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Citation:

Gold, J and D'Souza-Matthew, M and Pickard, H and Pickard, R (2015) "The struggle for product development and innovation in a family-owned business." In: Rae, D and Wang, C, (eds.) Entrepreneurial Learning: New Perspectives in Research, Education and Practice. Routledge, London, pp. 194-215. ISBN 9780415723244, 9781315857817

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**The Struggle for Product Development and Innovation in a Family-Owned  
Business: A Knowledge Transfer Partnership Approach**

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**Word Count: 9983**

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**Abstract:**

There is interest in how family-based small and medium-sized enterprises (SMEs), can grow and provide a sustainable future for their owners and staff. The chapter considers how a family-based business in West Yorkshire sought to make Entrepreneurial Learning (EL) generative by providing more recognition and action for Product Development and Innovation (PDI) through the formation of a Knowledge Transfer Partnership (KTP) with the University of Leeds, leading to the appointment of a highly qualified chemical engineer. Given that informality is a well-recognized feature of family business life, the programme could be seen as disturbance to the business. The chapter considers the struggle for PDI based on the sociology of translation and Actor Network Theory (ANT).

**Introduction**

Entrepreneurial Learning (EL) is concerned with both the creating of new ventures but also the how existing businesses are managed and sustained (Wang and Chugh 2014). Given that in the UK, there are approximately three million family businesses, mostly small and medium-sized enterprises (SMEs), forming two thirds of private sector firms (IFB 2011) there is an interest in how they can grow and provide a sustainable future for their owners and staff (Foremen-Peck 2012). Product Development and Innovation (PDI) therefore becomes crucial. However, if official figures are used to measure investment in such processes, it would suggest such firms do proportionately less and as a consequence innovate less (Harris 2009). This might be partly explained by the relatively informal processes used leading to under-

reporting of research and development (Lev 2001). However, a reliance on informality can just as easily result in PDI becoming a second or third order consideration as the business copes with the vagaries of resource limitations and is forced into a reactive strategic orientation (Qian and Li 2003). In EL terms, learning is adaptive by working within existing constraints and processes, and responding incrementally to any requirements for change. By contrast, for PDI to become significant, learning must become more generative, allowing key assumptions about the firm to be strategically surfaced and challenged (Slater and Narver 1995). Existing entrepreneurial business therefore face somewhat of a PDI conundrum. While studies suggest that formality of structure and strategy, just like larger firms, are likely to improve performance (Terziovski 2010), informality and adaptive learning provides a business with the ability to respond flexibly to customers – their nimbleness - and develop niche markets which provide a degree of competitive advantage over larger organisations in that niche (Fuchs et al. 2000). But such informality can, through resource constraints, pressures on meeting customer deadlines and restrictive performance measurement systems (Garengo et al. 2005), squeeze out the ability to innovate, even if there is desire to do so.

Our aim for this paper is to consider how a family-based business in West Yorkshire sought to make learning more generative by providing more recognition and action for PDI. Such an effort can be seen as crucial for an existing business, since it sustains the EL process and the development of the organization (Rae 2000; Cope 2005). Therefore, seeking to develop more PDI, the company formed a Knowledge Transfer Partnership (KTP) with the University of Leeds, leading to the appointment of a highly qualified chemical engineer. The paper has been co-written with members

of the KTP and is based on the idea that PDI in a mature family business is a disturbance to existing routines but a very necessary EL process to ensure sustainability. However learning does become a struggle. We will report on the results of this struggle, drawing key lessons for PDI in family businesses. Firstly we will consider some of the key ideas of PDI in small family businesses and our view of EL.

### **Product Development and Innovation and EL**

Much of the activity in a small family business is focused on dealing with present demands, solving problems as they occur or by making mistakes (Deakins 1996). Such processes are inherently reactive and give an impression that managers are consistently in fire-fighting mode. Thus even when managers do have time to take a more strategic view of activities, the return to everyday life soon prompts normal ways of working (Hudson et al. 2003) and that normality means that activities such as PDI become side-lined and informal.

