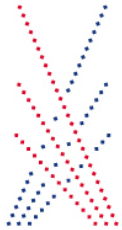

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This paper is from the BAM2019 Conference Proceedings

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Inter-Organisational Collaboration. A case study of the Oxford Biotechnology Industry

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INTRODUCTION

The concept of social capital is one that cuts across various disciplines like Sociology, Anthropology, Sciences and Management. Essentially, this could be viewed as a multidisciplinary discourse. Generally, like other forms of capital (such as physical, human and intellectual capital), social capital is productive in that; it enables the achievement of key ends that would probably have been impossible without it being present. What then is social capital? Tracing back to the early works of James Coleman (1988) and Putnam (1994), within the definitions of these foremost authors, two common determinants appear to be consistent- the evidence of some aspects of social structures and the facilitation of certain actions of actors (whether individual or group actors) within the structure (Coleman, 1988, S98; Mandarano, 2009). According to Coleman (1988), social capital refers to connections among individuals- social networks and the norms of reciprocity and trustworthiness that arise from them.

Generally, social capital theory asserts that networks of relationships are useful in providing a key platform for social interaction among individuals, which then develops into a network of mutual acquaintance and recognition (Bourdieu, 1986). Several schools of thought with differing perspectives on social capital exists; for example Baker (1990) views social capital from the perspective of relational structure, while Putnam (1995) and Boudeiu (1997) conceptualises social capital as resources that can be benefitted from a network of relationships. Following from these perspectives, it appears that these authors hold on to one common denominator- the creation of an interactive network of actors. To this end, we define social capital as the totality of the interaction of individuals and social units within a network, which helps them to pursue shared objectives.

RESEARCH CONTEXT

The past decade has witnessed industrial localisation activities (Steinfield *et al.,* 2010) which has been instrumental to economic growth. We can attribute this growth to co-location and increased innovation among firms within the industry. Of particular interest is the biotechnology industry which has grown in leaps and bounds globally (Mitton, 1990) and now popularly referred to as a cluster (Steinfield *et al.,* 2010; Nelsen, 2005; Waxell and Malmberg, 2007). Several authors acknowledge that this growth has not been without the existence of a social capital structure, which has enabled the interaction of various firms within the network (Maurer and Ebers, 2006; Gabbay and Leenders, 1999), as well as the enhancement of information and resource sharing among actors. Whilst industrial agglomerations may have its downsides, which are mainly competition effects (Knoben, 2009), this has no doubt proved effective especially in the area of interaction among actors. Particularly, industries that thrive on R & D such as biotechnology are beneficiaries of this arrangement, having accessed support

from other actors, specialised service providers and suppliers, and access to a pool of qualified workers (Steinfield *et al.,* 2010).

Literature abounds on the existence of several stakeholders (internal and external; direct and indirect) that make up the biotechnology industry (Lorenz and Zinc, 2005; Von Geibler *et* al., 2006). Past studies that have researched the stakeholders/actors in the biotech industry include, for example, Von Geibler *et* al. (2006). This study adopted a semi quantitative approach, which involved a dialogue with stakeholders to create KPIs for social sustainability in Biotechnology processes. From another perspective, Oliver (2004) used the concept of duality to provide a theoretical discussion on competition and collaboration among actors in the biotechnology industry, mainly by observation. Shan *et al*. (2004) investigated interfirm collaboration within the biotechnology industry although with some reference to social capital theory; however, this was restricted to startups. Till date, it appears that with the existing social capital structure that exists within the biotech industry, there has not been any study that has critically examined the level of interaction that exists among the stakeholders. Therefore, the novelty of this study is that, using Social Network Analysis (SNA) we use the concept of social capital and stakeholder theory to investigate the interactions and inter relationships among stakeholder groups within the biotechnology industry.

As a first step, the study aims to establish from a taxonomy of stakeholders developed by Mitchell *et al*. (1997) and Lagoke (2014) who the stakeholders within the Biotech industry are. Next, the study will investigate the interaction/interrelationship both within and among the various categories of stakeholders using SNA. This will be novel given that the study aims to extend stakeholder theory beyond a single firm, and by applying it to a network of various stakeholders in the biotech industry. We therefore consider the first phase of identifying the stakeholders a key precursor to the other stage, therefore we have considered extant literature on stakeholder theory.

