that university scientists' views of working with industry are quite conflicting, as the latter believes that such collaborations could limit communication with other scientists. Regarding IP, scientists also believe that university IP policies would help shield their ground-breaking discoveries from industry, which has the potential to attract university-industry partnership. Such conflicting assertions and assumptions are major factors that have led to U-I barriers. The interest by university and industry to exploit financial gain from collaboration seems to be a key factor militating against U-IC (Henderson *et al.*, 1998; Mowery and Ziedonis, 2002), although Perkmann *et al.* (2013, p. 423) contend that academic engagement differs from commercialisation since it is predominantly based upon *traditional academic research activities*. Suggested ways to mitigate U-I barriers include developing operating routines for such collaborations, deepening the existing level of interactions between university and industry and building trust from these interactions (Bruneel *et al.*, 2010).

Social Network Analysis (SNA)

Social life is becoming increasingly characterised by interdependencies, especially as technology continues to shrink the world, by bringing individuals geographically far from each other in close social contact. Social networks generally exist among people working together in a firm, corporation or industry. They are linkages of a group of people who possess similar or complementary characteristics (see Serrat, 2010 for further explanation). SNA can be used to investigate the interrelationship that exists between stakeholders in natural resource management (Reed *et al.*, 2009; Toikkanen and Lipponen, 2011). Ultimately, these interrelationships lead to the notion that the collective action of

actors within a network is pivotal for their outcome, compared to actors' individual attributes (Pinheiro *et al.*, 2015).

Several authors have utilised SNA as a methodological tool for research in higher education. Daly *et al.* (2010) examined the formal and informal social network structures that exist among teachers in an under-performing district. Three main social networks examined were: lesson planning, reading comprehension and effort recognition. Dawson and Hubball (2014) examined the use of curriculum analytics as a tool to map students' pathways as they progress through a programme. This was carried out using SNA to establish the links between different courses in order to inform strategic decision making on curriculum design. Pinheiro *et al.* (2015) utilised SNA as a methodological approach to understand U–I relationships in the context of R&D cooperation networks for innovation. These studies all utilised SNA as the methodological tool in an education-related research, and in fact considered the curriculum as an important aspect of their relational ties.

The novelty of our study is that it uses SNA to investigate U-IC, using the HEI curriculum as the main unit of analysis. While Pinheiro *et al.* (2015) focussed on U-ICs, using R&D as the unit of analysis, we emphasise the interaction of key actors within the network, using SNA as the key methodology. Their study utilised a more direct framework, which has the likelihood of introducing noise² into the data. Our study resolves this issue by using a hybrid framework. In addition, our study utilises data from an economically developing country, i.e. Nigeria, thus it is interestingly novel to see how the SNA tool will perform in this situation.

