Creating Sustainable Cities Through Knowledge Exchange: A Case Study of Knowledge Transfer Partnerships

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Structured Abstract

Purpose

The purpose of this paper is to examine the use of the Knowledge Transfer Partnership as a means for universities to generate and exchange knowledge to foster sustainable cities and societies.

Design/methodology/approach

This paper reports on a series of separate yet interrelated Knowledge Transfer Partnerships (KTPs) between a university and Local authority in the North East of England designed to enhance the environmental, social and economic performance of a large scale urban housing procurement project.

Findings

Results from the partnerships indicate that KTPs may play a crucial role in developing capacity within local authorities tasked with creating sustainable cities and societies, whilst at the same time enhancing skills and knowledge within the communities whom they represent and their industry partners.

Originality/value

The paper contributes an understanding as to how universities can act as a conduit for the generation and exchange of knowledge for sustainability. It presents a case study which examines how a series of KTPs can provide a useful mechanism for enhancing environmental, social and economic sustainability.

Keywords: Sustainable Cities; Private Public Partnerships; Knowledge Transfer Partnerships; Knowledge for Sustainability.

1. Introduction

Society is becoming increasingly urbanized as more than half of the global population now live in cities and urban areas, a figure expected to rise to over 70% by 2050 (UN Habitat, 2008). Many urban areas are seen as concentration points of environmental destruction where issues of pollution, noise, congestion, crime and security pose a serious threat to human well-being (Nijkamp and Perrels, 2014). Despite this cities have been identified as key enablers of sustainable development and actions to mitigate climate change as urbanites are often responsible for fewer carbon emissions than rural dwellers and effective, integrated solutions can be implemented at scale through dense urban societies (ICLEI, 2011). Increasingly urban and city regions are facing the key challenge of how to provide additional infrastructure and housing in order to meet increased demand, whilst at the same time ensuring that development is sustainable, improves quality of life, reduces social injustice and enhances environmental quality. In other words how can we develop and create ‘sustainable cities’ and societies.

Whilst there is no agreed definition as to what constitutes a 'sustainable city' it has been suggested that such a city should be able to create an enduring way of life across the four domains of ecology, economics, politics and culture (Hens and Luc, 2015). This necessarily requires the involvement of a wide range of actors who need to focus on strategies to encourage deep integrative relationships between industry, governments and universities as a means to ensure the sustainable management of human, ecological and economic capital (Bilodeau et al., 2014; McCormick et al., 2013). However this in turn poses significant challenges to the way in which cities are developed, organised and managed and how the required knowledge and skills are developed and operationalised. There continues to be an interest in the role that universities can play in contributing towards solutions for more sustainable cities and societies through their teaching, research and extramural activities (Barnes and Phillips, 2000; Whitmer et al., 2010).

This paper seeks to address the research question "What role can university led knowledge exchange play in fostering sustainable cities and societies?". In doing so it discusses the role of knowledge creation, exchange and transfer in contributing to sustainable development. It then outlines the various roles that universities play in developing and exchanging knowledge with its stakeholders offering a conceptual framework that describes some of the specific attributes of knowledge exchange for sustainable development. It Introduces the Knowledge Transfer Partnership (KTP) as a mechanism for facilitating the creation, transfer and exchange of knowledge for sustainable cities and developing innovative approaches to dealing with sustainability challenges. Finally the paper presents and analyses a case study that includes a series of separate yet interrelated KTPs between a university and Local authority in the North East of England designed to enhance the environmental, social and economic performance of a large scale urban housing procurement project.