Informality is a well-recognized feature of family business life (Goffee 1996), which has even been understood to some extent in policy making (CBI 2003; BIS 2012). It is argued that this informality provides a business with significant benefits, such as an ability to focus on niche markets based on a more limited variety of products and services. Further, as a result of informal systems and structures, SMEs are more flexible and responsive to customers and so acquire a competitive advantage in niche areas of their markets (Terziovski 2010). Interaction with customers and an understanding of their needs can result in the generation of new ideas, which may

well result in innovation (Konsti-Laakso et al. 2012). However, informality also has its downsides for PDI, resulting in its relegation to a second or third order consideration through the failure to plan and devote sufficient resources. Even if new ideas can be generated, many businesses have faced a variety of obstacles to PDI such as limited resources and qualified expertise, and the ability to manage the innovation process (Mohen and Roller, 2005). It is argued therefore that there is a need to formalize approaches to PDI and this will facilitate implementation (Prakash and Gupta 2008). Formalisation of PDI allows for a more considered approach, providing clarity and even responsibility within roles with sufficient time provided and accepted as necessary for new ideas to be generated and developed for feasibility. However, there are also downsides to formality with PDI through the risks attached to what may be uncertain outcomes and waste of resources entailed (Eisenhardt and Audretsch 2008). Further, family firms in particular may be averse to more formality, associating such a move with greater 'professionalism', which can be interpreted as a threat to valued beliefs about personal responsibility, family ownership and management, and succession (Stewart and Hitt 2011).

To avoid the pitfalls of either formality or informality in PDI, it is therefore suggested that attention needs to be paid to how innovation occurs, with particular emphasis on how implementation is managed. There is a need for an ongoing effort and commitment to PDI (Humphreys et al. 2005). However this has to be done and seen to be done by managers, who signify the values, attitudes and behaviours that are preferred. In this way, a culture of support for PDI becomes possible and provides the context for PDI activities since so much of the relationship between innovation and performance is context dependent (Rosenbusch et al. 2011). Further, a crucial factor

in context making is the innovation orientation of the SME, defined by Lumpkin and Dess (1996:142) as a "... tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, technological processes". This further allows the learning and development of the necessary skills and capabilities, receptiveness to information from different sources, acceptance of risk-taking and involvement in making decisions, all part of a learning orientation and the development of organisation learning capabilities which can play a key part in the link between an entrepreneurial orientation and enhancing organization performance (Wang 2008; Alegre and Chiva 2013).

In addition, an innovation orientation is more likely to help attract specialized staff and encourage more commitment among existing employees (Zhou et al. 2005). A crucial finding from Rosenbusch et al's (2012) analysis is that an innovation orientation has to be strategic rather than just focusing on delivering products and services that are innovative. A strategic approach is also a more formal approach through the attention given to setting goals, consideration of how budgets and resources are allocated, which also indicate the firm's intentions to both internal and external stakeholders. For more mature organisations, such as the firm considered in this chapter, PDI can become restrained by past successes which justify engrained routines (Schreyögg and Kliesch-Eberl 2007). Innovation in such firms may be restricted to responding to problems within existing routines, with little time or ability to step back and reconsider the appropriateness of the routine.

PDI therefore represents quite a challenge to many family based firms, where on the basis of a cherished culture and history, there is a fear that resources could be wasted

if PDI becomes too prominent. Even if market conditions suggest the need for PDI, the uncertain time lags inherent in the innovation process may prove too much of a risk for the commitment required for such decisions (Virtanen and Heimonen 2011). This can often lead to a retreat to the safety of reactive and informal PDI. Of course, even small changes through PDI can be seen as disturbances to existing ways of working. Learning therefore will be a requirement (Humphreys et al. 2005). Given that existing ways of working can become highly valued by staff, and protected if challenged, PDI has the strong potential to become a disturbance which can just as easily be dismissed as well as accepted. Support may therefore be needed to help managers become ambidextrous (O'Reilly and Tushman 2004), where managers can embrace both exploration for new products, structures and configurations, while also maintaining an exploitation of existing products and services and ways of working and organizing. Chang et al. (2011:1671) argue, based on a survey of Scottish organisations, that smaller firms are in a good position to embrace what they call 'innovation ambidexterity' through their greater responsiveness internally to external changes. What is needed are 'appropriate organizational structures'. This requires a both/and approach to considering PDI and current working; if achieved, it can help a business strategically align PDI processes with its culture (Narayanan 2001).

