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University-Industry Collaboration through Knowledge Transfer Partnerships in the UK: An Extension of Activity Theory

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Abstract:
The mechanisms for stimulating innovation are perennial subjects of concern. Despite the recognition of their importance they remain troublesome undertakings for individual organisations and national economies. The literature has only recently begun to recognise the importance of the micro-relations that exist between individuals and their effect upon the efficacy of these mechanisms. However, the intricacies of these micro-relationships remain underexplored.
Through an extended period of immersion of around two years in each of three organisations this study identifies the nature of the tensions that beset the micro-relations between individuals in Knowledge Transfer Partnerships in the United Kingdom. The research proffers an extension to the Activity Framework in order to explicitly recognise the dimension of 'Tacit Skills'.

Keywords: *Activity theory, knowledge transfer partnership, tacit skills*

1. Introduction

There has been a gradual evolution of the study of National Innovation Systems (NIS) in the thirty years since they first emerged (Watkins et al, 2015). Early work examined the macro structure of NIS and those factors that characterised economically successful countries. Later work, such as that around the concept of the Triple Helix (Etzkowitz, 2003; Etzkowitz and Leydesdorff, 2000), highlighted the role of educational establishments in fostering innovation and began to recognise the importance of regional and sectoral innovation systems (Ornelia, 2015; Guan and Chen, 2012; D'Este and Patel, 2007; Siegel, Waldman, Atwater and Link, 2003). More recent work explores International Systems of Innovation (ISI), in particular, the role of multinational corporations (MNCs) in the production and diffusion of knowledge and technologies (Malik, 2013; Chaminade, Intarakumnerd and Sapprasert, 2012).

The problems associated with growing innovative capacity are considerable. They range from observations that the development of ISIs have resulted in the erosion of political influence (Watkins et al, 2015), that initiatives such as the open sharing of research and development data are fruitful but may lead to loss of competitive advantages (Perkmann and Schildt, 2015), the time consuming nature of the successful transfer of knowledge (Tzabbar, Aharonson and Amburgey, 2013), finding

that publishable research output is negatively affected by very low and very high levels of university-industry engagement (Banal-Estanol, Jofre-Bonet and Lawson, 2015) and the fundamental cultural differences between university and industry (Cyert and Goodman, 1997).

Within this research there has been an increasing recognition of the need to more fully understand the complex micro foundations of systems of innovation (Razak and White, 2015; Leven, Holmstrom and Mathiassen, 2014). These have largely been ignored (Freitas, Guena and Rossi, 2013) but it is frequently the nature of the inter-personal relationships between collaborating institutions that determine the extent and success of the partnerships (Perkmann et al, 2013; Aalbers, Dolfsma and Koppius, 2013; Hewitt-Dundas, 2012; Ceci and Lubatti, 2012; Bettencourt, Ostrom, Brown and Roundtree, 2002). It is the "*actual relationships - rather than generic links* – [that] *play a stronger role in generating innovations*" (Perkmann and Walsh, 2007, p. 260).

Furthermore, much of the literature also identifies these developments as being initiated or driven by the transfer of technical knowledge, typically via patent or through the establishment of new or joint ventures (Etzkowitz, 1998, 2003; Etzkowitz and Leydesdorff, 2000; Perkmann and Walsh, 2007; D'este and Patel, 2007; Trim, 2003; Siegel, Waldman, Atwater and Link, 2003). What has received little attention is the acquisition of non-technical knowledge between university and organisations, such as business process improvement knowledge.

This paper addresses an important gap in the literature, namely the need to further understand the micro factors that influence university-industry relationships during the acquisition of non-technical business knowledge. In order to do so it makes an extended study of Knowledge Transfer Partnerships (KTPs) between a university in the South West of the United Kingdom and three partner organisations. Adopting an Activity Theory approach, Participatory Action Research was undertaken over an extended period of time in the organisational settings. The analyses indicate that the primary source of disturbances to the relationships between university and industry manifest between the individuals that are responsible for the efficacious transfer of knowledge. Furthermore, it is the lack of skills of the individuals that is the primary the nature of these tensions.

1.1. Knowledge Transfer Partnerships

Knowledge Transfer Partnerships (KTPs) are UK innovation initiatives that facilitate the relationship between university and organisations and are equally applicable for the transfer of technical knowledge and business management knowledge (KTP, 2020). KTPs projects aim to deliver a range of business improvements including the development of new and existing products, development of marketing strategies and the development of business processes and practices. Successful projects have, for example, delivered ISO9000 and ISO14001 certified management systems (White, Lomax and Parry, 2010; White, Samson, Thomas and Rowland-Jones, 2009). In brief, KTPs are government part-funded ventures whereby an Associate is employed to undertake a significant project for an organisation, supported by experts and academics from university. Up to 65% of the total cost may be funded; therefore some of the commercial pressures that have been shown to be influential and deleterious to knowledge co-production (Cyert and Goodman, 1997) can be significantly reduced by the adoption of KTPs as a mechanism for organizational development.

Figure 1 depicts the typical interactions between the various actors that are involved in KTPs. The interactions between the KTP Associate and the Industrial Supervisor, and indeed the whole organisation, are almost continuous; the Associate being physically located within the host organisation. The Associate is also in frequent contact with the Academic Supervisor, this being a stipulation of the KTP contract, and often necessitated by the work being undertaken by the Associate; at times there is a need to work closely together, for example, during the early stages of the partnership when the programme of work is being detailed. Contrastingly, the KTP Adviser will only be in direct contact with the other actors during Local Management Committee (LMC) meetings, although ad hoc communications may take place outside this. Similarly, the Academic and Industrial Supervisors may only make direct contact at the monthly management meetings, though in practice they tend to meet more often than this, for example, attending meetings that are scheduled by the Associate to discuss key developments.

