

BEST PRACTICE STRATEGIES
FOR SUCCESSFUL INNOVATION
THROUGH UNIVERSITY-BUSINESS
COLLABORATION

Technology Strategy Board
Driving Innovation



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INTRODUCTION

The study highlights the benefits for businesses of collaborating with universities to draw on research knowledge, skills and expertise and to increase their capacity for innovation. It outlines the challenges involved in the process of adapting academic knowledge and expertise for business use and it offers tried and tested tools for addressing these challenges.

The report describes a model of the ideal attributes and outcomes of effective knowledge transfer processes, drawing on a wide range of knowledge domains and operational research practice. The model is used to explore the conditions necessary for successful knowledge transfer (KT) from universities to business and to map the main challenges at each stage of the process.

Finally, it describes one of the Technology Strategy Board's funding programmes, the Knowledge Transfer Partnership, which can be seen as an illustration of how all the generic best practice approaches can come together within one scheme.

INNOVATION IS A COMPLEX PHENOMENON INVOLVING MANY INTERACTIVE PROCESSES

Innovation used to be described in a simple linear fashion - a university would develop a piece of research, a business would then take it on and turn it into a product. This view, which became known as Technology Transfer, led to an operational approach where formal intellectual property rights, such as patents and design rights, were applied to research outcomes. The rights were then licensed to interested businesses to adapt into their own R&D processes for exploitation.

Aspects of this approach are still important in some sectors, in firms with in-house R&D capacity such as biotechnology or where companies are spin-outs from university departments. However, it is now recognised that the linear 'technology push' model is inappropriate for most industry sectors. It is particularly inappropriate for the growing number of small and medium sized enterprises (SMEs) that are increasingly playing a critical role in driving innovation in the economy.

Indeed, the linear technology transfer model has been shown to be a narrow interpretation of the actual processes that generate success (CIHE, 2009). There is now a significant body of evidence that shows a more symbiotic relationship between research knowledge and innovation where innovation draws on research and, at the same time, the demands of innovation force the creation of new research knowledge (Kline and Rosenberg, 1986).

KNOWLEDGE TRANSFER PLAYS A KEY ROLE IN INNOVATION AND GROWTH



Innovation has been shown to be the greatest driver of growth, productivity and jobs in the UK. Between 2002 and 2008, half the growth in the UK economy could be attributed to the six per cent of companies that were most innovative.

Furthermore, this so-called 'Vital 6%' achieved double the sales growth of non-innovating companies and twice the level of growth in jobs (Nesta, 2009).

At the same time, trends in innovation have moved from being generated within a firm to being driven by knowledge and resources outside. The new approach has been termed 'open innovation'. If, before, innovation was dependent on the internal culture and management of a company, today it relies largely on connections with external organisations such

as universities, further education institutions, public sector research institutes, and research and technology organisations. These are known, collectively, as the 'Knowledge Base'. However, while Britain's universities and colleges are brimming with expert knowledge that attracts scholars and businesses from all over the world, only a small percentage of UK firms cite universities as their principal source of information for innovation: three per cent of SMEs and two per cent of larger firms (CIS7, 2010). That said, around 40 per cent of all firms' innovation projects rely on research published by universities (CIS7, 2010). So, what is it that prevents many British firms from benefiting from the closer creative collaboration with universities that supports innovation and has been shown to drive productivity and jobs in the UK economy?

INNOVATION DEPENDS ON A CONDUCTIVE CULTURE WITHIN FIRMS

A study published by the OECD in 2009 suggests the failure of organisations to innovate is connected less with lack of investment in R&D, as is widely believed, and more to do with the business culture of firms and the lack of a fertile environment for innovation (OECD, 2009). Research has shown that in European countries, where employees have a high degree of discretion in solving complex problems, businesses tend to be more active in developing innovations in-house (Greenan and Lorenz, 2009). On the other hand, in countries where there is little learning or problem-solving on the job and employees have little discretion, firms tend to engage in supplier-dominated innovation strategies.

It is now known that the key to continuous innovation lies in the ability of businesses to recognise the value of new external knowledge, assimilate it and apply it to commercial ends. The term that has been coined to describe this ability is 'absorptive capacity' (Cohen and Levinthal (1990). Absorptive capacity depends on many factors, including a willingness on the part of the business to be open to new ideas, new people and new ways of working.