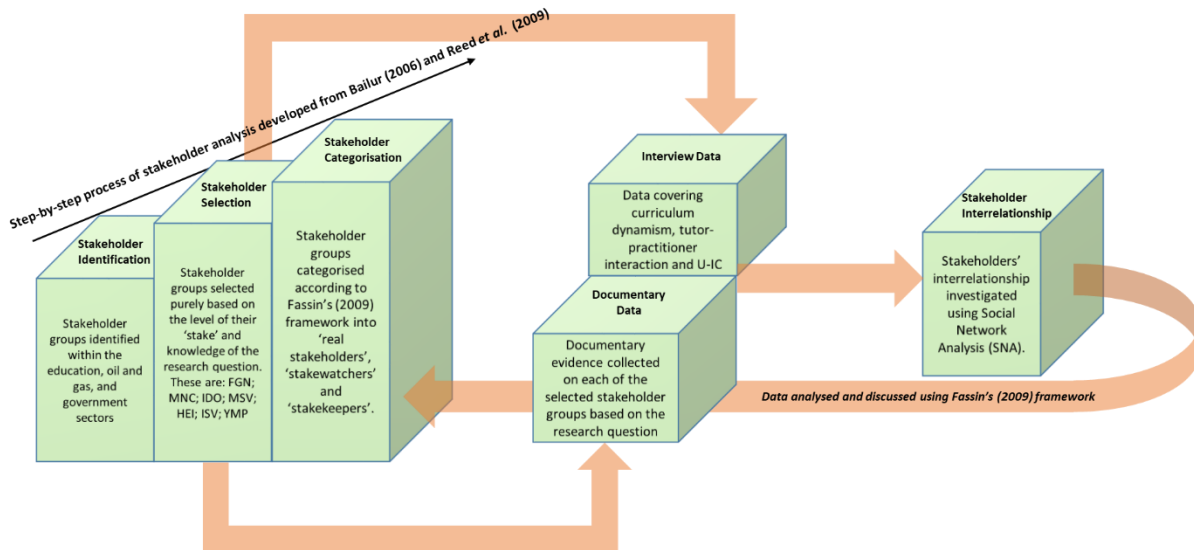
Stakeholder Framework

Several definitions from differing perspectives have been provided in the literature on stakeholders. These perspectives include legitimacy (Hill and Jones, 1992; Brenner, 1993; Donaldson and Preston, 1995), interest (Savage *et al.*, 1991; Clarkson, 1995; Argandoña, 1998) and influence (Clarkson *et al.*, 1994; Gray *et al.*, 1997; Miles, 2012). In line with the aim of our study, our research is centred on the latter perspective (influence), which defines stakeholders as an association or group that can influence the execution of work or its outcomes (Miles, 2012).

For this study, we adopted a hybrid framework developed from Reed *et al.* (2009) and Bailur (2006), intentionally to guide the step-by-step selection process of the participants that form each stakeholder group. Our aim was to select participants who would provide key information on the dynamism of the university curriculum. Whilst appreciating the model of Ackermann and Eden (2011), which helps to determine the level of power and interest of any stakeholder, it should be noted that we were not overly restricted by the level of power and interest exerted by any of the participants within the stakeholder groups. We however were more concerned with those who have a direct influence on the university curriculum in meeting industry demands. In addition to the hybrid framework of Reed *et al.* (2009) and Bailur (2006), we also adopted the selection and categorisation framework of Fassin (2009) who considers the level of power and interest, but as a further step to enhance precision and accuracy, examined their internal constituents.

² Noise in statistics comprises factors (activities, processes for example) that introduce inaccuracies into the data resulting in deviations or errors in the results.

Figure 1: Conceptual Framework developed from multiple hybrid frameworks



Source: Authors' developed framework (2018)

The conceptual framework developed from hybrid models (Bailur, 2006; Reed *et al.*, 2009; Fassin, 2009) explains in detail the entire process of the study from stakeholder identification through to discussion of our findings. Following the identification of stakeholder groups, semi structured interviews were carried out with the stakeholder groups selected for the study as depicted in the model (Figure 1). The semi-structured interviews were tailored specifically to each of the stakeholder groups selected; ultimately, these were intended to answer the research question from the perspective of each of the selected stakeholder group.

Fassin's (2009) framework considers stakeholders from three main categories: firstly, real stakeholders who have a direct claim and concrete stake in the firm; secondly, stakewatchers (for example, pressure groups) who do not necessarily have a direct claim but are indirect stakeholders that influence the firm; and thirdly, stakekeepers (for example, regulators such as government) who perform an oversight function and provide external control on the firm. In modern literature, stakekeepers are also referred to as gatekeepers. Stakewatchers and stakekeepers do not have a direct claim on the firm; hence, the firm has little power over, and no responsibility for, indirect stakeholders, whose legitimacy is "derivative" (Phillips, 2003, p. 120). On this basis, the indirect stakeholders play key roles in either protecting the interests of the real stakeholders or regulating them.

Method

The seminal works of Scott (2000) and Wasserman and Faust (1994) on social networks provide a framework for SNA. In analysing social networks, it is important to determine the level of analysis to be carried out. Hatala (2006) argues that the analysis can either be ego network analysis or complete network analysis. In the case of ego network analysis, the relationship exists from one end with no attempt to bring these actors together. On the other hand, complete network analysis brings the individuals together to exchange their views. For this study, ego analysis was preferred since the research data was not collected from focus groups. In addition, ego analysis is supported to enable each of the stakeholders to speak without any form of bias or external influence. Other levels of

analysis are the Dyad and Triad levels. Dyad census mainly consists of the relationship that exists between two actors (Pinheiro *et al.*, 2015; Prell, 2015). Such a relationship could be null (where there are no ties between x and y), asymmetric (where either x sends a tie to y or y sends a tie to x) or mutual (when the ties are reciprocated). On the other hand, triads consist of three actors and are basically seen as being composed of different dyadic relationships obtainable within the triad census (Prell, 2015). Our study considers a multiplicity of actors; however, we examine the dyadic relationships that exists between actors at each given time (null, asymmetric or reciprocal). Other levels of analysis include subgroup level (Luo and Zhong, 2015), network level (Prell, 2015) and position and roles analysis (Wasserman and Faust, 1994; Scott, 2000). Our study focusses on the first two levels we have discussed, i.e. ego analysis and dyadic relationships among a multiplicity of stakeholder groups.