THEORETICAL FRAMEWORK

The foundation of stakeholder theory emerged from Freeman's (1984) book titled: "*Strategic Management, A Stakeholder Approach"* where stakeholders are generally referred to as groups without whose support organisations would cease to exist (Bowie, 1998). These groups could be shareowners, employees, customers, suppliers, lenders and society.

The stakeholder concept developed from four main management streams-corporate planning, systems theory, organisational theory and CSR. While corporate planning argues that stakeholders place limits on the actions of the firm, the other three (systems theory, organisational theory and CSR) views stakeholder more positively. Particularly, organisational theory recognises the importance of stakeholders, even when they are external to the organisation. According to Thompson (1967), organisational theory share the view that groups outside the boundary of a firm, which are referred to as clientele should also be taken into account as relevant to the organisation. Based on this assertion, it appears that describing a firm without fully acknowledging the relationship on which it depends would be indicating a clear gap in critically evaluating the stakeholder concept. Based on these foundational assertions, it becomes imperative to consider the perspectives of various authors on who stakeholders are.

Who are the stakeholders in the biotechnology industry?

Several authors have defined stakeholders as those that exhume some level of power and/or influence on the organisation (Freeman, 1984; Nasi, 1995; Bucholz and Rosenthal, 2005; Gurkey *et al*, 2011). Along these lines, Freeman (1984) argues that stakeholders are those who

can affect, or are affected by the achievement of an organisation's objectives, Both Freeman and Nasi suggests that there exists some level of power and influence wielded by stakeholders in a firm, however Ackerman and Eden (2011) suggests that these power and influence levels may vary among stakeholder groups.

From another perspective, Rhenman (1964) posit that stakeholders are individuals or groups that are firm dependent or firms in themselves who are dependent on these individuals or group, both of them for the achievement of their objectives. In the words of Gibson (2000, p.245), stakeholders are *"those groups or individuals with whom the organisation interacts or has interdependencies and any individual or group who can affect or is affected by the actions, decisions, policies, practices or goals of the organisation*. This bears some similarity with Thompson *et al*. (1991) who refers to stakeholders as individuals or groups who exhibit some sort of relationship with an organisation. Although this definition appears to be quite simplistic however De Vita *et al.* (2016) provides more insights into these relationships arguing that it could be unidirectional (individualistic) or bi-directional (mutual).

The definition of Thompson *et al.* (1991) appears to resonate more with this study given that our aim is to examine the biotechnology cluster from the lens of social capital. Consequently, we refer to stakeholders within the biotechnology industry as Individual firm groups, with key distinctive specialisation and expertise, collaborating with other firms of such, to deliver the objectives (which could be the manufacture of products or rendering of services) of the biotechnology industry, for the benefit of consumers. With this in mind, stakeholders of the biotechnology industry could either be, or not be firms primarily involved in the production or delivery of biomedical services, but offer some key support that are necessary for the delivery of the objectives of the industry.

RESEARCH METHODOLOGY

The study will focus on the UK biotechnology industry, particularly the Oxford Biotechnology Cluster[i]. The UK biotech industry is the third largest, after US and China. The justification for selecting this cluster is mainly because it is one of the most mature biotech clusters in Europe, with around 10% of the firms being in existence for over 25 years. In addition, preliminary research suggests that there are over 150 different firms, representing various arms (stakeholder groups), within the industry that are actively engaged in their specialist areas of activities. Therefore, this diverse stakeholder groups will enrich the quality of data that would be collected for this research. Preliminary research suggests there are 20 different firm types in the industry. Therefore, based on our earlier discussion, these firm types can be deemed as stakeholder groups. These are:

a. Non-Pharmaceutical Biotechnology
b. Biologics
c. Medical Devices
d. Diagnostics
e. Stem Cells/Cellular Therapy
f. Vaccines
g. Bioinformatics
h. Veterinary Medicine
i. Equipment & Machines
j. Software
k. Small Molecule Pharmaceuticals
l. Contract Research & Development

m. Contract Manufacturing
n. DNA, RNA, Peptide Therapies
o. Antibodies
p. Clinical Research
q. Drug Delivery/Formulation
r. Genetics & Genomics
s. Consultants
t. Scientific Services