While seen as a crucial area of understanding for EL (Wang and Chugh 2014), the integration of exploitation and exploration in entrepreneurial firms is relatively under-researched. However, one study by Laforet (2011) was based on 15 in-depth interviews with board members of SMEs. Each was considered to have an innovation orientation or was seeking to move in this direction. The results were indicative of the challenge and the struggle for PDI. There were positive outcomes from innovation

such as better operations and efficiency, market advantage, employee satisfaction and improved skills of the workforce and ways of working. Interestingly, Knowledge Transfer Partnerships featured in two of these interviews. There was also recognition of negative possibilities, such as financial risk through failure, uncontrollable growth, damage to reputation and loss of skilled staff through added pressure on work conditions. Such outcomes could sap the energy for PDI and prevent the development of innovation orientation. PDI is a risk and there are consequences, some of which are unintended or cannot be foreseen, which highlights the challenge and the struggle of PDI and the disturbance that it inevitably brings. Therefore, given the dilemmatic conditions for PDI decision-making, it would be suggested that the pursuit of a path for PDI would involve attention to finding innovation possibilities in existing products and service. This can be achieved through modification and improvement but also by the introduction of external expertise to provoke the disturbance required (Autio 2009; Heimonen 2012).

Of course, even small changes through PDI can be seen as disturbances to existing ways of working. Learning therefore will be a requirement (Humphreys et al. 2005). Given that existing ways of working can become highly valued by staff, and protected if challenged, it requires a strategic reconsideration of the direction of the company, involving a coordinated effort to adjust structures and systems so that new practices can be developed to allow innovation (Van de Ven 1986). PDI therefore has the strong potential to become a disturbance which can just as easily be dismissed as well as accepted. EL can become single loop dependent with little chance for double loop learning (Argyris 1993), which becomes necessary when competition and change challenge existing routines.

EL usually takes place in the midst of action that entrepreneurs learn therefore such learning is based on their experiences (Rae and Carswell 2000). While most learning will be informal and hardly recognised as learning, there will also be occasions where such experiences become recognised as personally significant or critical events, creating insights that facilitate transformative learning (Cope and Watts 2000). Further this process can be enhanced through critical reflection (Cope 2003). These views of EL are augmented by ideas and frameworks which include the importance of an entrepreneur's identity, their career experiences, their relationship with the family (Rae 2004; Politis 2005), the influence of significant others as role models (Kempster 2009) and the networks of relationships that are maintained as crucial features of context (Taylor and Thorpe 2004).

Crucially, it is recognised that any understanding of EL has to take account of the situated experiences of practice within a community of practice, which closely aligns with the requirements, context, and indeed history of the firm. This would suggest a need to consider EL in more collective terms, as an aspect of organisation learning by working with the metaphor of the organisation as a community or, better, communities of practice (Lave and Wenger 1991). This considers learning as situated, which occurs through practice obtained from work. Situated learning, which is usually informal and incidental, would suggest that it is through participation in everyday practice, by watching, doing, talking and sharing stories that a community develops. These processes allow members of a community to make meaning and sense of the ideas, and through practice, they learn what is acceptable, or not. Taking this view of learning, and with consideration for PDI, we can see how any attempt to interfere

with what is acceptable to a community or communities, might be considered as a disturbance. EL needs to be contextual and relational if it is to be accepted. Anyone outside the communities seeking to disturb the practice of communities but might find difficulties in doing so, hence our view of PDI in a family business as a struggle. For the remainder of this chapter we will consider the case of Mark as the outsider and the business, LBBC.

### **The Case**

The business considered in this chapter is LBBC Technologies in Pudsey, West Yorkshire. LBBC began in 1876 as the Leeds Bradford Boiler Company, a manufacturer of boilers for local crane suppliers, tar stills and brewing pans for local pubs. Since 1892 it has remained connected to the same family and is now managed by their 5<sup>th</sup> generation. The company has become a leading designer and manufacturer of pressure vessels and autoclaves through precision engineering. It is a niche which has seen the company survive and sometimes prosper, but it has been recognized that, for long term sustainability, there is need for a more formal approach to PDI, through restructuring and the introduction of new routines. While LBBC has to some degree sought PDI through a number of collaborations with other organisations, including universities, it was recognized that a more stable and formalized approach was needed, because ‘so many opportunities for product improvement and development’ were being missed. Therefore a decision was taken by the owners to form a Knowledge Transfer Partnership (KTP) with the University of Leeds. KTPs are relationships formed between a company, an academic institution and a qualified

person (Associate). The purpose is to allow the transfer of knowledge, technology or skills to the company from the academic institution, via the Associate (TSB 2013).