2. Methodology

The study began with a literature review which sought to develop a set of specific attributes that define knowledge for sustainable development. This was combined with a review of the role of the university in knowledge creation, exchange and transfer to establish the range of activities through which knowledge exchange may be achieved. KTP was then examined as a mechanism that combines a wide range of activities useful for exchanging knowledge for sustainable development. The research primarily draws upon experiences of one particular university and its relationship with a public sector partner through a series interrelated KTPs. Despite the single case study approach, this research can provide useful generalisations to theory where similar conditions prevail (Yin, 2014) such as in other academic institutions . The KTPs examined have all brought about significant change in the capacity of the host organisation and local community to respond to sustainability challenges and so provide useful evidence as to the potential of extramural activities in creating sustainable cities. The case studies themselves draw their empirical material from the experience of the KTP associates themselves, the academic staff that managed the projects and employees of both the private and public organisations involved. Some of this information has previously been published in peer reviewed journals and conference proceedings (see for example Giddings et al., 2013a, 2013b; Hope, 2010, 2012; Hope et al., 2012; Hope and O'brien, 2010). Meeting minutes, board papers and final reports from each KTP project have also been included in the analysis as a means to improve the validity of the findings. The cases are analysed using the conceptual framework derived from the literature, whilst some of the barriers to effective knowledge exchange are also discussed.

3. Literature Review

Knowledge for Sustainable Development

The need to harness knowledge as a means to enable effective actions that address the challenge of meeting human development needs whilst protecting the earth's life support systems is well established (Cash et al., 2003) as is the need to improve knowledge about the impact of cities on the environment (Bulkeley and Betsill, 2005), strategies for improving city governance (Van Bueren and Heuvelhof, 2005), city planning (McCormick et al., 2013) and construction (Ahn et al., 2013). The challenge is that sustainability issues are by

their very nature complex, multifaceted, long term and large scale. What's more, sustainability requires social transformations that are complex and continuously changing. Given this, the nature of sustainability knowledge requires a fundamentally different approach to the way in which knowledge is conceptualised, organised and produced and transferred.

Knowledge has many different dimensions and can be conceptualised in a range of ways. One key consideration is the distinction between monodisciplinary, multi and interdisciplinary and transdisciplinary research. Monodisciplinary research involves a single academic discipline where all actions remain strictly within the boundaries of the specific field. Multidisciplinary research is the investigation of a complex problem from different angles by experts from a range of different disciplines, however each expert approaches the problem using their own disciplinary theories and approaches (Benard and de Cock-Buning, 2014). In the case of interdisciplinarity, the discipline boundaries are open and theories and approaches connected to find shared solutions to a problem (Bruce et al., 2004). In contrast to the previous approaches, transdisciplinary research acknowledges the relevance of experiential knowledge and non-academic stakeholders. It is directed at complex, societal issues and aims to develop knowledge and innovations that contribute to societal progress (Benard and de Cock-Buning, 2014). As such it is an approach that is perhaps best suited to sustainable development where the boundaries are fuzzy and the combination of knowledge from different disciplines is necessary to make progress (Brennenraedts et al., 2006; Parker, 2010).

Another consideration is the validity and reliability of knowledge generated, particularly from a social perspective as sustainability issues typically encompass a wide range of stakeholder groups each with differing needs, priorities and perspectives. In fact multi-stakeholder partnerships have become a common approach to dealing with sustainable development issues (Backstrand, 2006). From a research perspective validity is achieved by involving an extended group of experts, academics, and professionals in the knowledge creation process as a means to reveal divergent perspectives (Gibbons, 1999). Reliability is demonstrated through the extent to which disciplinary norms guide knowledge production within specified boundaries. In this respect knowledge for sustainable development must be stakeholder focused and participatory in nature. Whilst sustainable development is inherently normative (Waas et al., 2010), sustainability knowledge requires a degree of flexibility within disciplinary boundaries and the ability to operate between them (Lee, 1994). These approaches further strengthens the argument for the use of transdisciplinary approaches.