An organisation's absorptive capacity relies not only on employees to be open to new knowledge, however. It also relies on the effective transfer of knowledge through the systems and operational networks of the business. Most important is the way in which businesses can learn through accessing new knowledge. Zahra and George describe two dimensions to so-called absorptive capacity.

(Zahra and George, 2002):

- Potential absorptive capacity: a firm's receptiveness to external knowledge.
- Realised absorptive capacity: a firm's capacity to exploit the knowledge absorbed.

They show how absorptive capacity is critical at every stage of the innovation process and they describe it as follows:

- Acquisition: identification of relevant external information from knowledge sources.
- Assimilation: routines and processes to analyse, process, interpret and understand the information.
- Transformation: modification and adaptation of external knowledge and its combination with existing and internally generated knowledge.
- Exploitation: extending existing competencies or creating new ones by incorporating transformed knowledge into operations, leading to the creation of new products, systems, processes or organisational forms.

We have added the notion of ‘awareness’ to the first stage of Zahra and George’s framework. Awareness is a necessary pre-condition to the innovation process since a firm must be aware of the need for new knowledge before it is able to identify and acquire it (see figure 1, below).

HOW CAN KNOWLEDGE BEST BE TRANSFERRED FROM UNIVERSITIES TO BUSINESS?

So far, we have looked at *what* kind of culture is likely to lead to successful innovation in a business. Far more critical, however, is *how* to create that culture: how best to transfer and exploit the knowledge produced by universities to drive innovation.

In order to understand this process, we have built a generic model of good practice for successful knowledge transfer between academia and business. This model is based on extensive research, including 200 case studies of successful collaborations, as well as international studies of best practice. The model shows the five stages that successful projects go through in processing new knowledge for innovation.

These stages can be summarised as follows:

Company Opportunity (C1): a business recognises that there is an opportunity or a problem that it could address if it had access to knowledge and expertise in specific areas. This recognition needs to be combined with an awareness that a university or HEI might be the place from which to acquire such knowledge. Furthermore, the potential for a successful project depends on finding the right institution and the right partner within it.

Co-Recognition (C2): Seeds of the partnership begin with a potential match between business needs, appropriate research and willing researchers within an institution. An agreement formalises issues such as intellectual property and delivery conditions. This agreement process will also involve the Technology Transfer Office of the university (TTO) and legal representatives on both sides.

Co-Formulation (C3): The researchers' generic knowledge is adapted or 'localised' to meet the specific needs and opportunities of the business partner's processes, products and markets. Knowledge from the academic and business domains is synthesised. This requires collaborative working and the building of trust amongst the partners.

Co-Creation (C4): As the project develops, the partners create the opportunity for innovation in process, product or markets. This depends on the firm's absorptive capacity and also on its ability to deliver.

Commercialisation (C5): For business, successful commercialisation is the end goal. Success in the market place and adoption by end users is the mark of successful innovation.

Figure 1, below, maps out this model framework of the ideal attributes and outcomes of knowledge transfer. It also shows the importance of absorptive capacity at each stage of the process. It should be noted that, while the 5 Cs Model is presented in a linear fashion, knowledge transfer is not a linear process. Once an innovation project begins, the process of knowledge transfer and exchange may move backwards and forwards through the different stages in an iterative and recursive way. Indeed, it should be expected that as the project emerges, new knowledge will need to be drawn in.

It is also important to understand that the process of knowledge transfer between the knowledge base and business does not in itself guarantee successful innovation. There are a number of factors that can hamper a businesses' ability to execute their innovation strategies. Some of these are external to the knowledge transfer process and do not concern us here. In the next section we will look at those challenges that inherent in KT for open innovation.