In the case of LBBC, once approval for the project was obtained, recruitment began for a qualified postgraduate in engineering. In November 2012, Mark was appointed as the Associate. Mark has an Honours degree in Nanotechnology, and soon after joining the KTP, he gained his PhD in the field of Chemical Engineering related to nanoparticles and functional surfaces. The aim of the KTP was double-edged. Specifically, there was a focus on surface engineering related to the dewaxing stage of the investment casting process. Through its deliverables, the primary goal of the KTP was to seek and implement a cost effective resolution to what we will call *the deposition problem*. The secondary goal related more generically to PDI. LBBC had recently undergone restructuring to create a team committed to PDI. The goal was to complement the restructuring with an organised approach towards the collection and collation of new and existing knowledge.

Our approach to the study is based on the sociology of translation (Latour 1987; Callon 1986), which provided a framework for considering how the project worked. Sometimes referred to as Actor Network Theory (ANT), the sociology of translation is concerned with the progression of knowledge towards its status of a truth or fact through a focus on the concerns of human interests. It is a method that is recognized as appropriate for the study of innovation (Miettinen 1999). Further, Fox (2000) argued that ANT, combined with a communities of practice perspective, can strengthen our understanding of organisation learning.

According to Latour (2005:12), it is necessary ‘to follow the actors themselves...in order to learn from them’. The explanation of facts can then be discerned by working backwards to consider how various aspects of knowledge are ‘assembled’ to form a pattern, which through elaboration, repetition and possibly a great deal of argument, become accepted or appear to be accepted as a reality or truth. If we consider the move to a more formal PDI in LBBC, it can be seen as a knowledge progression and a flow of learning, which needs to be accepted as a new reality, therefore it can also be accepted as a process that might be rejected, disbelieved or, at the very least, greeted with skepticism; learning is interrupted or distorted.

In this chapter, the actor followed is Mark but the business owners, Howard and Robert were fully supportive of his project and this research. Thus access to key interests and artifacts such as documents, emails and texts was gained. In addition, regular meetings with Mark were held, as were a number of meetings with Howard and Robert. It became possible to construct a view of the struggle of the moves being made and how PDI was embraced.

### **Struggle 1: Mark as a Fact-Builder**

KTPs always involve an agreed project plan with goals set and a quarterly monitoring process involving all partners including a representative from the Technology Strategy Board, a Government agency. To begin with, the pattern for PDI was set in motion through the proposal for a KTP, which in November 2012 resulted in Mark’s appointment as the Associate. The proposal had a sufficiently solid status in this process, such that it became the baseline for the way the project unfolds and is used to

review progress, although there is some degree of flexibility to allow deviation. The terms ‘road map’ and ‘work plan’ are used to set the direction around the project’s objectives.

Mark’s task was to continue the work of the project plan by constructing a pattern that lined up all the key factors in favour of what he wanted to achieve, referred to in the sociology of translation as enrolment (Callon 1986). Crucially this has to involve others but not just people; enrolment also involves other elements both organic and non-organic that are needed to form a pattern and to sustain it. Law (1992:381) refers to this combination as a network of ‘bits and pieces’. The test for Mark would be how far he could enroll the key factors in his favour. However, even if this can be achieved, he could not be certain that the pattern will hold together as he would desire, since the elements can take actions according to their own interests rather than Mark’s. As an initial outsider to the various communities of practice, he lacked a certain legitimacy to practice. Despite his obvious academic credentials, he had not yet met the correct conditions for legitimacy to practice (Holland and Lave 2001). His efforts to enroll also faced a counter-enrolment (Callon and Law 1982), hence the struggle. Mark faces what Latour (1987:103) called the ‘quandary of the fact-builder’ in that in his quest to follow the road map, as set out the project plan, he cannot rely with certainty on the actions of others to stick to the map; they might just as easily follow their own ‘interest maps’ (Callon and Law 1982:617). In an SME, very often such interest maps highlight values and desires of communities, developed over time through practice. To achieve translation requires skills of argumentation, negotiation, persuasion and justification, occurring principally through conversations in which fact-building can be made meaningful. If this can work, Mark would become

‘indispensable’ within the company (Callon 1986:6).