Knowledge for sustainable development can be created through investing in the production of information and knowledge, increasing financial resources to promote specific areas of interest, encouraging a change in culture and incorporating learning as a core value (Janssen and Ostrom, 2006). More recently, integrated approaches that draw upon the fields of organisational learning and knowledge management have been identified as key areas for sustainable development (Preuss and Córdoba-Pachon, 2009). Organisational learning can be understood as the process of creating, retaining and transferring knowledge within an organisation. The idea is that an organisation improves over time as it gains experience and from this is able to create knowledge and adapt to an ever changing environment (Dodgson, 1993). From a sustainable development perspective organisational learning enables organisations, and the individuals within them, to better meet the complex sustainability challenges and develop sustainability competencies (Naudé, 2012). Knowledge management is the process of capturing, developing, sharing and effectively using organisational knowledge (Davenport, 1994). Solving complex multi-faceted sustainability problems requires the application of knowledge across a wide range of topics and disciplines (McNeil, 2011). As such a structured approach to managing and sharing large amounts of sustainability information is critical to the success of sustainable development as is the process of integrating knowledge into organisational practice. This approach may be seen as being practice-oriented as it seeks to combine theory and practical experience in order to allow organisations to react to the changing environment in a flexible manner. Knowledge should also be put to effective use in generating specific solutions to specific sustainability problems. In this respect knowledge for sustainable development should be problem orientated.

The role of the University

Universities have traditionally played a key role in society in three main ways: they train and educate people, produce research, and participate in governance at the national and regional level (Sedlacek, 2013). Through these roles universities are increasingly interconnected with, and interdependent on the wider society and economy, thus they have a responsibility to contribute productively to the communities within which they operate as well as society at large (Jongbloed et al., 2008; López, 2013). In recent years, the remit of the university has expanded beyond education and research to engage with a wider variety of stakeholders in order to deliver social and economic benefits to the communities within which they operate and society more broadly (Knight, 2013; OECD, 2007). Here there has been a transition of knowledge production towards more integrative approaches which requires a re-orientation of a research agenda originally defined by academics to those defined in a multi-stakeholder environment in order to solve multidisciplinary societal needs and problems (Miller et al., 2011; Sedlacek, 2013). The exchange of this knowledge is increasingly important to communities and public sector organisations who cannot internally generate all the knowledge necessary for new product, service or process development (Wiltshier and Edwards, 2014). Universities then play a key role in the journey towards sustainable development (Amaral et al., 2015).

The activities and processes through which universities accomplish their aims of transferring productive knowledge to the economy is often referred to as ‘knowledge transfer’ (KT) (Kelly, 2008) and the role of universities in engaging with business and other organisations through KT activities has steadily grown (Hewitt-Dundas, 2012). In recent years the role of the university as a ‘transferrer’ of knowledge to society has undergone a shift towards a more inclusive model of Knowledge Exchange (KE). Here knowledge is co-produced and exchanged between actors in a democratic process designed to result in mutual benefits to each party. However many definitions of KE still appear to limit the transaction to that of a two way process. Knight and Lightowler (2010, p. 1) describe KE as as a ‘dynamic, ongoing, *two-way* interaction and flow of ideas and people between colleges and universities and business, public and third sector organisations’ (emphasis added). Similarly the UK Economic and Social Research Council defines KE as a *two way* process where academics, scientists and individuals or organisations share learning, ideas and experiences (ESRC, 2015) (emphasis added). In reality the knowledge exchange process used by academics and institutions include many ‘hidden’ connections and there are multiple mechanisms through which to exchange knowledge both formally and informally (Hughes et al., 2011). Some of the main mechanisms through which knowledge can be transferred and exchanged are illustrated in Table 1.

Knowledge exchange activities can and do take place across a broad spectrum of disciplines and sectors. Similarly the processes and models available for knowledge exchange are many and include community research; collaborative or participatory research (Fazey et al., 2014); democratising science (Meadow et al., 2015) ; transdisciplinary research (Bracken et al., 2015) or open innovation (von Hippel, E, 2005). From a sustainable cities and societies perspective, community, participatory and transdisciplinary based research strategies offer benefits over more traditional researcher led interventions. With participatory research, the traditional approaches to research where researchers generate ideas for projects, define the methods and interpret the outcomes are turned around and the community is empowered to shape the research agenda (Balcazar et al., 2004). Such approaches have been used in the health and international development sectors for some time (Cornwall and Jewkes, 1995). More recently there has been a recognition that the use of participatory and community based research methods are important tools in understanding community level engagement in urban sustainable development (Daley et al., 2013; Kawabe et al., 2013). The common aspects of these practices are that they focus on research collaborations among scientists from a range of different disciplines alongside non-academic stakeholders in order to address grand sustainability challenges and co-create solutions (Lang et al., 2012).