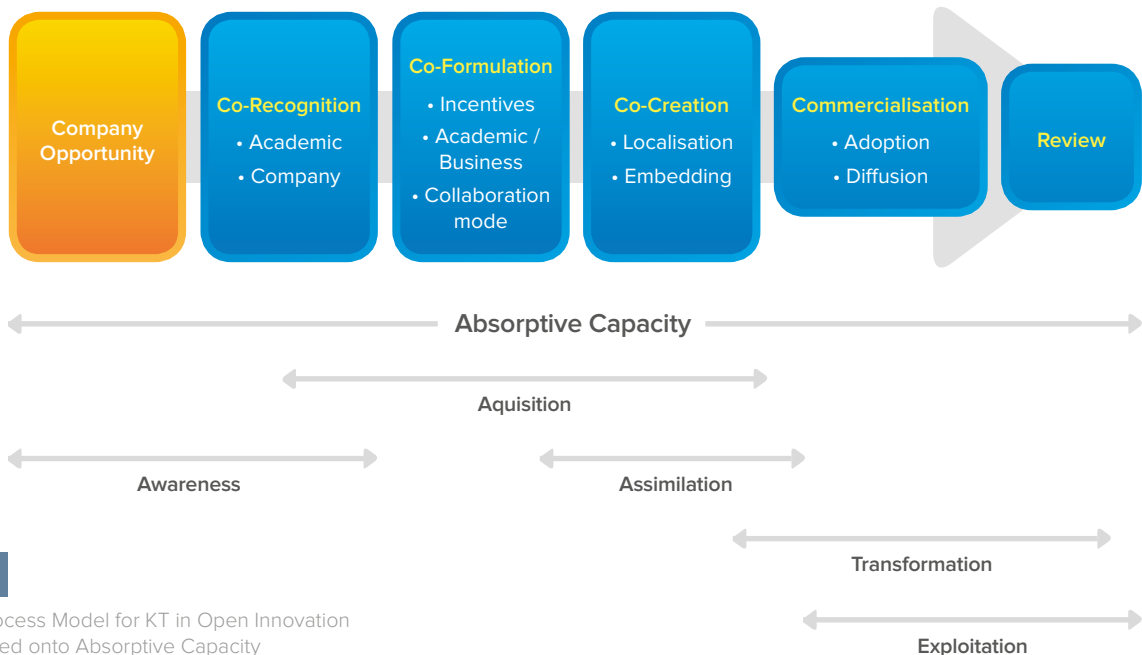


Figure 1

Generic Process Model for KT in Open Innovation
(5Cs) Mapped onto Absorptive Capacity

UNDERSTANDING THE CHALLENGES OF THE INNOVATION PROCESS

Firms experienced in open innovation recognise that considerable effort and investment can be required if the outcomes of the innovation process are to be embedded and successfully exploited (Cope et al. 2009). Our research has shown that a realistic perception of the resources required is a priority for successful innovation and critical to overcoming the barriers that are inherent in the process of knowledge transfer. Indeed, a failure to understand the input necessary for successful innovation can sometimes lead to firms giving up half way through the process. They often blame 'burdensome or bureaucratic processes. However, these processes play a very useful role in helping such businesses recognise, early on, that they are not prepared to invest the time and resources necessary for success.

Perseverance and good practice are the key to meeting the challenges of KT. We now look at these challenges and offer good practice mechanisms for overcoming them. To do this, we have analysed the process of innovation from the perspective of SMEs. We have also looked at the barriers that currently exist between universities and businesses. The challenges of knowledge transfer were recognised in 2003 when they were highlighted in the Lambert Review (Lambert, 2003). Since then, they have been studied extensively from all aspects of the KT process. One study of innovation in SMEs collated evidence from published literature and tested this against the views of business people throughout Europe (Innova, 2011). The top five barriers hindering innovation capacity, from the perspective of businesses, were considered to be:

- A shortage of financial resources and access to finance.
- A shortage of skills in innovation management.
- Insufficient use of public procurement to foster innovation in SMEs.
- A shortage of skills to manage intellectual property.
- Weaknesses in networking and co-operation with external parties.

Another study, which concerned the experience of innovation by UK businesses, found that over 65 per cent of UK firms surveyed reported the greatest hindrance to open innovation to be the long-term nature of university research. Fifty-five per cent cited regulations regarding confidentiality or intellectual property (Bruneel, et al., 2009a). More disturbingly, this study suggests that UK trends in university-industry engagement in innovation may be going in the wrong direction. Between 2004 and 2008, the proportion of business citing barriers arising from unrealistic expectations of the university technology-transfer offices (TTOs) increased from 24 per cent to 49 per cent. These results are of particular concern since they reflect the findings from firms that have considerable experience of university collaborations.

A more detailed piece of research, studied 22 significant firms and the role that university research played in their innovation (Docherty et al., 2010).

This study documented a range of factors that restrict knowledge transfer. These include the following:

- University researchers often have limited engagement across disciplines while business solutions require knowledge from different sources.
- University researchers are focused on achieving results that are robust and repeatable although business can cope with 80 per cent solutions.
- A lack of shared expectations creates obstacles and leads to broken trust.
- University TTOs act as barriers rather than facilitators of knowledge transfer. They often have unrealistic expectations of the economic value of the research and hinder the trust-building process.