To highlight the relatively high frequency of contact between the Associate and the Academic and Industrial Supervisors, those relationships have been indicated by bold arrows in Figure 1. It can be seen that these relationships are the primary means by which problems, skills gaps and their resolutions are identified and addressed within the KTP. Beyond these day-to-day relations between individuals, occasions arise, such as during monthly Management Meetings, where the KTP Adviser, the Associate, Academic and Industrial Supervisors will be working together as a small group. Also, recognising that the Associate spends the majority of their time working in the host organisation, they are frequently involved with other individuals that are affected by the KTP's activities but who are not directly involved with the KTP, and these interactions are therefore not indicated in Figure 1.The Associate's role among these relations is of paramount importance and forms the focus of this study. Bettencourt, Ostrom, Brown and Roundtree (2002) point out that the literature examines the many facets of business-to-business relationships that are significant in determining the success of any form of mutual partnership, but that they "overlook the role of individual contributions to effective partnerships" (p106-110).

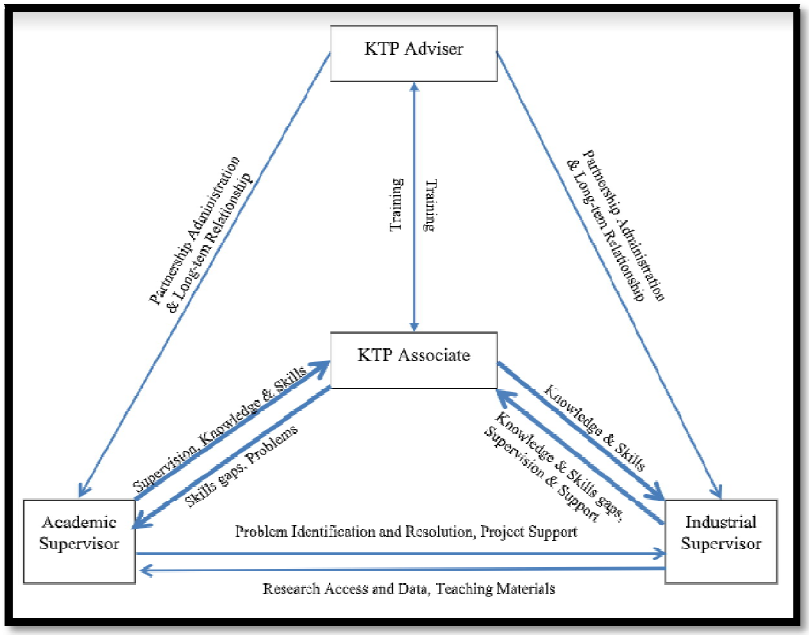

Figure 1: KTP Actors and Their Interactions

2. Activity Theory

Engestrom (2000a) emphasises Activity Theory among multidisciplinary researchers as a useful tool for studying and understanding work. Although constructed some time ago upon the works of Vygotsky (1978) and Leont'ev (1978) it has only relatively recently acquired status as a recognised research tool among multidisciplinary researchers. Activity Theory relates closely to the perspectives portrayed earlier that experience is a prominent factor in knowledge generation. The outcome of activity is not merely the achievement of the goal of the work performed but also the 'formation of an experience of goal achievement' (Bedny, Seglin and Meister, 2000, p201). Skaret, Bjorkeng and Hydle (2002) adopt the notion of knowing, and note Activity Theory's ability to provide insight into knowledge-generative activities that are dynamic and continuous processes.

Activity Theory has been widely used as a framework for academic research. It has been used to study the micro practice of strategy in UK universities (Jarzabkowski, 2003), in developing stronger links between psychology and ergonomics (Zarakovsky, 2004), in the development of ergonomics and the relationship between psychology and systems design (Bedny, Karwowski and Jeng, 2004), in the application of psychology theory to practical situations, particularly in the study of pilot-system ergonomics and design (Ponomarenko, 2004), to explain the dynamics of negotiations in Higher Education Institutes in the UK and US during the development of information systems (Benson and Whitworth, 2007), its role in tailoring the structure of the development method to suit organisational and situational requirements (Karlsson and Wistrand, 2006), the transfer of knowledge between university and industry (White, Cicmil, Upadhyay, Subramanian, Kumar and Dwivedi, 2018; White and Cicmil, 2016; White, Wang and Freeth, 2009), and to review the individual and societal customer-centered e-Commerce literature (Carillo and Beaudry, 2006).

In studies of work activities it is the identification of stresses or contradictions that are sought (Kain and Wardle, 2005; Blackler, 1995). They affect the achievement of the goal and the individuals' experience of goal achievement, and therefore influence the knowledge that they acquire. It is these disturbances that result in perpetual instability of the system thus forcing the various components of that system to readjust their relationship to one another. These disturbances are the focus of attention for redesign of the working system in order that they are reduced or eliminated.

2.1. Structure of Activity Theory

Thompson (2004) criticises Blackler's et al (2000) adaptation of the original representation of Activity Theory on the grounds that their use of the collective as the unit of analysis is incorrect. Although this and Blackler's (1995) earlier works are valuable Thompson (2004) stresses the importance of the individual during study. Engestrom (2000b) also warns of enlarging the units of analysis to encompass group-wide or organisation-wide activity networks, preferring instead to focus upon the complexity of interactions at the micro scale.

Activity Theory describes the components of an activity and the way in which they are related (Bedny et al, 2000). Activity is said to begin when an object or event emerges or becomes apparent that can satisfy a need. An object is therefore an

abstract or concrete goal for an activity. In other words, activity begins when it is possible to take action, which (if successful) results in the achievement of a goal (desired state or outcome) that satisfies a need.