Participants

A stepwise approach was utilised to select key stakeholders for the research and we treat each of the selected stakeholders (participants) as an entity belonging to a specific stakeholder group (Fassin, 2009). From the 16 stakeholder groups identified within the education, oil and gas, and government sectors, seven stakeholder groups emerged as primary stakeholders. These are: (1) Federal Government, otherwise known as government (FGN); (2) Multinational Oil Companies (MNC); (3) Indigenous Operators (IDO); (4) Multinational Service Providers (MSV); (5) Indigenous Service Providers (ISV); (6) HE institutions (universities) (HEI); and (7) Young Employees in the oil and gas industry (YMP). The FGN stakeholder group consists of participants from government establishments, while the HEIs were chosen from the six geo-political zones of Nigeria for representativeness. Consequently, the rationale for classifying YMP as a primary stakeholder was solely based on the views of respondents who have had experience in both HEI and oil and gas sectors over an approximately equal number of years, as depicted in Table 1.

Table I Analysis of stakeholder categories

Stakeholder group	Stakeholder category	Justification
Government	Stakekeeper	This stakeholder group acts as a regulator of all other stakeholders operating within the network of selected stakeholders (Fassin, 2009). Further, Laine (2010) argues that although they are external stakeholders, they protect the interests of the real stakeholders. Within the network of selected stakeholders, government can be viewed as external to the network, given the monitoring and supervisory role they play.
Multinational Oil Companies	Real Stakeholder	These stakeholder groups have a complete and direct stake (Fassin, 2010) within the network. They can also be viewed as primary stakeholders as they bear direct relevance to the research question at hand.
Indigenous Operators	Real Stakeholder	
Multinational Oil and Gas Service Providers	Real Stakeholder	
Indigenous Service Providers	Real Stakeholder	
HE institutions	Real Stakeholder	
Young Employees	Stakewatcher	This stakeholder group serves as a mid-point between the HEIs and the oil and gas industry; we deem them stakewatchers. Although they are not pressure groups, they are largely the main stakeholder group within the network who can provide, to some extent, a 'check and balance' between the HE stakeholder group and the industry stakeholder groups.

Authors' analysis (2018)

Procedure

After gaining ethical approval for the research, 28 respondents out of the 32 originally contacted, were interviewed, realising an 87.5% response rate. Though snowball sampling was adopted, four respondents each were identified from each stakeholder group. Our choice of sampling through snowballing was mainly due to accessibility to respondents who were largely senior executives in government parastatals, universities and multinational and indigenous oil and gas (operating and servicing) firms in Nigeria. These respondents work to very tight schedules and access required enormous bureaucracy and protocol. The participants also expressed anonymity given the sensitivity of the topic and volatility of the Nigerian oil and gas industry (Idemudia and Ite, 2006; Omeje, 2017). Each interview lasted 45-60 minutes with the respondents and we were confident that adequate interview data had been collected, having found similarities in the trends of their responses which signalled data saturation. Bell and Bryman (2007) who suggest that precision is the key element to consider in sampling and not necessarily the size of samples further strengthened this confidence. Though data was collected from a heterogeneous population, there were clear cases of saturation within each stakeholder group. All the interviews were recorded and transcribed verbatim by the research team. Questions asked centred on the level of relationships each stakeholder group exhibits with the other, based on some key variables. Prior to the semi-structured interviews, credible documentary evidence (such as students' satisfaction, graduate employability rate, statistics of universities in Nigeria by course) were collected to compensate for the limitations from interviews (Barclay, 2001; Saunders *et al.*, 2015), and to provide some key insights into the questions to be asked during the interviews (Gaborone, 2006).

Data Analysis

Both interviews and documentary evidence were analysed using thematic content analysis and SNA. The latter was used to transform qualitative responses to matrices that were then analysed to generate sociograms and similarity graphs. These were made possible by the thematic content analysis carried out whereby three major themes emerged from the analysis. These themes were: curriculum dynamism and the need for curriculum modification; tutor-practitioner interaction; and issues surrounding U-IC. These themes are addressed in detail in the results and findings section.

Results

We acknowledge that, in reality, HEIs cannot fully train an individual to become a professional. This is because the practical hands-on experience required to achieve this is not available in the HEIs. Notwithstanding, we believe HEIs should play a major role in providing at the very least, basic knowledge that students bring to the job when they are initially employed, because this forms the foundation upon which further practical experience is gained.