Not all of the challenges mentioned above can be addressed through the adoption of a good-practice approach to knowledge transfer. Some of them (access to finance, for example) arise from issues in the wider innovation system or are dependent on specific business capacities. However, many of them can be dealt with through the way knowledge transfer is approached. In the table opposite, we show the barriers distributed across all stages of our generic model and offer known operational mechanisms for overcoming them. We will look at these in more detail in the next section.

Table 2

(Opposite)
Recognised barriers
to knowledge
transfer and
mechanisms to
overcome them

Stages of Absorptive Capacity	Generic 5C's Model of Good Practice KT	Recognised Barriers	Known Operational Mechanisms to Overcome Barriers
Awareness	Company Opportunity Recognition (C1)	• Lack of awareness	• Case Studies and role models
		• Lack of understanding of potential in universities	• Networks; outreach and promotion by universities
		• Weaknesses in networks and information	• Active business engagement in networks
		• Finding the right information and the right partner	• Brokering Strategies
Acquisition	Co-recognition between business and university (C2)	• Institutional rules and reputations	• Culture improvement
		• Confidentiality issues	• Agreements up front
		• Legal formalities	• Trust-based relationship and skilled legal briefing
		• TTO unrealistic expectation	• Improved metrics
		• IPR Issues - different (non-aligned) objectives and incentives	• Agreements up front
Acquisition	Co-Formulation (C3)	• Values and "language" differences	• Working together on problems in collaborative team
		• Timescales - University long-term; business - shorter term	• Building mutual respect and trust
		• Disciplines versus solutions	• Multi-disciplinary teams
		• Different objectives	• Partnership approach to win-win
Assimilation and Transformation	Co-Creation (C4)	• Business ability to absorb new knowledge	• Increased capacity for RD&I
		• Internal Communication	• Knowledge Socialisation
		• Change management	• Managerial / Entrepreneurial learning
		• Business Learning	• Diffusions across business practice
Exploitation	Commercialisation (C5)	<ul style="list-style-type: none"> • Appropriate Business Models • Clean IPR • Business Management • Finance • Market Access 	Business Development e.g; <ul style="list-style-type: none"> • market development • market planning • production planning • investment appraisal • implementation

MEETING THE CHALLENGES OF OPEN INNOVATION

From the previous summary, it can be seen that most of the challenges in the innovation process can be met by building relationships in which collaborative practices can be realised and by ensuring that the business has sufficient managerial and organisational capacity to embed new knowledge. Critical to success are individuals who can bridge the differences between the world of business and the world of academia.

Building relationships in which collaborative practices can be realised

Most research suggests that the formation of trust-based relationships is paramount to the success of any project. The OECD defines a partnership in the knowledge economy as an agreement to do something together that will benefit all involved, bringing results that could not be achieved by a single partner operating alone (OECD, 2006). Trust needs to be built from the beginning (from the awareness-raising stages of C1 and C2) and should grow throughout the process (C3, C4 and C5).

A partnership can be described as successful if it:

- Promotes innovation.
- Enhances the impact and effectiveness of action through combined and efficient use of resources.
- Involves a strong commitment from each partner who pursue a shared strategic vision, compatible targets and are equal in a predetermined organisational structure.
- Emotionally binds the persons involved.
- Brings together different actors in collaborative action as well as in collaborative efforts to effect change.
- Enables the co-creation of an intellectual asset (for example a new business process or product development process) under the partners' control through a deliberate series of actions to embed knowledge as a changed capability.

The partnership usually involves a mixed team and for such a team to be effective it must develop an understanding of the roles that each member is to perform and the expectations each has of the other. In order for this understanding to come about, the team must develop a strong sense of collaboration.

HOW ARE GOOD PARTNERSHIPS BUILT?

Below offers six key rules for developing good partnerships.

- 1 Look for common ground: find shared values and personal experiences.
- 2 Learn about others: let them express themselves, consider their perspectives, accept differences, appeal to their highest motives.
- 3 Critique results not people: make others feel good, be respectful, pay attention and give feedback.
- 4 Proceed slowly: check for understanding and acceptance before moving to the next idea.
- 5 Communicate clearly and concisely: speak in a logical sequence, tactfully and with confidence.
- 6 Share ideas and feelings: pay attention to non-verbal communication and ensure eye contact. (Spence, 2006)

Adapting and absorbing knowledge for successful innovation

Nonaka and Takeuchi describe the creation of knowledge as a continuous process of dynamic interactions and conversations between the expert knowledge held by individuals (tacit knowledge), which is a combination of experience, learning and skills “wisdom”, and the codified knowledge held within a firm (explicit knowledge). In order for knowledge to be used successfully for innovation.