Figure 2 shows how the six elements depicted within Activity Theory conspire to generate disturbances, or tensions, that affect the activity being performed. The 'Subject's' engagement with an activity to achieve the 'Object' is mediated by the elements 'Tools', 'Rules', 'Community' and 'Division of Labour'. Tools may be approaches or devices employed during the activity that is undertaken; Rules relates to the codes of conduct or procedures that govern the activity; Community refers to other individuals that are involved in, or affected by, the activity; Division of Labour refers to the roles and responsibilities of other individuals.

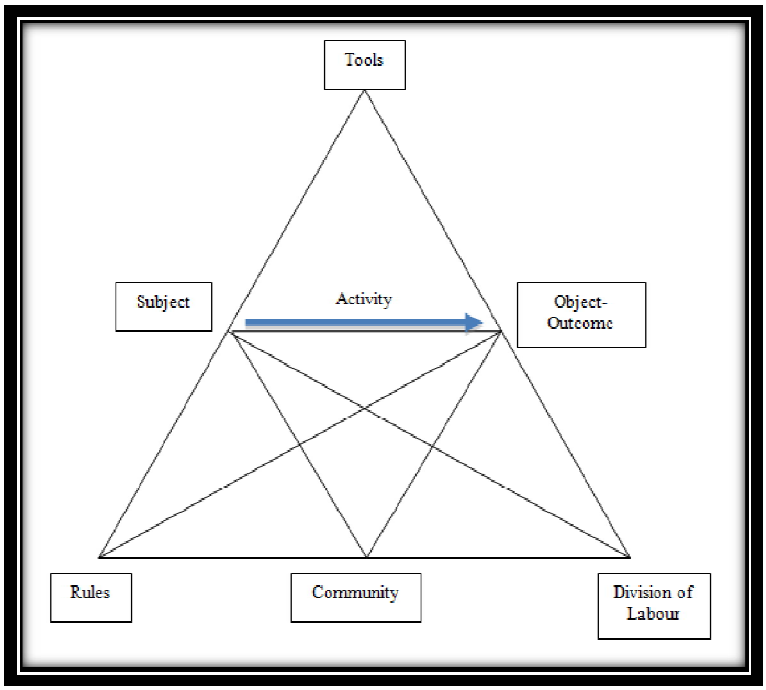

Figure 2: Activity Theory Framework

3. Methodology

This research adopts a Participatory Action Research (PAR) strategy. Whyte (1989) proffers PAR as a distinct form of research that is rooted within the action research paradigm and places the researcher as an active agent of the system being investigated. Adopting a role that is deeply embedded within the research context affords advantages that arguably cannot be achieved by other approaches (Vinten, 1994).

The study comprises longitudinal examination of three organisations engaged in business process improvement. The first organisation is a non-profit, rural, agricultural society: hereafter referred to as the 'Rural' organisation. The organisation was attempting to gain bottom-line savings through gaining an accredited Environmental Management System (EMS).The second organisation is a nationwide provider of refrigeration, mechanical and electrical services to a range of businesses, predominantly supermarkets and food distributors: hereafter referred to as the 'Service' organisation. The organisation was engaged in developing its information systems to deliver bottom line benefits. The third organisation is a design and manufacturing company providing electro-pneumatic products for a range of military applications: hereafter referred to as the 'Military' organisation. The organisation was developing and implementing a New Product Development (NPD) process to improve the efficiency and effectiveness of new product introduction.

While the goals of the improvement initiatives were different, Process Mapping was utilised as a common approach to investigate the current state of the business processes and to design the desired future states. Process Mapping is an analytical technique that graphically depicts how areas of an organization work (Parry, Mills and Turner, 2010; Lasa, Laburu and Vila, 2008; Naslund, 2008; Siha and Saad, 2008; Paradiso and Cruickshank, 2007; Vollmer and Phillips, 2000; Hines and Rich, 1997). It is used extensively throughout manufacturing industries but has also been used in laboratories (Frederick, Kallal and Krook, 2000), construction (Winch and Carr, 2001) and in service environments (Linton, 2007). Though there are numerous variants of this approach they all attempt to provide a mechanism for gaining detailed understanding of the current-state of how organizations work (White and James, 2014; Nash and Poling, 2009; Innovations, 2005; Hines and Rich, 1997).

In each organisation, a single individual ('The Associate') was responsible for undertaking the business process improvements. In accord with the assertion in the literature review, that it is the individuals that are fundamental to the success of knowledge transfer initiatives (Perkmann et al, 2013; Aalbers, Dolfsma and Koppius, 2013; Hewitt-Dundas, 2012; Ceci and Lubatti, 2012; Osterlund and Carlisle, 2005; Thompson, 2004; Bettencourt, Ostrom, Brown and Roundtree, 2002), these individuals were the unit of analysis of this study. The study of each organisation lasted for a minimum of two years and the entire project took four years to complete. Triangulation of the research findings across research sites and long-term immersion in the field of research contribute to the quality of action research (Whittemore, Chase and Mandle, 2001; Eden and Huxham, 1996; Vinten, 1994; Sanday, 1979; Jick, 1979; Miles, 1979; Schwartz and Schwartz, 1955), termed 'recoverability' by Checkland and Howell (1998).

Twelve semi-structured interviews were conducted in each organisation along with approximately forty hours of on-site observation and the compilation of instantaneously-sampled field notes over the two-year duration of each of the projects (Paolisso and Hames, 2010), to the point of theoretical saturation (Guest, Bunce and Johnson, 2006; Glaser and Strauss, 1967).Interviews were conducted with the individual responsible for conducting the business process improvements in each organisation. Research questions were developed around the six elements, and the sources of organisational disturbances, depicted by Activity Theory. Questions were cyclically developed to probe discussion around the subject of 'skills' following initial data analysis (Halcomb and Davidson, 2006; Miles, 1979; Becker, 1958). Data analysis was performed using thematic indexing (Guest, MacQueen and Namey, 2012).

