Knowledge Exploitation and Value Creation: Lessons from the Energy Sector

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Abstract: A systemic knowledge management (KM) strategy will be underpinned by a model of the whole knowledge cycle. In such a strategy, key knowledge areas and processes pertaining to the acquisition, organisation, dissemination and exploitation of knowledge, will be defined that are intended to drive organisational activities. A systemic approach to KM was adopted by an innovation organisation in the energy sector. The planned finite life span of the organisation drew attention to the need to repeatedly complete the knowledge cycle – including the exploitation of knowledge - so as to deliver impact and to ensure a significant legacy beyond its operational life.

Current literature concentrates on micro-level inhibitors and enablers of knowledge transfer that often view exploitation as a goal, rather than a process. The experience of this organisation highlighted a gap in empirical work which investigates system level knowledge interactions.

The qualitative study reported herein relates to an event in the case study organisation's calendar; anticipated to be pivotal in its knowledge exploitation activities. Fourteen semi-structured interviews were undertaken capturing the perceptions and understandings of staff regarding the event. Aspects such as expectations of the aims, target audience, benefits and measures of success of the event, were explored. A three tier (macro-, meso- and micro-level) data analysis approach was adopted to reflect the systems level interactions and influences.

Major themes were identified relating to the knowledge management and exploitation work in the organisation that can improve knowledge exploitation activities in the case study organisation, as well as in other knowledge intensive organisations. These themes included: (i) An ongoing requirement to tailor activities to the individual needs of stakeholders; (ii) The need to focus on planning and implementing knowledge utilisation (KU) as distinct facets; and (iii) The development of specific skills that reflect the relational nature of KU to maximise value creation and deliver impact. Further, complex system influences meant that KU was never guaranteed to occur; this makes adaptability and responsiveness important qualities for knowledge producers and emphasises the importance of stakeholder engagement through the building of interactive relationships.

Key words: knowledge exploitation; knowledge management strategy; stakeholder engagement; impact; knowledge utilisation.

1. Introduction

The goal of the innovation process is to create products and services that provide economic and social benefit (Edquist, 1997). Central to this is an organisation's ability to effectively adopt a whole cycle knowledge management system, encompassing both knowledge exploration and knowledge exploitation activities. Knowledge exploitation activities can be difficult to implement and monitor in complex innovation systems, where dynamic, multi-level influences affect knowledge flows. Current literature, while offering useful insights on the micro-level analysis of knowledge transfer as a goal, has tended to neglect the complexity of innovation systems approaches and the utilisation of knowledge as a process. This paper aims to empirically investigate the multi-level influences of knowledge utilisation (KU) through the perceptions of staff within a Public Private Partnership (PPP), adopting a qualitative case-study. Thematic analysis over macro-, meso- and micro- levels, reveals a number factors that can maximise opportunities for KU to occur, whilst also providing a useful theoretical distinction between knowing and using that clarifies the terminology used within the literature.

2. Knowledge utilisation and innovation systems

A systemic knowledge management strategy is underpinned by a model of the whole knowledge cycle (Dalkir, 2013; Evans et al, 2014). The pursuit of knowledge exploitation and application activities is as critical to innovation as the exploration and creation of knowledge (Li et al, 2018). Furthermore, the establishment of business models that support exploitation work, is critical for capturing the value created in exploration work (Wood, 2004). The recognition of innovation as an interactive process, in which organisations are embedded in a wider system, led to conceptualising innovation as systems, rather than linear models (Edquist, 1997; Lundvall, 2007). However, further work is needed that investigates system wide influences of KU.

Extant literature contains many terms concerning creating actions from knowledge, including: knowledge transfer (KT); knowledge exchange; knowledge utilisation; knowledge implementation; knowledge dissemination; and knowledge diffusion (Graham et al, 2006). Liyanage et al (2009: 122) characterise 'knowledge transfer' as a one-way movement of knowledge from one place to another. The literature is dominated by a micro-level analysis of enablers and inhibitors of KT, where KT is viewed as a goal, rather than a process (Frank et al, 2015). In contrast, Graham et al (2006) suggest 'knowledge utilisation' specifically relates to the application of knowledge. KU incorporates the motivations and cognitive abilities of the user (Aita et al, 2007); thus, non-utilisation can occur when users are unable or unwilling to apply it (Weiss, 1979).