Lack of adequate knowledge in curriculum

Our findings revealed that, the curriculum has not provided adequate knowledge needed by industry.

".....definitely not, my response is based on comparison with people who studied the same course as I did at undergraduate level in foreign universities. They have far more background knowledge than we do". [Young graduate educated in Nigeria]

The government seems to acknowledge this too:

".....no doubt, there is a knowledge gap between Nigeria-trained graduates and those trained abroad". [Senior government official]

In a similar study, Chiemeké *et al.* (2009) interviewed graduates of engineering and management studies, and found that only a few respondents perceived that most of the theories they learnt at Nigerian universities were applicable to their job. Graduates rated the practical aspects of their education very poorly.

Unfortunately, the standard of Nigerian universities has been rated poorly in terms of knowledge base, learning experience and the ability to provide the adequate knowledge required for graduates, particularly to kick-start their career. As eloquently argued by Dabalén *et al.* (2001, p. 143) regarding Nigerian university graduates: “*graduates are poorly prepared for work. a university degree is no longer a guarantee of communication skills or technical competence.*”

Ties and interactions within the network of stakeholders

Next, we employ the use of SNA to investigate the ties and interactions within the network of stakeholders selected for this study. The results of the analysis are first presented in matrices which were generated from qualitative responses (semi-structured interviews). We present two matrices, the first of which is in valued form which is based on a Likert scale of 1 to 5 where 1 represents a very weak relationship and 5 represents a very strong relationship. These were based on a set of questions regarding stakeholder relationship, as informed by the literature (Jamali *et al.*, 2008; Timur and Getz, 2008) and a review of the documentary evidence. We took the mean of these responses from each respondent to generate the valued matrix.

Table II. Matrix of valued data

	FGN	MNC	IDO	MSV	ISV	YMP	HEI
FGN		4	3	4	3	3	2
MNC	5		3	4	3	3	3
IDO	4	3		3	4	3	1
MSV	4	5	3		3	3	3
ISV	3	3	4	4		3	2
YMP	3	3	3	3	3		3
HEI	2	3	2	3	2	3	

Authors’ analysis (2018)

The numbers in Table II represent the valued data, rating the strength of each possible relationship among stakeholders in the network on a scale from 1 (very weak) to 5 (very strong).

The second matrix is presented in binary form. We dichotomise the valued matrix into binary form for two main reasons: firstly, because of its non-user friendliness, and secondly, for carrying out SNA, using UCINET software. In order to generate the binary data, we represent 0 as no relationship and 1 as the existence of a relationship. Therefore, we recode values 1 to 2 as binary code 0 and values 3 to 5 as binary code 1. At this point, it is important to clarify that, with the valued matrix (Table II), the relationship between the stakeholders is not equal and opposite. This suggests that the strength of the relationship that stakeholder A claims to be in existence with stakeholder B does not necessarily correspond to that perceived by stakeholder B.

Table III. Matrix of “binary” data

	FGN	MNC	IDO	MSV	ISV	YMP	HEI
FGN		1	1	1	1	1	0
MNC	1		1	1	1	1	1
IDO	1	1		1	1	1	0
MSV	1	1	1		1	1	1
ISV	1	1	1	1		1	0
YMP	1	1	1	1	1		1
HEI	0	1	0	1	0	1	

Authors’ analysis (2018)

The numbers in Table III are binary data transformations. 0 denotes no relationship, whilst 1 denotes the existence of a working relationship.

Relational ties between HEI and FGN

As a first step, we consider the level of interaction between the stakekeepers (government) and HEIs. The rationale for this is twofold. First, this is because government are the main stakeholders who could facilitate any (non-existing) relational ties in the absence of any. Second, this goes a long way to determine the extent of interrelationship and collaboration that will exist between HEIs and other stakeholder groups, given that the regulators are supposed to be an umbrella that brings the stakeholders together.