4. Analysis

This section presents the analysis of data from each of the three organisations in turn, focusing upon the micro-relationships between The Associates and their work environment. The individuals that form the focus of the investigation in each of the three organisations are referred to as I_1, I_2 and I_3 respectively. The names of all other individuals have been changed to maintain anonymity.

4.1. Rural Organisation

The issue of personal skills and abilities appears as a source of tension throughout the project. Some skills issues are related to the personal skills of the individual undertaking the business process improvements, and some are related to the skills of the individuals of other employees within the Activity Theory element of 'Community'. At the start of the project and when asked about his initial presentation to the organisation I_1 replied:

Umm, its, well, it's my delivery.

I think, my delivery wasn't the best.

I've done quite a number of presentations and some of them go better than others.

This is a source of tensions that could be attributed to the element 'Subject'. However, 'Subject' issues usually revolve around issues of motivation. While his apparent lack of 'Skills' could be interpreted as being a motivational issue, this is in fact an outcome rather than a cause: it is the lack of skills that appear to adversely affect his motivation. He notices that his personal skills are also sometimes lacking even though he had previously noted that he had been successful in courting the support of some members of staff:

I should have spent a bit more time with them and tried to kind of get them on board a bit more, that would have helped…

As the project progresses he continues to critically examine his own practices:

Yeah, I think again it's something that I could have managed a bit better

Later in the project, I_1 relates the difficulties that are being caused by other employees not using the modified systems in their intended way:

...it's a good system and a good way of working but in practice it seems that they're deliberately not using it.

It emerges that some employees are not using the modified systems due to their inability to use information technologies. When referring to a key member of management I_1 notes:

He's never sent a text message, umm but he can just about use his emails and, ring people off it.

He's got to grips with his Blackberry but he's still not opening these communications on his desktop.

While the tensions caused by an apparent lack of personal skills and abilities were commented upon by I_1, they were also observed in the actions of others within the organisation. This suggests that the observations are not merely due to the personal characteristics of the Subject but are sources of tensions throughout the activity system.

4.2. Service Organisation

The element Skills emerges at intervals during the project around I_2 and other employees. Most significant are those tensions surrounding another employee, hereafter named C. It is notable however that a combination of I_2 own relative lack of skills and the senior management's apparent lack of skills, or at least their lack of appreciation of person C's lack of skills, contributes to the difficulties that were observed to surround this person:

Because he's reporting on it all [To Senior Management], he's the only one who knows a lot about the databases …which, makes him very important.

Person C appears to favour Microsoft Access derived solutions to the majority of management system problems that were encountered during the project:
[Looking at the project plan] you can look here, here's his proposed solution, "Access", what's the next one, "Access".

Senior Management also appear to have relatively low skills, in terms of management system development and information system development, and they regard person C's efforts highly. As I_2 relates:
You can see why the Directors think the sun shines out of his arse though.
...he had to show what he'd done and they thought his new Access project tracker was amazing because it gives them the results at the end and that's all they care about.
But, you could get an A-level student to write that database to be honest with you.

The general lack of skills, particularly information technology skills, is prevalent throughout the organisation. One event, retold by I_2 recalls:
[The Head of Finance] sent her a spreadsheet the other day; she printed it, filled it out by hand, scanned it and emailed it back to him.

Interestingly, the organisation appears to have offered person C further training in database development. This would suggest that they recognised the need to improve his level of skills. However, person C apparently refused the training. If this was recognised by senior management as being a necessary skill for the business to acquire then one could expect him to have been instructed to partake in the training; or at least for the organisation to have identified a suitable alternative employee to receive the training. It appears though that the opportunity to acquire these seemingly necessary skills has not been taken, I_2 commenting:
They've offered to put him on SQL training courses before
Yeah and he's never done it.
I don't understand really why you would ever turn something like that down. It's just a bit odd.

I_2 also briefly relates his growing abilities to generate process maps:
Yeah I can generate a process map in no time but I don't think I was particularly slow before,

He compares the process mapping activity to the roll activity diagram (RAD) technique, commenting:
...it's quite hard to sort of say specifically because at a first glance they [RADs] look very complicated, but its only once you learn how to read them that they're actually not.

He draws attention to the value that a short training session provided and enabled him to engage with process mapping relatively quickly. Contrastingly, the RAD technique required significant levels of study and practice:
You can capture more in a RAD. But The RAD takes more thought.

4.3. Military Organisation

From the start of the project I_3 identifies the need to record the current activities of the organisation in the form of a flow chart, value stream map, or process map. Although the exact type of charting method has yet to be decided upon she recognises that there are many versions to choose from. When asked about how the new product development process would be captured and examined she replies:
...a process, either a flow process or just well stage gate process.
I am intending to use value stream mapping…how I'm not too sure yet.

I_3 identifies another area of the organisation for investigation but recognises that value stream mapping may not be an appropriate tool for this particular activity:
Value stream mapping for the shop floor certainly but I don't think I can do a value stream map for the components because it will be a map that goes all over the place.

This brief exchange serves to identify the importance of the Associate's 'skills'. On the one hand her understanding of value stream mapping enables her to identify it as a potentially useful tool in one situation, but furthermore, to recognise its limitations and probable inappropriateness in another.