The tacit and explicit knowledge has to reach, be comprehensible and benefit the whole organisation This can happen in a number of different ways.

- Tacit knowledge can be shared through mentoring or apprenticeship.
- Tacit knowledge can be formalised into written procedures and shared.
- Explicit knowledge from different sources within the organisation can be combined in a new form.
- Explicit knowledge diffused throughout the firm can be internalised by individuals.

Nonaka and Takeuchi describe this process as knowledge socialisation (Nonaka and Takeuchi, 1995). It is also referred to as embedding knowledge or organisational learning. It takes place in stages C3 and C4 of our generic model. Key to this process is reflection and reaction where problems and opportunities are resolved through discussions around a real-time problem. The most effective way of embedding new knowledge is to enable employees to learn by doing ('action learning', it is also called). Indeed, if learning is to be embedded at the organisational level, it has to be incorporated into routines and systems. Managers and entrepreneurs play a crucial role here. So, too, do the knowledge management systems of the business, which must adapt the knowledge into formal processes and functions that can be performed by employees.

Key role of individuals that span the boundaries of academia and business

A prerequisite of organisation learning or embedding knowledge in a firm is that the knowledge is expressed in terms that are comprehensible and relevant. This usually means that it has to be 'translated' from the specialist language and jargon of the particular academic domain from which it comes into terms that are relevant to those who are using it in the business context. The job of carrying out this translation usually falls to an individual, or individuals, in the partnership who have an understanding of both worlds. Such people are often described as 'gate keepers' or 'boundary spanners', in the sense that they span the boundaries between the two spheres (Ternouth, 2011). In the Technology Strategy Board's Knowledge Transfer Partnership programme, for example, this role is partly carried out by the Associate. The Associate is a recent graduate, who is brought in to supplement the in-house resources of the business partner. He or she brings academic knowledge into the business context and manages it together with the business knowledge, through the innovation process, thereby enabling a synthesis of the two. In the last section we look briefly at how the KTP works and how it can support businesses and universities through a creative partnership that's lead to successful knowledge creation or innovation.

KNOWLEDGE TRANSFER PARTNERSHIP

KTP offers support to UK businesses wanting to improve their competitiveness and performance by accessing the expertise available within the UK knowledge base. It establishes a relationship between a business and an academic institution that facilitates the transfer of knowledge, technology and skills to which the business partner has no access.

The KTP facilitates the transfer of knowledge through projects undertaken by high calibre, recently qualified people (Associates) under joint supervision from a business and an academic institution. It provides business-based training for such people to enhance their business and specialist skills. It also stimulates and enhances business-relevant training and research undertaken by the academic institutions.

One could say that, in the KTP scheme, all the best practices for knowledge transfer are brought together. The key to its success lies in what might be called its 'holistic' nature and its lasting value: every element and process, beyond its immediate function, builds a firm's capacity to absorb new knowledge and embed culture change, which are vital for continuous innovation. With the KTP model, energy invested in any element of the scheme, whether it be identifying the partnership team or writing the final report, also contributes to these higher goals. Take, for example, the apparently bureaucratic task of writing the proposal. Time spent at this stage not only ensures a good application, it also enables shared objectives to be developed, trust to be established and team-building to begin. These are the foundation stones of a successful project. Similarly, time spent on

planning the project ensures that the key elements for effective KT are recognised and included.

The programme enables the KT process to develop in a recursive way and includes numerous feedback loops that encourage reflection. So, for example, the preparation and writing of the final report is not simply a funding requirement. It offers a valuable tool for feedback and review, which are critical elements in organisational learning that have lasting value for the firm beyond the intrinsic task and beyond the end of the project.

KTP has been shown to be particularly useful where businesses do not have sufficient expertise and resources to manage an open innovation partnership since it supports partners throughout the process and helps them develop the necessary skills.

The KTP process also comprises a number of specific value-adding elements which combine to deliver successful outcomes. These include:

- The mentoring role of the KTP Adviser for the business and the Associate.
- The role of the Associate and the Adviser in bridging and brokering between the research base and the business.
- The processes of partnership building and reflective learning which are encouraged by the KTP's formalised processes. These drive positive behaviours beyond their apparent administrative functions and can embed fundamental culture change within the business.