There is no single conceptualisation of KU (Landry et al, 2001). Some authors have developed multi-stage models of KU (e.g. Landry et al, 2001); others propose it is a single stage in a larger process that encompasses knowledge creation, transfer and uptake (e.g. Graham et al, 2006). Still others present lists of variables that affect KU (e.g. Belkhodja et al, 2007) or epistemological factors to consider (e.g. Jacobson, 2007); this research is predominantly theory based, with limited empirical studies in the area (Heinsch et al, 2016). Table 1 synthesises characteristics of the predominant models and theories in the KU field.

Table 1: Synthesis of characteristics of the predominant knowledge utilisation models and theories

Model or theory	Prominent Characteristics
Seven standards of utilisation (Knott and Wildavsky, 1980)	7 stage process model (reception, cognition, reference, effort, adaption, implementation, impact); theoretical
Uses of knowledge (Rich, 1997)	Four 'uses' of knowledge (use, utility, influence and impact); theoretical
Ladder of utilisation (Landry et al., 2001a)	6 stage process model (transmission, cognition, reference, effort, influence, application); quantitative methods using Knott and Wildvasky's (1980) scale
Variables of knowledge utilisation in social work (Landry et al., 2001b)	7 variables (list) which affect knowledge utilisation; quantitative methods using Knott and Wildvasky's (1980) scale
Science push and Socio-organisational models (Landry et al., 2003)	Two overarching models: Science push (linear and technical) and Socio-organisational (interactive and relational); quantitative data based on Knott and Wildvasky's (1980) scale
Knowledge to action (Graham et al., 2006)	Cyclical phases from knowledge creation to action (as a goal); conceptual model
Organisational determinants of research knowledge utilisation (Belkhodja et al. 2007)	Organisational variables (organisational learning, culture and absorptive capacity); quantitative methods using Knott and Wildvasky's (1980) scale
Fourth wave of knowledge transfer and exchange (Jacobson, 2007)	Social epistemology as basis for researchers to better understand knowledge properties (knowledge as a social process); theoretical
Solution-oriented knowledge (Gredig and Sommerfield, 2007)	Cooperative model of knowledge utilisation; the context of where knowledge is being utilised is key; theoretical
Determinants of research knowledge utilisation (Chagnon et al., 2010)	List of 10 variables which affect utilisation; quantitative
Knowledge and technology transfer value chain (Landry and Amara, 2012)	Conceptual model of knowledge and technology transfer as a value chain (recognise value – transform into actual value – appropriation of value); theoretical
Influencers of social science research utilisation (Cherney et al., 2015)	List of variables; quantitative data based on Knott and Wildvasky's (1980) scale

These well cited, but dated, models of KU offer similar linear process, which arguably contain aspects more related to the transfer of information, rather than the utilisation of knowledge. Additionally, the various studies of KT and KU have been conceptually unclear, offering a variety of interchangeable terms, models and definitions (Graham et al, 2006). This paper, therefore, seeks to address these shortfalls.

3. Research context

The growth in UK low carbon innovation is motivated by the UK government's ambitious energy commitments. These obligations result in the government introducing regulations aiming to increase renewable energy and reduce greenhouse gas emissions (Energy and Climate Change Committee, 2014:5). Subsequent government manifestos prescribe innovation initiatives that generate collaborative knowledge and influence stakeholder behaviours (van der Schoor and Scholtens, 2015). This requires the ability to traverse many knowledge boundaries to effectively deliver both technological outputs and social outcomes. The innovation system has unique characteristics that complicate innovation: a diverse technology portfolio with many knowledge requirements (Foxon et al, 2005); short-term, unstable policy (Grubler, 2012); and the need for policy measures that address innovation generation and demand side factors (Chmutina and Goodier, 2014; Heffron, 2013; Vincent, 2012).