Significantly, the organisation employs a single person to generate all of its process maps. When this person was asked to construct a simple map for a hypothetical process the resultant maps were found to contain many logical errors. This was observed result in not only deficient process maps but also reluctance for other staff to follow them. As I_3 observed, other members of staff commented:
...ahh, as per one of his processes, it's over-complicated!

In addition to identifying her own and other staff's skills as being important factors, the skills of individuals in other organisations are also significant. This becomes most apparent when she discusses her investigation of the supplies base and interrogates the organisation's information systems:
I've looked at their ERP system because that's another thing that causes a lot of problems within the company and nobody really knows how to use it.

5. Discussion

Analysis of the research data identified a considerable number of instances and discussions that revolved around the skills and abilities of individuals. In the Rural organisation the project owner identified his own lack of skills as a barrier to completing the work toward the beginning of the project and later identifies the lack of other employee's technical skills as being both barriers to the completion of the project and a failure for the project deliverables to be sustained. Even after one new system had been in place for over six months, a lack of skills among the individual employees of the organisation were still preventing it from being utilised as effectively as possible.

The element of tacit skills was also discovered through analysis of the Service organisation's data. This manifested within the individual under observation and in the community within which he worked. The Associate identifies his own initial inability to compile process maps. Over time however he reports upon an improvement in his own speed and accuracy. A lack of skills is also identified in the observation of the general poor levels of information technology abilities throughout the organisation. This was evident within employees at all levels of the organisation.

The Military project owner's own lack of familiarity with process mapping techniques, along with the overly complex manner in which one individual in the organisation constructed the existing procedures and process maps, suggests that employee skills is a significant issue. Additionally, there was observed to be a general lack of ability of suppliers to correctly use their ERP system.

In this study, the ability of the individuals to perform the activity of process mapping was found to develop and improve over time. This is consistent with Activity Theory that is useful in unravelling processes that occur over relatively long periods of time. Also, it finds that the rate at which those tacit skills develop are *dependent* upon the form of process mapping, or the type of tool, that is employed. This may seem unsurprising, but it indicates the importance that must be placed upon the selection of tools that are employed to facilitate work-based activities: the knowledge to utilise some tools may be more easily acquired than others. It also suggests that if tools are employed that require the input or involvement of other individuals, then the ability of those individuals to acquire the tacit skills to be able to contribute effectively must also be taken into account. The effectiveness of the tool, not just for the immediate performance of work but also for the continued acquisition of knowledge in other individuals is an important factor to be taken into consideration as part of a wider knowledge management strategy.

5.1. Extending Activity Theory

Activity Theory centres upon the performance of an activity, by an individual, in order to achieve an outcome. It recognises that the activity is moderated, in some way, by the combined influences of the organisational environment in which it is performed and that the activity may be facilitated by the use of tools. However, just as the various models of knowledge production and distribution have been criticised for assuming that the sharing of tacit knowledge or the performance of management imposed activity occurs unopposed, Activity Theory assumes that the use of tools to facilitate the performance of activity also occurs without difficulty. To utilize the bicycle analogy, possessing the necessary equipment and instructions does not imply an ability to ride it. Similarly, being in possession of, or having access to relevant tools and their instructions, in no way implies having the skill to use them.

The term 'tacit skill' has become a favourable term within the literature, appearing to provide a valuable differentiation between the unknowable tacit knowledge that is perceived to exist within the individual and the observable knowledge that those individuals demonstrate when they perform activities. Employees' abilities to engage in organisational improvement are dependent upon the skills that they acquire during their everyday work and their future performance relies heavily upon their previous experiences (Cooke, 2003).

Wood (1987) states that skill is generally recognised to comprise three factors or debates. Firstly that it is socially constructed, containing tacit elements. 'Skilled jobs' are argued to be those that are labelled as such by management in order to maintain power over the workforce, or alternatively as those that are labelled as such by workers to identify their unique abilities that are vital for the industry (Debrah and Reid, 1998). Secondly, tacit skills are those skilled actions that are based upon individuals' tacit knowledge and are highly specialised, are acquired over long durations and difficult to describe (Debrah and Reid, 1998). Finally, the gender-influenced division of labour that alludes to the notion that female aptitude for certain jobs is not rewarded as the same rate for jobs that require male aptitudes or characteristics (such as strength).

Similar to Wood (1987), Ambrosini and Bowman (2001) allude to a dimension of consciousness or awareness within what they term 'tacit skills'. Some such skills may be more easily described than others: though this, strictly speaking, is in contradiction of the term inarticulable that tacitness denotes. Some skills at least are wholly inexpressible and remain unreachable while others are at least partly explicable (Evans, Kersh and Kontianen (2004). Reflecting the importance of knowledge to modern organisations that seek to gain competitive advantage, 'tacit skills' are said to be one of the key elements that organisations must learn to assimilate in order to sustain that advantage (Lei and Slocum, 1992).

The element 'Tacit Skills' has been incorporated into the Activity Theory framework adjacent to the factor Tools (Figure 3). This maintains the framework and Engestrom's insistence on retaining the activity as the focus of the study and avoiding enlarging the unit of analysis beyond the individual. It also signifies the relationship between Skills and Tools within the framework, that it is the individual's skills that enables them, or prevents them, using the relevant tool in order to

undertake the activity, and that this skill may develop over time. An individual's tacit skills are therefore a further source of disturbances that impart instability to the activity system.

It could be argued that the element 'Skills' should be incorporated into the Activity Theory framework adjacent to the factor 'Community', thus indicating the importance of the skills of the employees in the organisation. However, as previously stated, the focus of Activity Theory is the activity that the Subject is carrying out. Therefore the element of 'Tacit Skills' is portrayed as an element that mediates an individual's performance of the activity.