Table 1 Knowledge Exchange Mechanisms: (Adapted from Mathieu, 2011)

Informal Interaction	Formation of social relationships and networks.
Participation in conferences	Active participation in conferences by presentation of research results.
Publications	Use of codified knowledge within industry including joint-publications with the business sector and the scientific publications of the academic researcher.
Mobility of people	Employment of graduates, staff and researchers in the business sector.
Cooperation in education	Training of business employees by academics, and business employees influencing the curriculum of university programs or guest lecturing.
R&D services, cooperation and sharing of facilities	Activities such as contracted R&D and consultancy, joint supervision and/or the financing of PhD research by the business sector. Sharing and/or financing of facilities with academics and industry.
IP rights, licensing and spin-offs	Transfer of university-generated IP (such as scientific research results, patents, software, trademarks, databases) to firms via licensing. Development and commercial exploitation of technologies pursued by academics through industry.

Conceptual Framework

Combining the attributes of knowledge for sustainable development with the range of formal and informal knowledge exchange activities available to the the university results in a conceptual framework that describes a number of specific attributes of knowledge exchange for sustainable development:

- *Transdisciplinarity:* The integration of natural, physical and social sciences transcending traditional boundaries and through interaction between the academic and non-academic institutions
- *Participatory:* Knowledge developed in liaison with a broad range of stakeholders at the local, national and international level who co-produce the research.
- *Problem-oriented:* Knowledge that contributes towards the learning and development of skills required to to act in the context of sustainable development.
- *Practice Orientated:* Combining the academic theory with practical industry and community experience.
- *Formal and Informal interactions:* Knowledge should be created and exchange through a range of interactions such as those set out previously in Table 1.
- *Networked:* The interactions should result in the formation of social relationships and networks that are able to endure after a specific project has been completed.

One mechanism that may have the ability to combine many, if not all of the attributes described above, and which therefore may be used to translate the knowledge created by universities into action at the industry and societal level is the KTP.

4. Knowledge Transfer Partnerships

Knowledge Transfer Partnerships is a programme designed to assist organisations in improving competitiveness and productivity through use of knowledge, technology and skills that reside within universities (KTP, 2015a). A KTP is a relationship formed between a company and an academic institution which facilitates the exchange and transfer of knowledge, technology and skills to the company partner who is unable to access these from other sources, and practical industry experience back to the university (KTP, 2015b). The partnership employs one or more recently qualified graduates (known as an Associate) to work in the company for between 6 and 36 months on a project of strategic importance to the business, whilst being

supervised by university academics (KTP, 2015b). KTPs can provide a range of benefits for each partner depending on the specifics of each project. For the business partner benefits may include an increase in annual profits, the creation of new jobs and additional staff training (TSB, 2013). University benefits include the development of business-related teaching materials, initiation of new research projects and publishing of research papers which may contribute to funding and quality assessments such as the UK Research Excellence Framework (TSB, 2013). For the associate employed on the KTP, benefits include the opportunity to manage a challenging project and participation in a recognised route to fast-track career development which results in an average of 73% of associates being offered employment by the host business on completion of their project (TSB, 2013). The KTP incorporates multiple formal and informal activities such as those set out previously in Table 1 whilst also facilitating the development of a symbiotic relationship between the university, public and private sectors (Openjuru and Ikoja-Odongo, 2012). From a sustainable cities and societies perspective this is essential as such deep relationships are required to produce the depth and range of knowledge necessary to deal with complex sustainability problems. As such KTPs have been identified as a key vehicle in promoting innovative change (Wynn et al., 2008) and are being increasingly used to promote innovation and change from a sustainable development perspective.