One respondent reiterated that between 2003 and 2017, university lecturers have gone on strike no less than eight times with the shortest of these strike actions lasting for over two months, characterised by a complete shutdown of academic activities. These strike actions in most cases are in relation to government underfunding universities. One major concern expressed by an FGN respondent is:

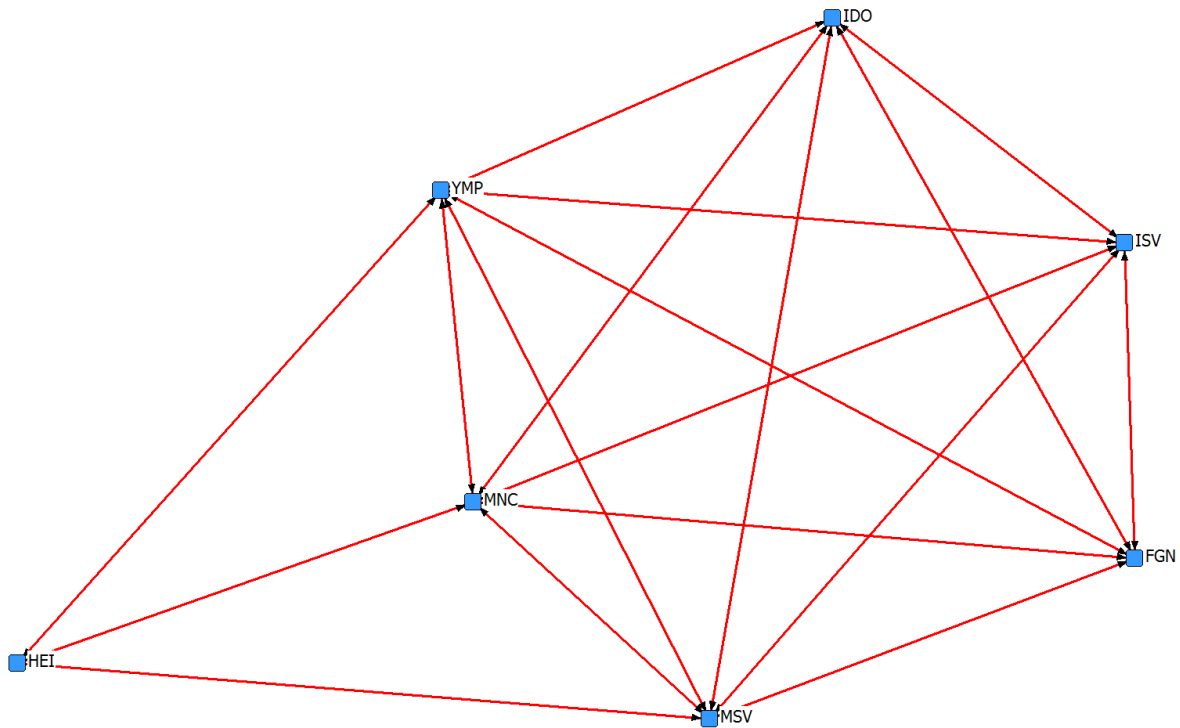
“.....The major fear that is being expressed now is that the standard of education in-country is dropping due to incessant strike actions. Yet, the government is not investing in education and in the near future our graduates will compete even less favourably.....” [Local Content Manager, IDO]

The concern of this respondent is borne out of the role (local content manager) because the government claims to aim at developing indigenous capacity in key sectors, in order to achieve local content development (NOGIC Act, 2010). In the recent global ranking of universities issued by Times Higher Education (THE, 2018), it was found that only one Nigerian university (University of Ibadan; ranked among 801-1000), made it to the top 1000 world universities. For specificity and to minimise bias, we considered data in science subjects (engineering, technology and geo-sciences); it was however surprising to see that no Nigerian university featured in the top 1000 in Chemical/Petroleum Engineering. This does not reflect well for a country whose oil and gas resources are in the top 10 world global rankings.

Using UCINET (Borgatti *et al.*, 2002), the sociogram in Figure II reveals a spring embedding analysis to further shed light on the relational ties between HEI and FGN. Spring embedding analysis uses both distance and direction to summarise information about the structure of the network. It helps to visually estimate the relational distance between the actors within a network. While the other

stakeholder groups appear to be considerably close to one another, the HEI stakeholder group is at a considerable distance from the other stakeholder groups – the farthest being FGN. This further strengthens the responses from the respondents and clearly provides an indication that the government and HEI need to bolster their relationship and stay not too far from each other.

Figure II: Spring embedding analysis



Source: Authors’ Analysis (2018) Graphic generated using network analysis software: UCINET 6.0 (Borgatti et al., 2002).

Note: What counts is the relative distance between points, which are arbitrary.

Using Figure II, we determine the centrality of the network (see Hatala, 2006; Prell, 2015). Centrality consists of two measures: local centrality, which is determined by the number of ties an actor has in a network, irrespective of the direction of the ties; and global centrality, which is determined by investigating how strategically a stakeholder group is positioned within the network. From Figure II, the analysis of local centrality suggests that a high level of centrality exists among all stakeholders with the exception of the HEI stakeholder group, which exhibits limited local centrality in comparison with the other stakeholder groups.