The research organisation is a public-private partnership (PPP) established by the UK government in partnership with major industrial companies. The PPP was established for a 10-year duration; however, its innovation objectives encompass the delivery of near-term and long-term benefits, including contributing to the achievement of the governments legally binding 2050 energy targets. The PPP operates through three main functions: strategy, programme delivery and stakeholder engagement. In line with the espoused strategic objectives, the PPP's knowledge management strategy identifies knowledge as a key product and recognises that knowledge needs to go to, and be received from, stakeholders to add value. Value creation for the PPP is achieved through the ability to acquire, organise, disseminate and utilise knowledge to deliver outputs, achieve outcomes and produce impact.

Participants represented the three main organisational functions and all hierarchical levels (up to executive level of each function) as shown in Table 2.

Table 2: Overview of the participants

Function	Number of Interviews
Stakeholder Engagement	3
Strategic	6
Delivery	5
Total Interviews	**14**

4. Research design and approach

The literature review revealed the need for studies investigating systems-wide influences of KU, empirically examining what KU encompasses and clarifying the associated terminology. This case study explores staff expectations of knowledge activities at a one-day stakeholder event, prior to the event taking place. The event was an opportunity for the PPP to showcase its work portfolio to a range of stakeholders with staff from all functions in attendance.

4.1 Data collection and analysis

Purposeful sampling methods were used, and an interview schedule was designed which centred on the aims, benefits, activities and success measures of the stakeholder event. Fourteen semi-structured interviews were undertaken in compliance with established ethical Codes of Practice. All interviews lasted between forty and fifty minutes, and were transcribed using Nvivo10 software. In this study, the main unit of analysis was the organisation. However, to understand the complexities within the innovation system context, additional units of analysis are used, in what Yin (2003: 42-43) defines as an 'embedded case study'. Each unit of analysis represents a different analytical level (macro-, meso- and micro-level).

5. Data analysis

This section presents the themes that emerged from the data, over the three different levels.

5.1 Macro-level analysis

This section presents the contextual factors that appear at the wider system level and their influence on KU.

The participants perceived many different stakeholders who engaged with the organisational knowledge outputs. These include member organisations, government, industry, academics and project partners. The participants often referred to characteristics of different stakeholders including 'decision makers', 'influencers' and 'existing contacts'. Figure 1 below, represents the stakeholders mentioned by participants; the larger the word, the more times that stakeholder group was mentioned.

Figure 1: The stakeholders discussed by participants

Participant A7 states:

"I see the target audience as those people that [the PPP] sees as having the ability to influence the future of the UK energy system. What [the PPP] can do is stand up and say 'these are the areas that are going to matter, and this is the evidence as to why we think it matters'. We can't make the decisions, because many of the decisions are governed by policy decisions".

This places the PPP within the role of knowledge creator only (i.e. informer), suggesting that other actors are those who create action. These distinctive roles between knowledge creator and knowledge user can potentially inhibit KU (Kruckenberg, 2015).

Participants suggested that the target audience for the event were "*existing contacts"* (participants A3, A4, A6, A7, A11). However, participant A5 also recognised the need to engage new stakeholders: *"In terms of getting new people, that's something we're still working on. When you're approaching new people… you've just got to lead them in with something that they are particularly interested in"*.

Participant A4 suggested that the need to engage a wider stakeholder group was an inherent part of the organisational strategy to extend their influence through targeting those with different motivations: "*[The PPP's] strategy is, increasingly now, to have impact on the broader range of stakeholders…influencing the whole low carbon environment; the market, policy landscape".* However, to engage a wider group of stakeholders, participant A1 proposed that the PPP must ensure different stakeholders understand the knowledge being produced:

"[We] are really trying to make sure that [a much broader range of stakeholder] understand the work that we've been doing and giving them a route into engaging with what we're doing, so that we deliver greater impact from that work".