KTPs for Sustainability

The co-production of knowledge between academic and non-academic communities is a prerequisite for sustainable development paths (Pohl et al., 2010). This being true, KTPs would appear to offer an ideal mechanism for both the generation and exchange of knowledge for sustainable development. In terms of the types of projects carried out, KTPs have been developed across a number of main knowledge and technology areas and a broad range of industry classifications. The KTP Online website offers a comprehensive database of projects carried out since 2005 and whilst it is difficult to define what a ‘sustainability’ KTP actually is, some broad conclusions can be drawn from the data. In the statistics, sustainability projects are classified rather narrowly as those relating to waste management, water remediation and heat recovery (KTP, 2007), however there has been an increase in the percentage of KTPs that seek to address sustainability issues from around 6% in 2006 to 25% in 2013 (KTP, 2015c)

There are numerous specific examples of KTP projects that have contributed to both knowledge and practice on strategies to create sustainable cities and communities. In the UK, The University of Salford has undertaken KTPs on issues such as sustainable retrofit programmes, building design and off-site manufacturing projects that seek to develop more energy efficient construction methods (University of Salford, 2014). The University of Birmingham and Birmingham City Council developed a KTP that contributed to the delivery of the Council’s vision that the City would be the UK's first sustainable global city with a low-carbon energy infrastructure prepared for the impact of climate change (University of Birmingham, 2015). Internationally, the University of Cape Town established its African Centre for Cities (ACC) in 2007 with the aim of fostering an interdisciplinary focus on urban studies (Pieterse, 2013). In 2012 the centre launched a KTP programme as a means to provide a way of the City and the University to work together. The KTP projects have gone some way towards providing city officials in Cape Town defensible, evidence based policy responses to complex city sustainability issues whilst academics have been able to generate data to input into policy processes and contribute to academic debates on urban sustainability (Smit et al., 2015).

It is clear then that KTPs are increasingly being used to develop knowledge and strategies for creating sustainable cities and societies. The paper now examines a case study which illustrates how three separate but interrelated KTP projects were used by one local governmental authority to build capacity, skills and knowledge to assist their aim of developing approaches to urban sustainable development.

5. Case Study: Northumbria University and North Tyneside Council KTPs

Northumbria University is located in Newcastle upon Tyne in the North East of England, UK. It has a strong history of engagement with business and the community to which it offers a range of research and

development, consultancy, commercial growth and KTP services. The university has been particularly successful in its application of KTP projects due in part to its close engagement and deep partnerships with local business and public sector organisations, but also through its academics, many of whom come from an industry background and combine key business experience with academic knowledge. Since 1987 the University has been involved in a total of 56 KTP projects with a combined grant value of more than £4.5 Million. In 2008 the university partnered with the North Tyneside Council, a metropolitan borough council situated to the east of Newcastle. The local authority had approached the university to for assistance in developing a project tasked with improving and increasing its social housing stock as a means to reduce the vulnerability of its tenants from fuel poverty and climate change. Initially two projects were developed to exchange expertise and experience in sustainable energy systems and architectural design quality, but following the success of these projects a further one was developed focusing on service delivery.

In total three separate but interrelated KTPs were developed, the first (KTP1) focussed on sustainable energy and ran from 2008-2011. The aim of this KTP was to build capacity and knowledge in the local authority with regard to specifying and operating low carbon renewable energy technologies, and assist the authority in its goal of creating a low carbon economy (Hope et al., 2012). The second (KTP2) dealt with architectural design quality and ran from 2009-2012 and sought to improve architectural design quality within the local authority procured social housing (Giddings et al., 2013b). The third (KTP3) ran from 2012-2015 with the aim to develop new and innovative approaches to housing service delivery in order to assist the local authority in improving the health and wellbeing of its social housing tenants. KTP1 and KTP2 formed part of a £300 Million Private Finance Initiative (PFI) project that sought to find a private sector consortium that would finance, design, build and maintain local authority managed housing over period of 25 years. KTP3 built on the previous two by working with the private sector consortium to develop new service delivery models. Each project involved an associate employed by the university but embedded within the specific authority project team. The associates were recent graduates who were each supported by two senior academics with experience working in relevant academic and professional fields.

6. Results

Returning to the conceptual framework described in Section 3 the attributes of knowledge for sustainable development can be used to analyse the three KTPs to establish their contribution to the creation of sustainable cities and societies. Each attribute is examined in turn.