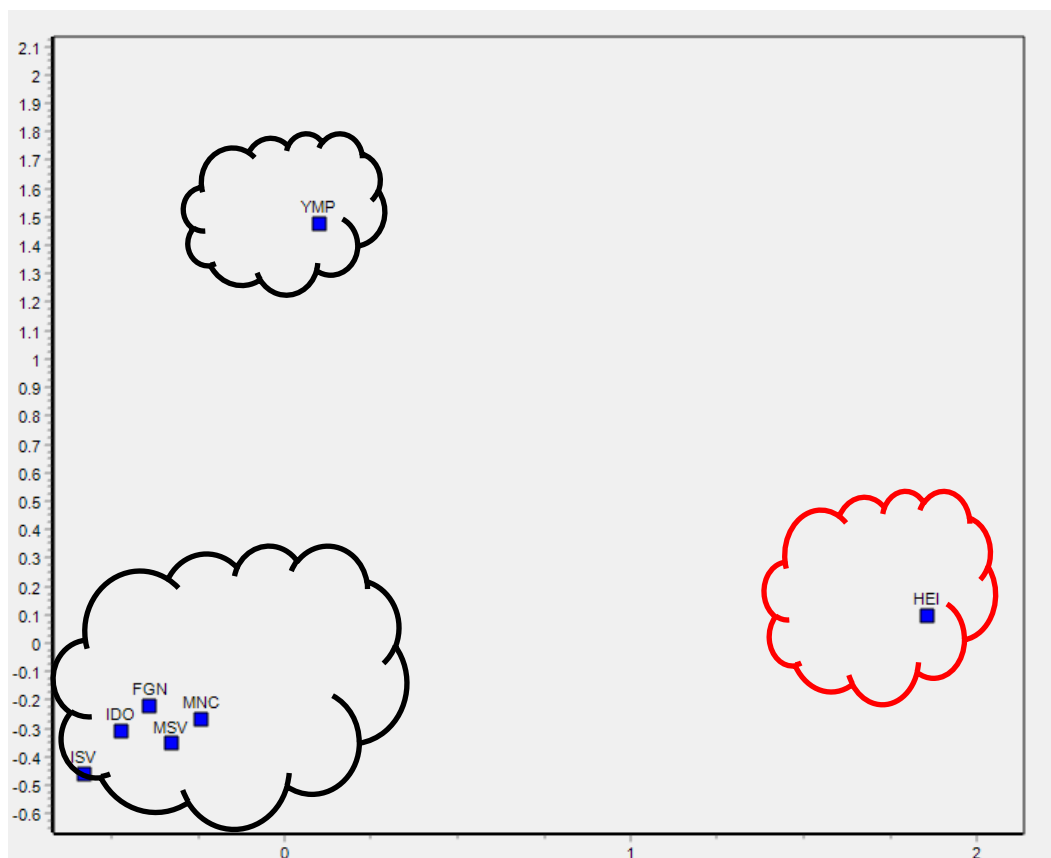
Analysis of the global centrality suggests that the MNC stakeholder group does exhibit global centrality. The result of the test shows that the government who are the gatekeepers are not playing a regulator’s role within the network. We analyse the betweenness, which determines if an actor sits on the geodesic (shortest possible path) or acts as a cut point within the network; in other words, if an actor acts as a key connector between other actors within a network. According to Prell (2015), what is important in this case is where an actor is positioned within the network and not the number of actors that this particular actor relates to within that network. Again, the MNC stakeholder group occupies this position, as shown from Figure II. Having carried out various centrality tests, it appears that the role of FGN as gatekeepers and regulators comes under scrutiny; this is because a network

where a stakeholder plays the role of both real stakeholder and gatekeeper is prone to disparity and unevenness (Fassin, 2009).

HEI tutors and Industry

Next, we sought to find out if there are any existing fora that bring HEI tutors and industry players together. The results from the interviews revealed that there are limited fora, platforms, conferences or business engagements that exist where academics and practitioners meet to engage in critical interactions that could spur a need for HEIs to constantly update their curriculum to meet industry demands. This appears to be a huge setback at a time when there are significant technological advancements in the industrial sector (Gautier *et al.*, 2009; Taiwo, 2010; Howarth *et al.*, 2011), which can render these non-updated modules irrelevant and eventually obsolete. We further investigated the presence of (any) similarities of interest among the stakeholders selected.