The study will mainly employ a mixed methods approach, which consists of the use of a survey instrument- semi-structured questionnaire (draft questionnaire is provided in Appendix) to gather both qualitative and quantitative data from the different stakeholder groups selected. In addition, follow-up interviews will be carried out with some stakeholders (participants) to obtain some qualitative data. Both semi-structured questionnaires and interviews will be analysed using thematic content analysis and mainly social network analysis (SNA). Both UCINET and PAJEK softwares will be used to investigate the interrelationships among the stakeholder groups. Key variables adopted to investigate these interrelationships are obtained from a similar study, which is ongoing. More details on these variables are found in the draft questionnaire in appendix.

The study will develop a framework that can be adopted for other industries alike to facilitate successful collaboration among stakeholder groups. Key aspects that will be analysed to determine the interaction/interrelationship are:

Similarities: The similarities application calculates the similarities of attributes i.e organisational interests between stakeholder groups within the cluster.

Hierarchical Clustering: The Hierarchical Clustering application is another method to calculate similarities. This analysis starts with all the actors in a universal set and then successively evaluates the similarities between the actors generating smaller and smaller subsets of like actors. The output are presented in graphic and tabular formats, which reveal to what extent a network is partitioned into groups of actors who share unique characteristics.

Density: The density analysis will be done from an industry perspective. Density calculates of the total number of actual ties between organizations in the network divided by the total number of possible ties. For example, if a social network has a network density of 100% then all of the members in the network have formed direct relationships with all other members.

Centrality: Centrality calculates each actor's (Business Type) network density (i.e the number of ties) and reveals the extent to which each actor was successful at developing ties with others in the cluster.

Multidimensional Scaling: Multidimensional Scaling (MDS) develops a map of the network structure based on the community's similarities or differences. In MDS, the distances between actors are significant and represent the relative proximities of actors based on the degree of similarity or difference. Both types of graphs reveal network structure, as well as facilitating understanding and interpreting the results of other social network analyses.

Overall, it is expected that this research will both contribute to theory and practice. Theoretically, the study will be extending stakeholder theory beyond firm level, while from practitioners view point, the study will develop a framework that can be adopted by both firms and industries to facilitate better interaction and interrelationships.

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Appendix

Draft Questionnaire

1. Name of company----------

2. Company business type (category)

    1. Non-Pharmaceutical Biotechnology
    2. Biologics
    3. Medical Devices
    4. Diagnostics
    5. Stem Cells/Cellular Therapy
    6. Vaccines
    7. Bioinformatics
    8. Veterinary Medicine
    9. Equipment & Machines
    10. Software
    11. Small Molecule Pharmaceuticals
    12. Contract Research & Development
    13. Contract Manufacturing
    14. DNA, RNA, Peptide Therapies
    15. Antibodies
    16. Clinical Research
    17. Drug Delivery/Formulation
    18. Genetics & Genomics
    19. Consultants
    20. Scientific Services

3. How long has your company been in existence

    a. 1-5 years
    b. 6-10 years
    c. 11-15 years
    d. 16-20 years
    e. Over 20 years

4. How long has your company been in Oxfordshire
    a. Same as (3) above
    b. 1-5 years
    c. 6-10 years
    d. 11-15 years
    e. 16-20 years
    f. Over 20 years

5. Do you have other offices/branches outside Oxfordshire
    a. Yes
    b. No

6. On a likert scale range of 1 to 5, where 1 is least and 5 is most, please could you outline the extent to which you derive the following benefits from the cluster

s/no	Benefits	1	2	3	4	5
1	Spatially proximate access to specialist suppliers					
2	Spatially proximate access to customer feedback					
3	Observation of competitors					
4	Spatially proximate to collective knowledge					
5	Spatially proximate access to specialised labour					
6	Spatially proximate access to research institutions					
7	Spatially proximate access to scientific equipment					
8	A dedicated regional infrastructure					
9	Reduced knowledge search costs					
10	Others (Please state)					