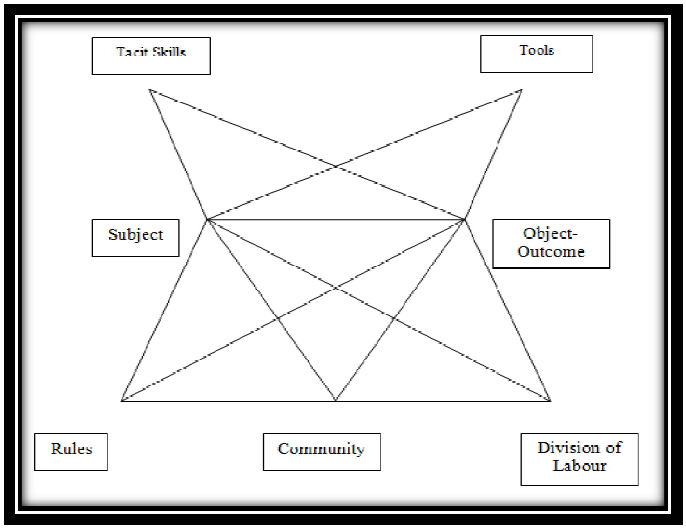

Figure 3: Extension of Activity Theory

6. Conclusion

The ability to acquire and utilize knowledge has long been recognised as a necessary core competency for organizations. A substantial body of literature has examined the means by which various systems of innovation may be employed to leverage knowledge resources. However, it has been recognised that it is the micro-relationships between individuals that are a significant determinant of the efficacy of such knowledge-based collaborations.

Adopting an Activity Theory approach, this research examines the tensions that arise between key individuals in three Knowledge Transfer Partnerships. The study identifies that the skills of the individuals are the primary source of issues that affect the execution of the knowledge transfer activities. Specifically, it is the ability of individuals to successfully utilise tools and techniques that gives rise to tensions that threaten to cause the Partnerships to fail. These findings suggest that the dimension of 'Tacit Skills' needs to be explicitly recognised within the Activity Theory framework, and a discussion of this extension is proffered.

There is a substantial body of literature that seeks to explore approaches to innovation. However, very little of this focuses upon the micro-relations between the actors that are involved in the processes. Future research should endeavour to recognise and unpack the complex social arrangements that exist within and around innovation initiatives. In particular, schemes such as Knowledge Transfer Partnerships in the UK, are numerous and are successful, but remain under explored. The vagaries of such schemes are in need of rigorous examination.

This study is limited due to its examination of three organisations. However, the findings are confirmed to some degree through examination of organisations in both the private and public sectors. Future research should seek to examine the usefulness of the proposed extension to Activity Theory in other scenarios.

7. References

i. Aalbers, R., Dolfsma, W., & Koppius, O. (2013). Individual connectedness in innovation networks: on the role of individual motivation. *Research Policy*, 42, 624-634.
ii. Acworth, E.B. (2008). University-industry engagement: the formation of the Knowledge Integration Community (KIC) model at the Cambridge-MIT Institute. *Research Policy*, 1241-1254.
iii. Ambrosini, V., & Bowman, M. (2001). Tacit Knowledge: Some Suggestions for Operationalization. *Journal of Management Studies,* 38(6), 811-829.
iv. Banal-Estanol, A., Jofre-Bonet, M., & Lawson, C. (2015). The double-edged sword of industry collaboration: evidence from engineering academics in the UK. *Research Policy*, 44, 1160-1175.
v. Becker, H.S. (1958). Problems of Inference and Proof in Participant Observation. *American Sociological Review*, 23(6), 652-660.