Transdisciplinarity

All three KTPs exhibited transdisciplinarity throughout the course of the projects, partly due to their being derived from three different disciplines. KTP1 was embedded in a geography and environment department, KTP a built environment department and KTP3 from the department of health and life science. In the cases of KTP1 and KTP2 in the associates and academics involved met regularly as a larger group to share knowledge from both an environmental and architectural perspective. The transdisciplinary approach was further demonstrated through the interaction of the KTPs with the non-academic environment. All three projects necessitated close working with both the public sector local authority and private sector housing developers and their advisors to collaborate on developing solutions to the specific sustainability problems. In addition to this the associates drew on the university's wider network of industry contacts to transfer knowledge into the project. For example, during KTP1 a small conference was held to communicate and share good practice in sustainable energy system design. Non-academic industry experts were invited and the project benefited from the knowledge they exchanged.

Participatory

From the outset of the projects, the local authority set out their intention to consult widely with their housing tenants, employees and wider stakeholders such as local third sector organisations and other public sector

bodies. During KTP3 an innovative approach to stakeholder engagement was adopted based on the work of Reed *et al* (2005, 2008) who developed principles of involvement of older people in policy and service decision-making and grassroots involvement in key service planning. As a result local authority tenants were actively involved in the development of a new and innovative approach to the identification and design of new services. A similar approach was adopted on KTP1 and KTP2 where a tenant's user group was established with members invited to participate in some of the housing design meetings to ensure that thier needs were being met. Future tenants focus groups were convened to elicit the views of potential future tenants as a means to ensure that the project designs were future-proofed as much as possible.

Problem-oriented

Problem-oriented knowledge should contribute towards the learning and development of skills required to act in the context of sustainable development. One of the key aims of all three KTPs was to build skills and capacity within the local authority with respect to designing and specifying sustainable housing and service delivery. KTP1 achieved this formally by training staff on key aspects of sustainable housing policy whilst KTP2 developed an architectural design handbook for local authority staff. KTP1 also offered building developers a chance to gain expertise in specifying and operating sustainable technologies and therefore gain commercial advantage and begin the process of developing environmental capacity within their own businesses (Hope and O'brien, 2010). KTP3 helped to integrate and join up different types of services to provide housing tenants with greater opportunity to participate in leisure and social activities that can impact positively on their physical and psychological well-being.

Practice Orientated

KTP1 combined academic theory with practical industry and community experience to develop the 'PFI Sustainability Evaluation Tool' a multivariate methodology for evaluating and comparing sustainability within developments procured through PFI procurement (Hope et al., 2012). The tool offered a comprehensive and holistic assessment of the environmental, economic and social sustainability of a construction development at the procurement stage and proved useful in directing contract negotiations, managing information, ensuring legislative compliance and educating local authority and private sector employees on good practice in sustainable development and construction. In parallel with KTP1, KTP2 developed an Architectural Design Evaluation Tool that set out a clear process of assessment criteria enabling the evaluation of proposed building designs and the extent to which the housing would meet key health and wellbeing criteria. The project resulted in clear and targeted advice to housing developers as to where their designs could be improved to facilitate the provision of high-quality, sustainable and affordable housing (Giddings et al., 2013b). KTP3 led to the development of new community based services that deliver nutritional support for healthy eating, direct access to specialist nurses and multidisciplinary healthcare teams, and the development of dementia friendly environments.

Formal and Informal interactions

Knowledge was created and exchanged through the full range of mechanisms set out in Table 1. KTP1 and KTP2 resulted in the publication of conference papers (Giddings et al., 2013a; Hope, 2010) as well as academic journal articles (Giddings et al., 2013b; Hope, 2012; O'Brien and Hope, 2010). Aside from the associate, KTP2 employed six graduates from the university as architectural assistants towards the end of the project thus contributing to the mobility of people between institutions. In addition to this all three KTPs resulted in the training of business employees by the academic associates and guest lectures at the university from the industry project managers. KTP1 and KTP2 resulted in the completion of PhD research by the associates involved and on-going consultancy and R&D from the academic supervisors to the public sector client. Both these KTPs resulted in the transfer of university generated IP in the form of the sustainability and design evaluation tools.