Figure III. Social structure: proximity by mutual interest



Source: Authors' Analysis (2018) Graphic generated using network analysis software: UCINET 6.0 (Borgatti *et al.*, 2002).

Note: Mathematically derived representation of the proximity of actors. What counts is the relative distance between points and not the corresponding coordinates, which are arbitrary and normally have no interpretable meaning (Laumann and Senter, 1976).

Figure III highlights the social structure of the stakeholders selected for our study based on their level of interaction within the network. We employed non-metric multidimensional scaling (MDS) to depict a visual view of the interaction within the network. In addition, hierarchical clustering was applied to the data to further investigate the presence of clusters of shared interests within the network. Organisations that tend to be close to one another share some similarity in their interests,

while the outliers do not. The results of the analysis indicate that the HEI stakeholder group and the YMP stakeholder group are two main outliers on the map. This further reveals the weakness of the tie between the HEIs and the industry players and dissimilarities in their interests. The position of the YMP stakeholder group reveals that industry players do not associate with other stakeholders that cannot provide mutual benefits. This is further justified by the significantly visible relationship between the government and the industry players, whom they operate with on Production Sharing Contracts (PSCs) and Joint Ventures (JVs). It is expected that as stakekeepers, government should exhibit similar relationship ties with both HEIs and industry players.

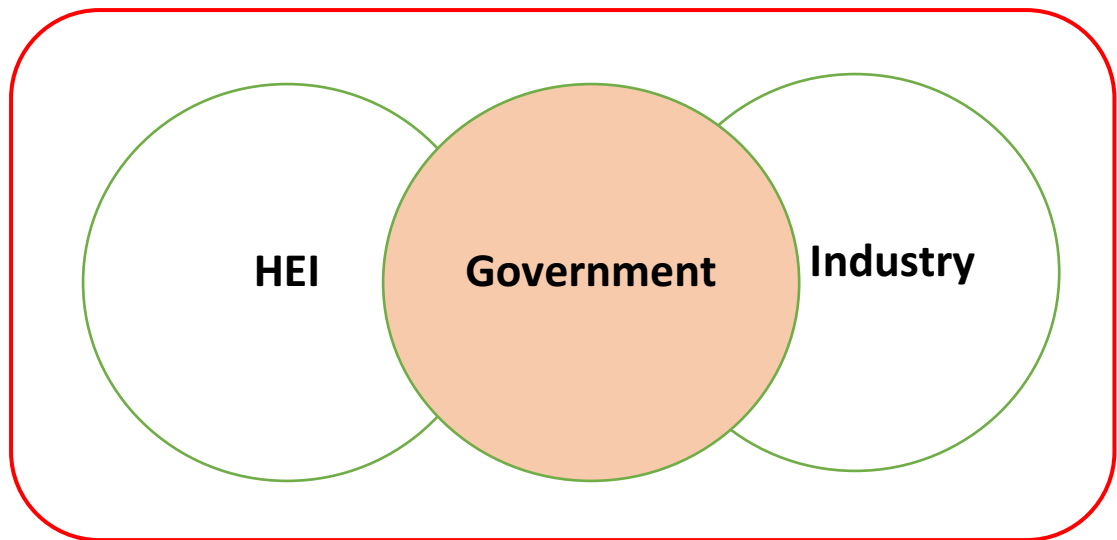
Density of the network

Finally, we analyse the overall interconnectedness of the stakeholder groups by calculating the density of the network. The facilitation of shared information, diffusion of institutional norms and values are dependent upon how densely connected actors are, within a network (Meyer and Rowan, 1977). Using the equation:

$$\frac{l}{n(n-1) / 2}$$

where l represents the number of lines (ties) present and n the number of nodes present within the network (see Hatala, 2006, p. 56). The value of the density ranges between 0 to 1, where 1 depicts complete density. A density of 0.86 was obtained, thus the actual number of ties present within the network is 86% of the potential number of possible ties. The result suggests a high level of interconnectedness, which is positive overall, although the HEI stakeholder group remains an outlier within the network. This shows the industry players are highly interconnected. This is mainly responsible for the high-density present. As gatekeepers and regulators, the government is expected to play the role of a broker between the HEIs and the industry stakeholders to ensure there is mutual interaction between industry and academia. This is visually represented in Figure IV.

Figure IV: Proposed configuration to enhance HEI-Industry collaboration



Source: Developed by authors (2018)

The figure represents an extension of Fassin's (2009) stakeholder framework beyond firm level. We propose that within a network of actors, government should play an unbiased role of regulator and broker.