When Mark was appointed, the first translation was of the project plan by Mark so that he could decide how to allocate his time. While significance was given to the first part, the deposition problem, he quickly found that insufficient attention had been given to the second, the development of product development methodologies. In particular, he could see how he could add value to the project by aligning himself with the newly created product development team in LBBC. His interest map was adjusted accordingly to work with this emerging community of practice. Initial efforts to participate with the time highlighted his position on the periphery; he ‘felt out of my depth in understanding the topics and motives at play’. This was his first struggle. Clearly as a novice in this particular community, he had still to find a way to legitimate his participation (Lave and Wenger 1991). Mark understood this and that the apparent disinterest in his work was to ‘due to my not having penetrated the inner circle yet, and therefore I felt only time would help settle’. As his attendance at the meetings became more regular, a sense of urgency was generated around a ‘functional design idea generation structure’. Working with the team, Mark was able to focus discussion by recording minutes, thus creating a ‘bit’ for the pattern. Finding that the team were struggling to make progress on their interests, due to lack of paperwork and manpower for processing data, he proposed an automated system that would integrate within LBBC’s network, manage the collection of data and allow sorting so that design decisions could be made. He could even add for further ‘bits’ to the pattern by setting up a server that hosted a dedicated website for the storage and automation of idea evaluation.

Latour (1987:110) saw such moves as one of the easiest ways to enroll others in the creation of facts; translation one is a process of showing how what Mark wanted is also what the team wanted. In this way, while the team had goals for PDI, they were struggling to find a way forward. By focusing on their interests, Mark could move his forward too in what is referred to as a ‘piggy-back’ strategy. For the idea of the automated system to become more real, Mark needed to repeat his claims and elaborate further, allowing the emergence of what was quickly called the ‘LBBC Technologies Portal’. He created an image in a map of possibilities for the portal, still rhetorical but yet sufficiently powerful for others to be enrolled as supporters. Through display, discussion and adjustment, the value of the proposed portal is an effect of the energy given to the claims by Mark, the product development team and others. Such others had to include Howard and Robert, and in turn other members of the KTP. Howard in particular could see that the portal could help ‘service engineers’, who operated close to customers and therefore could be a source of ideas for PDI, but had ‘expressed their frustration at being unable to register and capture ideas in real time’. The portal therefore would solve the problem, apparently. Crucially, the portal, even though it was not yet operating, was sufficiently real and through translation, an association was forming that made it appear durable (Grint and Woolgar 1997), but would need ongoing and continuous persuasive talk to keep it moving (Bardini 2003). The first struggle was over.

The ‘piggy-back strategy’ continued. Mark could cite how LBBC ‘seems inundated by internal requests for change, even though processes have been put in place to address them. The product development methodology is part of an initiative to standardize these processes and to ensure all change is monitored, recorded and

approved in a centralized and accessible location’. The *Portal* (Mark’s emphasis) was an indication of the network becoming more concrete. With the help of an online learning resource (buildamodule.com), a content management system was installed and tailor-made for its application at LBBC. The ‘alpha form’ was soon ready, and Mark saw the need for further development prior to ‘roll out’. Howard suggested that it didn’t need to be fully developed before being rolled out to a selected group for testing. This presented an apparent dilemma for Mark, between the need for ‘fast’ and ‘slow’ movement of the project. The second struggle was now beginning.

Mark did meet counter-enrolment efforts to ‘park this work and pick it up again at an agreed time in the future’. However, he injected further energy into the translation with the result of working *Portal*, shown as Figure 1.1.

Insert Figure 1.1 near here

At a demonstration of the *Portal* to the KTP, Mark could point to 118 ideas logged and the inclusion of the stages of uploading an idea, reviewing these ideas, through to effecting design changes based on the outcomes; this helps provide accountability. Robert, in-company supervisor in the KTP and a family owner of LBBC, could immediately see how this could replace the current process where ideas could get lost or cold; the *Portal* could help centralise all ideas and ensure they are dealt with as priorities dictate. However, others saw the need for adjustment, where only the high value meaningful issues and significant ideas are logged. Further, it was argued that it was not just the receipt of ideas that they wished to log, but the ability to see that they

were being taken through to fruition. There was a need for ‘a good evaluation process of which issues to deal with and which are most important would be useful, as well as an idea of how many times people should log in to check the Portal for new and existing projects’. For the KTP at least, the reality of *Portal* was now more visible but its progress was still to be tested, or a trial of strength (Callon 1986) and this would need action. For Mark, at this stage, this meant agreement to draw up a How-To guide for users. Nevertheless, the demonstration provided a situation for EL, and a proto-community of practice was now emerging.