This was seen to be a challenge for the PPP, which has historically been linked to producing knowledge suitable for technical audiences, as participant A4 explained:

"It's an organisation that's dominated by technology and engineering people and they like to go and talk to other technology and other engineering people. But actually, to have impact you need to move beyond that into talking to different audiences".

The ability for stakeholders to absorb knowledge is subject to it being conveyed in a relevant 'communicating language' (Dawes et al, 2012; Green et al, 2009). When creating knowledge outputs, the PPP needs to recognise these diverse motivations, values, communication styles and engagement processes, to maximise the opportunity for KU amongst wider audiences (e.g. Head, 2010; Green et al, 2009).

Participant A5 indicated that a series of recent non-technical reports, was seen to attract and reach a wider audience, by putting context around individual technologies and projects:

"Historically, when we have issued work, its individual pieces of work. And then when you make that available to other people, it's missing the broader context. The reports are really trying to paint that broader picture, and explain what it means, rather than just this [technology] is the answer."

This infers that there was a challenge in converting technical knowledge outputs suitable for project partners, into a format relevant for other stakeholders. However, this is necessary to encourage KU with a wider audience.

5.2 Meso-level analysis

This section presents the organisational level factors and their influence on KU.

The work that the organisation undertakes is divided into strategic and delivery functions - participant A13 explained how these functions operate together:

"[The delivery function] gets the stuff onto contract and delivers the contract and then exploits the outcomes of the project. Whereas strategy sits side by side [and] frames what the projects ought to be. Then [the strategy team] try and knit together all the learnings from all the different bits of the projects".

The quote suggests that project outputs are delivered first, prior to the synthesis of value from across the project portfolio and conversion for a wider audience, post-project. However, Green et al (2009) suggest that to maximise the opportunities for KU to occur, the knowledge user should be involved as early and continuously as possible.

Participant A7 viewed the key organisational capability as "*providing the engineer's solution…what we're doing, is we're saying these are the technical facts, it's for politicians and others to consider the other risks*". Participant A4 commented on how the dominance of technical capabilities was partly caused by 'engineering mind-sets':

"Traditionally we love to create models [that] create pictures of what an ideal world would look like, if engineers were in charge. But how do you actually turn that into reality? That involves engaging in the horrible, messy, complex, contradictory world of reality and different people's views [and] motivations".

Participant A4 further suggested this involved: *"time consuming, laborious work that actually involves building relationships with stakeholders; making sure that you can communicate…in a way that audiences can engage with and find compelling".*

However, participant A11 reflected on the resource challenge associated with KU: *"At times we struggle to resource (knowledge exploitation). There hasn't necessarily been recognition about the workload associated with that."*

The analysis suggests that KU is influenced by having: technical and stakeholder knowledge; communication skills (the ability to convey information); relational skills (influencing according to individual motivations); and adequate resources.

5.3 Micro-level analysis

Participants suggested that talking to different stakeholders was their predominant activity at the event. For example, participant A8 would be *"demonstrating a database",* whilst participant A9 stated: *"If (the stakeholders) are interested in the subject…I'll talk a little bit about the projects we've done."*

Emphasis was placed on the dissemination of reports: "*I've got two science reports that I'll talk to people about*" (participant A4); "*there are three (reports) which are being promoted*" (participant A6); and *"communicating key messages"* (participant A4). These activities suggest a demonstration, rather than application, of expertise and are based on a linear KT model (disseminating 'messages' and publicising explicit knowledge). This reflects knowledge-as-an-object *(*Newell et al., 2009; Cook and Brown, 1999) in which knowledge can be 'moved' to another person or place.

The analysis shows two main value creation mechanisms: informing decision makers through providing neutral evidence; and influencing stakeholders to create action. Participant A2 suggested value is created by "*show(ing) that there's good, well respected, independent evidence that [stakeholders] can use to inform their decision making".* Participant A5 suggested value creation is achieved by creating action and helping stakeholders to ascertain: *"How [to] move from a set of words, into something that can actually be delivered - what's actually got to happen".* Participant A1 suggested value creation is realised through encouraging future engagement: *"the benefit of it will actually come from when [stakeholders] engage with us further".* Value was seen to be created if the PPP received invitations to attend other broader audience events, evidence of the organisation developing stakeholder relationships outside technically focused groups. These two value creation perspectives are suggested to be a continuum rather than two distinct and separate facets with different characteristics; presented in Table 3.