In Nigeria, the Federal Government (Government) acts as the governing body under which the public and private sector operates. There are several stakeholder groups within the oil and gas industry and they are all profit driven. If one of the actors undertake the role of broker, fairness could be compromised and policies will be in the interest of this particular actor rather than for the industry as a whole.

Discussion, Implications and Conclusion

The paper aimed to investigate the role of multiple stakeholders in enhancing an up-to-date curriculum. Seven stakeholder groups were selected for our study, consisting of five real stakeholders, one stakekeeper and one stakewatcher based on Fassin's (2009) stakeholder framework. The study addressed three main themes to answer the research question: curriculum dynamism and the need for curriculum modification; tutor-practitioner interaction; issues surrounding U-IC.

Our investigation on curriculum dynamism revealed that HEI's curriculum is not in tandem with industry demands as there were lags between the present curriculum and the level at which industry currently operates. Furthermore, this finding was strengthened by the stakewatchers, as one of the respondents, YMP, confirmed that colleagues at the same level who studied at HEIs abroad seemed to demonstrate greater amount of background knowledge compared to him. Therefore, we rate the standard of education in Nigeria as low, and in fact is heading for a downward spiral. This can only be prevented if the stakekeepers (government) impartially regulate the education sector and fulfil their responsibilities of strengthening the overall infrastructure.

Our investigation on tutor-practitioner interaction found that FGN – the regulators – are positioned at a considerable distance from the HEIs, suggesting that their level of interactivity is low. Furthermore, our analysis showed that MNC occupied a position of global centrality rather than FGN who are meant to play a pivotal role in bringing the stakeholder groups together. Similarly, we analysed the betweenness of the network and it showed that the MNC sits in a central position within

the network, hence acting as the facilitating actor that links the other stakeholder groups together. Furthermore, we investigated if the stakeholders within industry shared some mutual/similar interests. Our findings revealed that, apart from the fact that the industry stakeholders shared mutuality of interests among themselves, they also shared similar interest with FGN, while HEI and YMP remained as outliers. This finding is important as it is expected that the regulators should ensure fair play and not lean towards any group, whilst leaving others out. Although this might not be an extreme case of not sharing any common interest at all, clearly we can see from a graphical point of view that the level of mutual interest is actually quite low.

We draw some implications from these findings and provide some recommendations on this. To start with, our findings emphasise that for the HEI curriculum to be relevant to industry, there must be an interaction between HEI and industry, with government playing the role of a broker within the network. This is in addition to regulating these stakeholders (HEI and Industry). Computation of the network density suggests a considerably high-density index (86%). However, we are unable to fully determine this by means of comparison, given that this is the first study to investigate the effect of HEI curriculum on industry demands using SNA. Further scrutiny of this result clearly shows that the high interconnectedness result (86%) is undoubtedly the case but the 14% of unconnectedness attracts more attention as the HEI stakeholder group largely contributes to this.

The facilitation of the interaction needed between HEI and industry stakeholders for the curriculum to be relevant to industry is evidently the main responsibility of the stakekeepers (the government). Yet, the inability of the government to serve as a fulcrum within the network, which would bring both HEI and the industry together, is currently affecting the achievement of the HEI curriculum being on a par with industry demands. MNCs continue to exhibit their own personal interests, given their position in the network.

Finally, we acknowledge certain limitations of the study. Firstly, we had to be selective on the most useful analytical tools to deploy to examine our data. For example, in determining centrality, apart from considering betweenness, and local and global centrality, as a further test, we could have considered other centrality indicators such as eigenvector, in-degree and out-degree. Furthermore, we could have considered some quantitative statistical tools to support the visual analyses carried out using SNA. However, since the study intended to draw the attention of practitioners, our choice of analytical tools was strengthened by the argument of Worren *et al.* (2002) who assert that practitioners demonstrate a preference for narrative and visual knowledge. The study might appear to be biased, given that we focussed on one industry to draw our conclusions. To a large extent, we consider this result representative, as the Nigerian oil and gas industry remains to date, the industry that is most focussed upon and given much attention, because over 90% of Nigeria's revenues still come from the oil and gas industry (CBN, 2019).

Future studies may seek to replicate this study in other countries, using their key sector(s) as the focus of analysis. This would provide a useful platform for comparison, drawing from these findings as a starting point. Further studies may look to investigate the present and/or future implications of this low level of interaction between HEIs and industry on the Nigerian economy in the medium- and long-term.

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