vi. Bedny, G., Karwowski, W, &Bedny, M. (2001). The Principle of Unity of Cognition and Behaviour: Implications of Activity Theory for the Study of Human Work. *International Journal of Cognitive Ergonomics,* 5(4), 401-420.
vii. Bedny, G. Z., Seglin, M., H., & Meister, D. (2000). Activity Theory: history, research and application. *Theoretical Issues in Ergonomics Science,* 1(2), 168-206.
viii. Benson, A. D., & Whitworth, A. (2007). Technology at the Planning Table: Activity Theory, Negotiation and Course Management Systems. *Journal of Organizational Transformation and Social Change*, 4(1), 75-92.
ix. Bettencourt, L. A., Ostrom, A., Brown, S. W., &Roundtree, R. (2002). Client Co-Production in Knowledge-Intensive Business Services. *California Management Review*, 44(4), 100-128.
x. Carillo, K.D., & Beaudry, A. (2006). The Customer-Centered B2C Literature through the Lens of Activity Theory: A Review and Research Agenda. *Communications of AIS,* 17(21), 2-102.
xi. Ceci, F., &Lubatti, D. (2012). Personal relationships and innovation diffusion in SME networks: a content analysis approach. *Research Policy*, 41, 565-579.
xii. Chaminade, C., Intarakumnerd, P., &Sapprasert, K. (2012). Measuring systemic problems in National Innovation Systems: an application to Thailand. *Research Policy*, 41, 1476-1488.
xiii. Checkland, P., & Holwell, S. (1998). Action Research: Its Nature and Validity. *Systemic Practice and Action Research*, 11(1), 9-21.
xiv. Cooke, F.L. (2003). Maintaining change: the maintenance function and the change process. *New Technology, Work and Employment*, 18(1), 35-49.
xv. Cyert, R.M., & Goodman, P.S. (1997). Creating effective university-industry alliances: An organizational learning perspective. *Organizational Dynamics*, 25, 4, 45-57.
xvi. Debrah, Y.A., & Reid, E.F. (1998). Internet professionals: job skills for an on-line age. *The International Journal of Human Resource Management*, 9(5), 910-933.
xvii. D'Este, P., & Patel, P. (2007). University-industry linkages in the UK: what are the factors underlying the variety of interactions with industry? *Research Policy*, 36, 1295–1482
xviii. Eden C., &Huxham C. (1996).Action Research for Management Research. *British Journal of Management*, 7, 75-86.
xix. Engestrom, Y. (2000a). Activity Theory as a framework for analyzing and redesigning work. *Ergonomics,* 32(7), 960-974.
xx. Engestrom, Y. (2000b). Comment on Blacker et al. Activity Theory and the Social Construction of Knowledge: A Story of Four Umpires. *Organization,* 7(2), 301-310.
xxi. Engestrom, Y., Miettinen, R., & Punamaki, R. (2005).*Perspectives on Activity Theory,* Cambridge University Press.
xxii. Etzkowitz, H., &Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109-123.
xxiii. Etzkowitz, H. (2003). Innovation in innovation: The triple helix of university-industry-government relations. Social science information, 42(3), 293-337.
xxiv. Evans, K., Kersh, N, & Kontiainen, S. (2004). Recognition of tacit skills: sustaining learning outcomes in adult learning and work re-entry. *International Journal of Training and Development,* 8(1), 54-72.
xxv. Frederick, L., Kallal, T., &Krook, H. (2000). Quality through Metrics. *Quality Assurance,* 7, 5-16.
xxvi. Freitas, I.M.B., Geuna, A., & Rossi, F. (2013). Finding the right partners: institutional and personal modes of governance of university-industry interactions. *Research Policy*, 42, 50-62.
xxvii. Glaser, B.G., & Strauss, A.L. (1967.)*The Discovery of Grounded Theory: Strategies for Qualitative Research.* New York, Aldine Publishing Company.
xxviii. Guan, J., & Chen, K. (2012).Modeling the relative efficiency of national innovation systems. *Research Policy*, 41, 102-115.
xxix. Guest, G., Bunce, A., & Johnson, L. (2006). How Many Interviews are Enough? An Experiment with Data Saturation and Variability. *Field Methods*, 18(1), 59-82.
xxx. Guest, G.S., MacQueen, K.M., &Namey, E.E. (2012). Applied Thematic Analysis. Sage Publications, UK.
xxxi. Halcomb, E.J, & Davidson, P.M. (2006). Is verbatim transcription of interview data always necessary? *Applied Nursing Research*, 19, 38-42.
xxxii. Hewitt-Dundas, N. (2012). Research intensity and knowledge transfer activity in UK universities. Research Policy, 41, 262-275.
xxxiii. Hines, P., & Rich, N. (1997). The seven value stream mapping tools. *International Journal of Operations and Production Management,* 17(1), 46-64.
xxxiv. Innovations (2005). The new improvement frontier. *Strategic Direction*, 21(11), 33-35.
xxxv. Jarzabkowski, P. (2003). Strategic Practices: An Activity Theory Perspective on Continuity and Change. *Journal of Management Studies*, 40(1), 23-55.
xxxvi. Jick, T.D. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly*, 24(4), 602-611.

xxxvii. Kain, D., & Wardle, E. (2005). Building Context: Using Activity Theory to Teach About Genre in Multi-Major Professional Communication Courses. *Technical Communication Quarterly,* 14(2), 113-139.

xxxviii. Karlsson, F., &Wistrand, K. (2006). Combining Method Engineering with Activity Theory: Theoretical Grounding of the Method Component Concept. *European Journal of Information Systems,* 15, 82-90.

xxxix. Kluge, J., Stein, W., & Licht, T. (2001).*Knowledge Unplugged: The McKinsey and Company Global Survey on Knowledge,* Palgrave.

xl. KTP (2020). Knowledge Transfer Partnerships: what they are and how to apply. Available from: https://www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply (Accessed 10th March 2020).

xli. Lasa, I.S., Laburu, C.O., & Vila, R., de C. (2008). An Evaluation of the Value Stream Mapping Tool. *Business Process Management Journal*, 14(10, 39-52.

xlii. Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

xliii. Lei, D., & Slocum, J.W. (1992). Global Strategy, Competence-Building and Strategic Alliances. *California Management Review*, Fall, 81-97.

xliv. Leont'ev, A.N. (1978).*Activity, Consciousness and Personality.* Prentice-Hall, NJ.

xlv. Leven, P., Holmstrom, J., &Mathiassen, L. (2014). Managing research and innovation networks: evidence from a government sponsored cross-industry program. Research Policy, 43, 156-168.

xlvi. Linton, J. (2007). Process Mapping and Design. *Circuits Assembly*, February, 26-30.

xlvii. Malik, T.H. (2013). National institutional differences and cross-border university-industry knowledge transfer. Research Policy, 42, 776-787.

xlviii. Miles, M.B. (1979). Qualitative Data as an Attractive Nuisance: The Problem of Analysis. *Administrative Science Quarterly,* 24(4), 590-601.

xlix. Miller, W.L., & Morris, L. (1999).*Fourth Generation R&D: Managing Knowledge, Technology and Innovation,* Wiley.

l. Nash, M.A., & Poling, S.R. (2009). Process Mapping for the 21st Century. *Quality,* August, 24-25.

li. Naslund, D. (2008). Lean, Six Sigma and Lean Sigma: fads or real process improvement methods? *Business Process Management Journal*, 14(3), 269-287.

lii. Ornella, W.M. (2015). Determinants of university-firm R&D collaboration and its impact on innovation: a perspective from a low-tech industry. Research Policy, 44, 1341-1359.

liii. Paolisso, M., & Hames, R. (2010). Time Diary versus Instantaneous Sampling: A Comparison of Two Behavioural Research Methods. *Field Methods*, 1-21.