Table 3: Informing and influencing value creation perspectives

Value creation perspectives		
Factors	**Informing** ⟷	**Influencing**
Value created by	Expert, knowledge creator	Co-created
Value captured in	Dissemination to stakeholders	Motivating action by stakeholders
Value located in	Knowledge creation and provision	Knowledge utilisation and action
Driver	Expert knowledge	Stakeholder motivations
Focus	Organisation (knowledge creator)	Stakeholder (knowledge user)
Knowledge type	Explicit (information), general, content	Explicit/tacit, customised, know-how
Engagement	One off, linear, passive	Continuous, iterative, proactive
Learning	Stakeholder learns from expert	Both parties learn from each other
Skills	Technical, communication	Technical, communication and relational

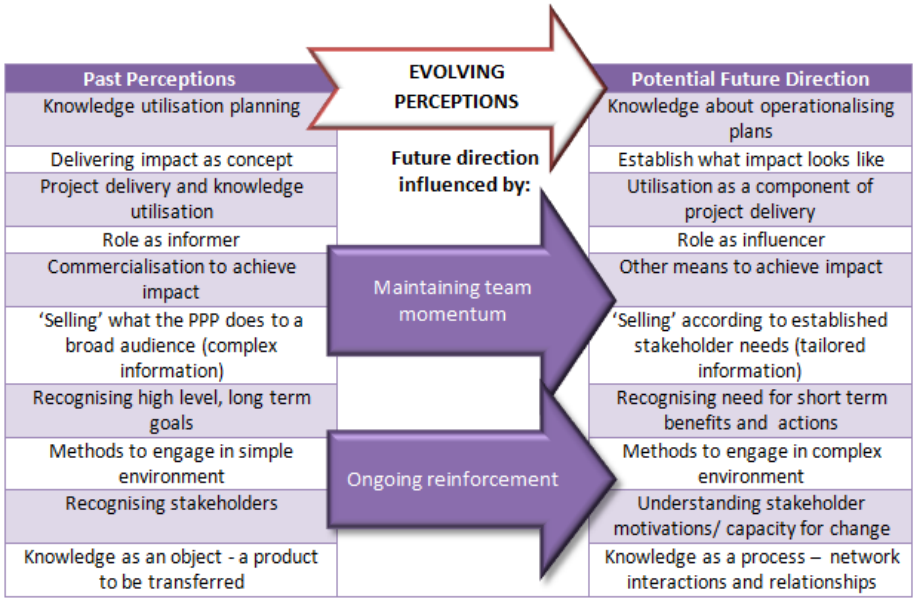
5.4 Additional data analysis: Organisational initiatives to improve KU

The opportunity to attend a KU training workshop occurred six months after the initial interviews, allowing observations of any changes in perceptions of KU since the original interviews.

Participant A10 suggested there had been an increased awareness that knowledge exploitation plans had been focussed on commercial exploitation of outputs; suggesting that different types of exploitation would need to be considered to maximise KU amongst wider stakeholders. Additionally, it was recognised that while emphasis had been on creating exploitation plans, there had been a difficulty in operationalising the plans due to the complex and dynamic system environment.

The analysis shows a clear difference between the original interviews and the subsequent training workshop in relation to KU summarised in Table 4. It suggests that the perceptual change process was supported by the development of necessary skills and the adoption of facilitative processes. It also acknowledges that whilst these perceptual changes are recorded at a point in time (i.e. the workshop), factors such as team momentum, organisational reinforcement and systems influences effect the embedding of perceptual change.

Table 4: Potentially evolving perceptions of KU within the PPP revealed by the analysis



6. Discussion

This section presents a holistic discussion of the main findings from across the three levels of analysis, before concluding the paper.