Networked

All three KTPs resulted in the formation of professional and social relationships and networks that have endured post project completion. All of the associates remain in touch with the colleagues with whom they worked on the project with, as well as with each other, and continue to work in academic institutions. The result is that both formal and informal knowledge continues to flow between the individuals and by extension the institutions they represent.

Despite the positive outcomes described above, there were a number of barriers and difficulties that limited the overall effectiveness of the KTP projects. Firstly the focus on KT rather than KE meant that much of the knowledge generated flowed one way - from the University to the Local Authority. Whilst the researchers involved made efforts to encourage and develop a more mutually advantageous relationship based on the principles of KE, the public sector stakeholders were of the mindset that they were paying for the knowledge to be transferred as opposed to acting as co-investigators. In this respect the researchers were perceived more as consultants than university researchers (Hope et al., 2012). This perception was perhaps encouraged due to the use of the word ‘transfer’ in the KTP acronym, but also due to the fact that during the KTP the associate who acts as a conduit between the university and the host company is embedded within the company and adheres to their working terms and conditions.

Another barrier was contractural. During the development of KTP1 it became apparent that the multivariate tool that would prove useful to other local authority PPP projects. This resulted in the host company and university seeking to renegotiate terms relating to the ownership of this intellectual property (IP). Both organisations saw the potential for future revenue stream generation rather than the development of a tool that may be useful to civil society stakeholders seeking to enhance community sustainability. In fact IP management is recognised as one of the main barriers to successful KT in general (Ternouth et al., 2012). Finally there were initially issues relating to commercial confidentiality from the private sector organisations that were involved in the various projects. Whilst the necessary legal and contractual arrangements were all in place to ensure confidentiality was adhered to, the companies were reluctant to openly share ideas and solutions which they felt gave them a competitive edge in project negotiations. The result of this was that many of the ‘best’ solutions to sustainability problems did not fully emerge. This is a common issue in university-industry engagement (Bruneel et al., 2009).

7. Conclusion

As society continues to become increasingly urbanised, the sustainability of cities and societies becomes more of a challenge. Communities and organisations now understand that the key to dealing with the complex challenges raised by sustainability problems is to develop partnerships, build capacity and improve resilience. This paper provides an overview of the way in which universities can act as a conduit for facilitating such partnerships resulting in the creation and exchange of knowledge to foster sustainable cities and societies. It demonstrates that a KTP can be an effective in exchanging knowledge between universities, industry, communities, and local governmental authorities through a range of mechanisms. They may also be well placed to generate knowledge for sustainable development that is transdisciplinary, participatory, problem-oriented, practice Orientated, generated through formal and Informal interactions and networked.

However the study has also highlighted a number of weaknesses in the current KTP model that act as barriers to effective knowledge transfer and knowledge exchange processes. The focus on *knowledge transfer* as opposed to *knowledge exchange* can act as a barrier to effective co-production of knowledge and strategies for sustainable cities. Whilst many KTPs do indeed result in knowledge exchange, the use of the word ‘transfer’ does imply a one way flow of knowledge. In addition to this the case study has demonstrated that the perception of the KTP associate by some stakeholders is of either as an employee of the host organisation and therefore only present to perform traditional work based tasks, or as an external consultant whose role is to provide advice or transfer their expertise into the project. Contractual difficulties and fears over

confidentiality can also result in inadequate knowledge exchange and act as a barrier to the development of tools and approaches to deal with sustainability challenges.

Universities have the ability to foster sustainable cities in a number of key ways: through their function as educators providing the skills and knowledge necessary for the design, construction and management of sustainable cities; through their research roles generating new knowledge for sustainable cities and codifying existing strategies and disseminating case studies; and through their participation in the governance of societies assisting in nurturing and developing links between different community stakeholders. This paper demonstrates how KTP may be used as a mechanism for achieving all of the above within a single project activity. The results from the three KTP case studies indicate that when KTP is applied from a truly transdisciplinary and participatory perspective, the knowledge exchanged can play a crucial role in developing capacity within local authorities tasked with creating sustainable cities and societies, whilst at the same time enhancing skills and knowledge with the communities who they represent and the private sector companies involved.

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