7. Of these business types (actors) within the cluster, please tick the level of interorganisational relationship you have with them based on each of the **key points** listed on a likert scale of 1-5, where 1 is weak and 5 is strong

Key point: COMMUNICATION						
s/no	**Business type**	**1**	**2**	**3**	**4**	**5**
1	Non-Pharmaceutical Biotechnology					
2	Biologics					
3	Medical Devices					
4	Diagnostics					
5	Stem Cells/Cellular Therapy					
6	Vaccines					
7	Bioinformatics					
8	Veterinary Medicine					
9	Equipment & Machines					
10	Software					
11	Small Molecule Pharmaceuticals					
12	Contract Research & Development					
13	Contract Manufacturing					
14	DNA, RNA, Peptide Therapies					
15	Antibodies					
16	Clinical Research					
17	Drug Delivery/Formulation					
18	Genetics & Genomics					
19	Consultants					
20	Scientific Services					

Key point: IDEA EXCHANGE/INFORMATION SHARING						
s/no	**Business type**	**1**	**2**	**3**	**4**	**5**
1	Non-Pharmaceutical Biotechnology					
2	Biologics					
3	Medical Devices					
4	Diagnostics					
5	Stem Cells/Cellular Therapy					

6	Vaccines					
7	Bioinformatics					
8	Veterinary Medicine					
9	Equipment & Machines					
10	Software					
11	Small Molecule Pharmaceuticals					
12	Contract Research & Development					
13	Contract Manufacturing					
14	DNA, RNA, Peptide Therapies					
15	Antibodies					
16	Clinical Research					
17	Drug Delivery/Formulation					
18	Genetics & Genomics					
19	Consultants					
20	Scientific Services					

Key point: SUPPLY CHAIN NETWORKS						
s/no	**Business type**	**1**	**2**	**3**	**4**	**5**
1	Non-Pharmaceutical Biotechnology					
2	Biologics					
3	Medical Devices					
4	Diagnostics					
5	Stem Cells/Cellular Therapy					
6	Vaccines					
7	Bioinformatics					
8	Veterinary Medicine					
9	Equipment & Machines					
10	Software					
11	Small Molecule Pharmaceuticals					
12	Contract Research & Development					
13	Contract Manufacturing					
14	DNA, RNA, Peptide Therapies					
15	Antibodies					
16	Clinical Research					
17	Drug Delivery/Formulation					
18	Genetics & Genomics					
19	Consultants					
20	Scientific Services					

	Key point: TECHNOLOGY (SHARING)					
s/no	**Business type**	**1**	**2**	**3**	**4**	**5**
1	Non-Pharmaceutical Biotechnology					
2	Biologics					
3	Medical Devices					
4	Diagnostics					
5	Stem Cells/Cellular Therapy					
6	Vaccines					

7	Bioinformatics					
8	Veterinary Medicine					
9	Equipment & Machines					
10	Software					
11	Small Molecule Pharmaceuticals					
12	Contract Research & Development					
13	Contract Manufacturing					
14	DNA, RNA, Peptide Therapies					
15	Antibodies					
16	Clinical Research					
17	Drug Delivery/Formulation					
18	Genetics & Genomics					
19	Consultants					
20	Scientific Services					

Key point: COLLABORATIVE RESEARCH						
s/no	**Business type**	**1**	**2**	**3**	**4**	**5**
1	Non-Pharmaceutical Biotechnology					
2	Biologics					
3	Medical Devices					
4	Diagnostics					
5	Stem Cells/Cellular Therapy					
6	Vaccines					
7	Bioinformatics					
8	Veterinary Medicine					
9	Equipment & Machines					
10	Software					
11	Small Molecule Pharmaceuticals					
12	Contract Research & Development					
13	Contract Manufacturing					
14	DNA, RNA, Peptide Therapies					
15	Antibodies					
16	Clinical Research					
17	Drug Delivery/Formulation					
18	Genetics & Genomics					
19	Consultants					
20	Scientific Services					

8. Would you be please willing to have an interview to explore some of these information in further detail
    a. Yes
    b. No

[i] As argued by Porter (1990), a cluster is formed when there is a **concentration** of **interconnected companies** or institutions that manufacture products or deliver services to a particular field or industry