6.1 Distinguishing between knowing and using

This study supports prior work (e.g. Green et al, 2009) suggesting that dissemination activities do not guarantee KU, despite the analysed KU models in the literature review often incorporating the receipt of knowledge. It is, therefore, useful to distinguish between 'knowing' and 'using' to clarify what KU encompasses. The distinction between increasing stakeholders' knowledge (knowing) and motivating others to apply knowledge (using) facilitates the attainment of organisational goals by clarifying what activities are needed as part of an organisation's KM strategy. This study suggests that: KU is a value creating *process* that encompasses the ability to motivate knowledge recipients to use knowledge in a way that contributes to predetermined objectives. This definition raises the importance of motivating users as a key factor in achieving KU; emphasises the relational aspects of KU; and explicates the necessity of the eventual knowledge use being in line with organisational goals.

6.2 Context

A key finding of the study is the importance of context when pursuing KU goals. The systems perspective adopted revealed a high degree of complexity within a system. This study, therefore, explicates that 'knowledge utilisation' is not a replicable process: there is not a single model that can be followed to guarantee KU occurs as planned: the system is too complex. Returning to the definition of KU offered in section 6.1, and the ability to motivate others, this is a contextual process that necessitates understanding what those motivations are. The study findings highlight the need for knowledge producers to become embedded within the innovation system to maximise KU opportunities.

The notion of social embeddedness (e.g. Granovetter, 1985) proposes that economic activity does not occur in a rational vacuum but is heavily embedded in social processes and structures. When applying this in this study's context, the findings indicate that the likelihood of KU occurring, in line with established objectives, is partly influenced by how embedded knowledge producers are in the innovation system. Crucially, the study

suggests that this involves going beyond analytical aspects of stakeholder management (e.g. the identification and prioritisation of stakeholders), to include understanding stakeholder needs. The study suggests that this requires technical knowledge and communication skills, but also stakeholder knowledge and relational skills. Empirically this builds on theoretical work emphasising the importance of viewing KU as an interactive and relational process (Fitzgerald and Harvey, 2015; Heinsch et al, 2016) and extends work that proposes specific skills sets for innovation (e.g. Donofrio et al, 2010).

6.3 Distinguishing between planning and implementing activities

A key finding of the study is the importance of distinguishing between planning and implementing KU, identifying that these two components require different activities and skills. It was found that *planning* for KU was well developed, with a focus on the development of knowledge exploitation plans, but static, where plans were made in somewhat isolation from the real-life influences that affect KU. *Implementing* these plans was identified as a more difficult task, due to: the long-time frames involved in reaching innovation objectives; the relational processes needed; the complex and dynamic nature of a system; and the differing skills needed to implement plans. The implementation of exploitation plans was seen to be secondary to delivering the physical outputs of the projects. Another suggested difficulty in implementing the plans was developing capabilities to measure KU in a systems environment that is characterised by multiple influences. A complex system requires innovation system actors to create a shared institutional logic so that systems goals can be achieved (Hogstrom and Tronvoll, 2012; Weick, 1995).

7. Conclusion

This paper aimed to explore the multi-level influences of KU within a complex innovation system, through the perceptions of staff within a low carbon energy PPP. The literature review revealed the need for studies that investigate systems-wide KU influences, examine what KU encompasses empirically and clarify KU terminology. The three-tier analysis suggests that taking the role of knowledge creator only, can inhibit KU. Instead, organisations can maximise KU opportunities by not only identifying stakeholders, but by establishing their motivations, values and knowledge requirements, adapting knowledge outputs accordingly. The analysis suggests this should be done early and continuously throughout engagements. This requires technical and stakeholder knowledge, communication and relational skills, and should be underpinned by adequate resources. This allows organisations to become socially embedded in the innovation system. Lastly, the study suggests that KU should be considered a social process rather than a goal, where shared institutional goals are developed.

This study is part of a larger comparative study, investigating the influences of KU in two knowledge creating organisations. Future studies could explore perceptions from knowledge recipients and consider different sectors, organisational structures and countries to further enrich the literature on KU.

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