liv. Paradiso, J., & Cruickshank, J.R. (2007). Process Mapping for SOX and Beyond. *Strategic Finance*, March, 31-35.

lv. Parry, G., Mills, J., & Turner, C. (2010). Lean competence: integration of theories in operations management practice. *Supply Chain Management: An International Journal,* 15(3), 216-226.

lvi. Perkmann, M., &Schildt, H. (2015). Open data partnerships between firms and universities: the role of boundary organizations. Research Policy, 44, 1133-1143.

lvii. Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Brostrom, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013). Academic engagement and commercialisation: a review of the literature on university-industry relations. Research Policy, 42, 423-442.

lviii. Polanyi, M. (1983). *The Tacit Dimension*. Peter Smith, US.

lix. Ponomarenko, V.A. (2004). The Significance of Theoretical Concepts in Activity Theory for Applied Research in Aviation. *Theoretical Issues in Ergonomics Science,* 5(4), 297-312.

lx. Razak, A.A, & White, G.R.T. (2015).The Triple Helix Model for Innovation: a holistic exploration of barriers and enablers. International Journal of Business Performance and Supply Chain Modelling, 7(3), 278-291.

lxi. Sanday, P.R. (1979). The Ethnographic Paradigm(s). *Administrative Science Quarterly,* 24(4), 527-538.

lxii. Schwartz, M.S, & Schwartz, C.G. (1955).Problems in Participant Observation. *The American Journal of Sociology,* 60(4), 343-353.

lxiii. Siegel, D.S., Waldman, D.A., Atwater, L.E.A, & Link, A.N. (2003). Commcrcial knowledge transfers from universities to firms: improving the effcctivcncss of university-industry collaboration. *Journal of High Technology Management Research,* 14, 111-133.

lxiv. Siha, S.M., & Saad, G.H. (2008). Business Process Improvement: empirical assessment and extensions. *Business Process Management Journal*, 14(6), 778-802.

lxv. Thompson, M.P.A. (2004). Some Proposals for Strengthening Organizational Activity Theory. *Organization,* 11(5), 579-602.

lxvi. Trim P.R.J. (2003). Strategic marketing of further and higher educational institutions: partnership arrangements and centres of entrepreneurship. The International Journal of Educational Management, 17(2), 59-70.

lxvii. Tuomi, I. (1999). Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory. *Journal of Management Information Systems,* 16(3), 107-121.

lxviii. Tzabbar, D., Aharonson, B. S., &Amburgey, T. L. (2013). When does tapping external sources of knowledge result in knowledge integration? *Research Policy*, 42, 481-494.

lxix. Vinten, G. (1994). Participant Observation: A Model for Organizational Investigation? *Journal of Managerial Psychology*, 9(2), 30-38.

lxx. Vollmer, M., & Phillips, T. (2000). Process mapping key starter in knowledge management. *Management & Economics*, April, 130-132.

lxxi. Vygotsky, L.S. (1978).*Mind in Society: The Development of Higher Psychological Processes.* Edited by Cole, M., John-Steiner, V., Scribner, S., and Souberman, E., Cambridge, Harvard University Press.

lxxii. Watkins, A., Papaioannou, T., Mugwagwa, J., & Kale, D. (2015). National innovation systems and the intermediary role of industry associations in building institutional capacities for innovation in developing countries: a critical review of the literature. *Research Policy*, 44, 1407-1418.

lxxiii. White, G.R.T., & James, P. (2014). Extension of Process mapping for the Identification of 'Green Waste'. *Benchmarking an International Journal*, 21(5).

lxxiv. White, G.R.T., &Cicmil, S. (2016). Knowledge Acquisition through Process Mapping: factors affecting the performance of work-based activity. *International Journal of Productivity and Performance Management*, 65(3), 302-323.

lxxv. White, G.R.T., Cicmil, S., Upadhyay, A., Subramanian, N., Kumar, V., &Dwivedi, A. (2018). Soft Side of Knowledge Transfer Partnership between Universities and Small to Medium Sized Enterprises: exploratory study to understand process improvement. Production Planning and Control, In-Press.

lxxvi. White, G.R.T., Lomax, M., & Parry, G (2012). The Implementation of an Environmental Management System in the Not for Profit Sector. *Benchmarking: An International Journal*. 21(4), 509-526.

lxxvii. White, G.R.T., Samson, P., Thomas, A., & Rowland-Jones, R. (2009). The Implementation of a Quality Management System in the Not-For-Profit Sector. *The TQM Journal*, 21(3), 273-283.

lxxviii. White, G.R.T., Wang, X., & Freeth, I. (2009). Knowledge Transfer Partnerships at the University of the West of England, Paper presented at the Innovation through Knowledge Transfer, Hampton Court.

lxxix. Whittemore, R., Chase, S.K., & Mandle, C.L. (2001). Validity in Qualitative Research. *Qualitative Health Research*, 111, 522-537.

lxxx. Wood, S. (1987). The Deskilling Debate, New Technology and Work Organization. *Acta Sociologica*, 30, 3-24.

lxxxi. Whyte, W.F. (1989).Advancing Scientific Knowledge through Participatory Action Research. *Sociological Forum*, 4(3), 367-385.

lxxxii. Winch, G.M., &Carr, B. (2001). Processes, maps and protocols: understanding the shape of the construction process. *Construction Management and Economics,* 19, 519-531.

lxxxiii. Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: knowledge types and the role of intermediaries. *Research Policy*, 1205-1223.

lxxxiv. Zarakovsky, G.M. (2004). The concept of theoretical evaluation of operators' performance derived from activity theory. *Theoretical Issues in Ergonomic Science,* 5(4), 313-337.