Our research showed that KTP has a transformatory power. It enables an increase in ‘absorptive capacity’ in businesses and, thus, in the UK innovation system as a whole. This is achieved not only by the way it combines good-practice processes to overcome the barriers to knowledge transfer, but also because the model stimulates and facilitates organisational learning (Figure 2).

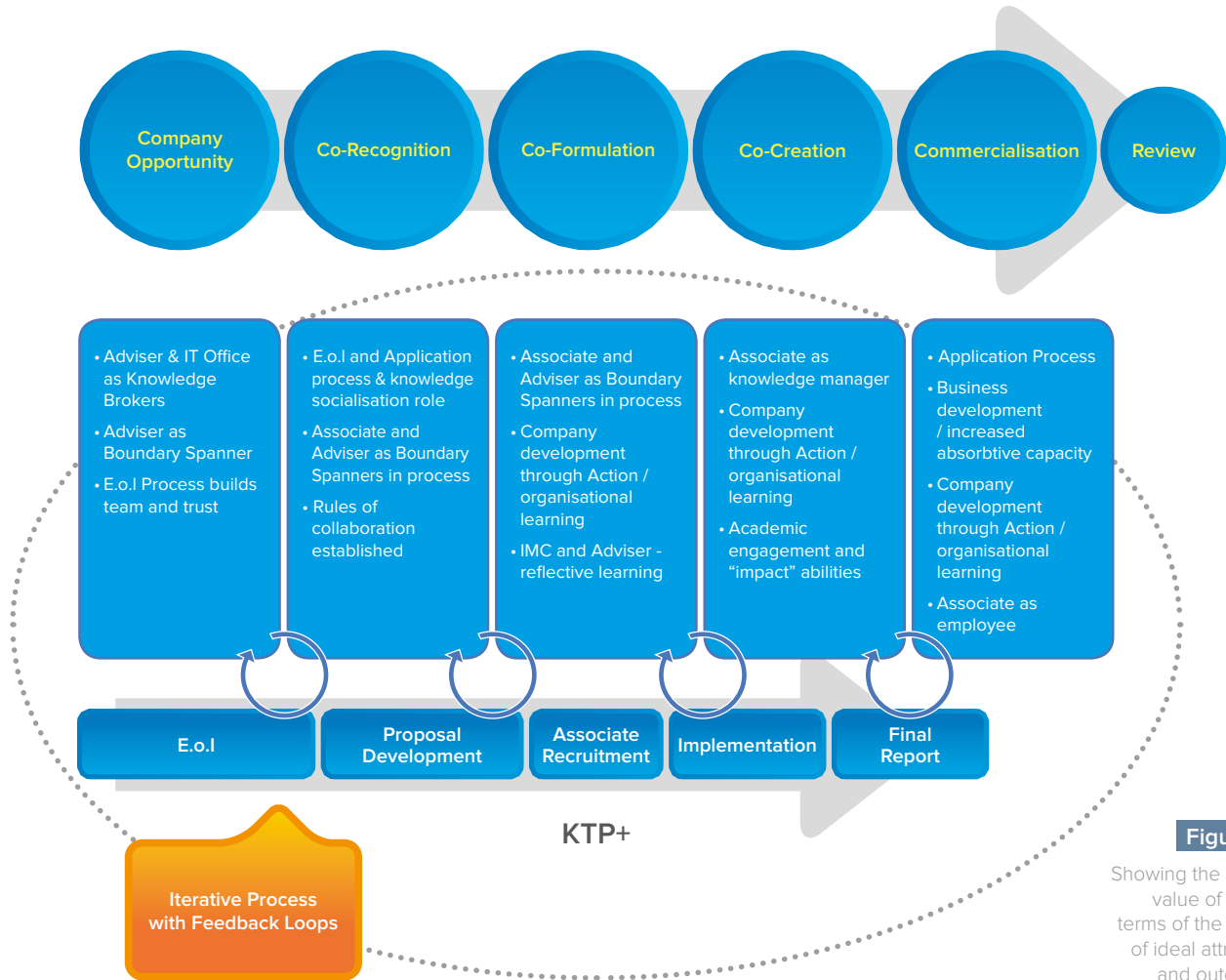


Figure 2

Showing the added value of KTP in terms of the model of ideal attributes and outcomes

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