While seeking to advance the *Portal*, Mark was also working on the first objective of the project - developing solutions for high temperature fouling by organic compounds or *the deposition problem*. As LBBC’s principal product which is widely used in the dewaxing stage of the investment casting process, the problem represented Mark’s main struggle for PDI. Wax build up reportedly impaired its efficient operation. Further, a newly commissioned dewaxing autoclave had recently suffered from undesirable reactive processes occurring within the vessel which also warranted further investigation. Mark could see that in combination, a study of these reactions would also contribute to a consideration of the *deposition problem*. The KTP recognized that understanding the problem was a key issue, with a lot of work to do before this could be achieved and solutions proposed. Through recording in the project plan, the various actors came to define the story and enable the actions that followed. It also supports the view that PDI should initially consider innovation possibilities in existing products, and that external experts can provide the possibilities for action (Autio 2009; Heimonen 2012).

As Mark began this third struggle, he had certainly proven his expertise elsewhere as a highly academically qualified chemical engineer. While not averse to an academic slant, Howard was concerned to strike a balance between academic analysis and practical problem solving. However, Mark was quickly able to dispel any doubts by applying expertise to two small projects:

- research, design and development of a standardized risk management document for the Boilerclave® in response to a customer requirement
- improving the efficiency of the Alkaline Hydrolysis processes of another product.

From both cases, Howard and Robert had evidence of the value of such expertise. In particular, the risk management documentation had never been previously supplied with an order. However, it would now be routinely supplied, and the process of producing it was embedded in the product development team – product development was now alive! Mark had gained some power through the translation of Howard and Robert's interest into his world and thereby began a degree of shift in the innovation culture (Burgess 2000). Enrolling Howard and Robert allowed Mark some time and space to advance work on the *deposition problem*. He could devote energy to working carefully and *slowly* on:

- a literature review into the mechanism of wax deposition
- a literature review on engineering solutions for preventing wax deposition
- analysis of wax blend components responsible for deposition
- isolation of Asphaltenes in the anti-corrosive paint as a likely cause

- offering potential solutions to the problem
- construction of an experimental rig to test the effectiveness of coatings

This list represents how Mark assembled a variety of ‘heterogenous’ elements (Law 1992; Mol 2002) to make progress on the *deposition problem*. While much of this work took place either in the University or through visits to external sites, it required assembling by Mark for it to become available for making associations. However, there would need to be more attention to the relations that would be necessary for further facts to emerge and be considered as real or a solution for the problem. Without such relations, a solution could not exist and PDI would flounder (Alcadipani and Hassard 2010). This was also sensed by members of the KTP who suggested that Mark ‘should consider structuring his time spent at LBBC and to arrange short presentations to interested groups within the business, as appropriate.’ The struggle for PDI moved to a new stage.

## **Struggle 2: Building relationships to make the facts**

Having begun to develop sufficient claims for expertise, Mark needed to enroll others in the network of the *deposition problem*. His association of the literature, analytical results from the lab and representation in a 2D model formed the resource needed to persuade others to become enrolled. However, this would also require others, without any strong degree of certainty, to accept identities, roles and make choices in conformance to the direction set by Mark (Callon 1986). Latour’s (1987:111) translation two suggests that some might be prepared to follow Mark because their

interests are best served by doing this, although this might be ‘rare’. More possible is translation three or ‘if you must make a short detour...’ which would represent the solution to the *deposition problem* as something that could not be achieved quickly, but if others could follow Mark, even for a short time, it would enable their interests to be served. To do this, Mark would need to show that:

- the very quick route is not solely recommended,
- the slower route is clearly laid out and
- the slower route does not look too slow.

However, it is not sufficient to just show; Mark must enact through conversations that build relationships (Mol 2002). The facts that already exist for Mark are still to be made with others so he can expect contests, controversy and alternative views (Law 2008). As part of this struggle for acceptance, Mark needed to begin the process of persuasion, or rhetoric, defined by Latour (1987:30) as ‘the name of the discipline that has for millennia, studied how people are made to believe and behave and taught people how to persuade others’. Figure 1.2 highlights this process.

Insert Figure 1.2 near here

Through the conversations and relationships built with peers, it became apparent to Mark that there are significant differences in the problem solving/innovation methodology employed by academia and a business like LBBC, where the former is generally focused on obtaining quantitative and unbiased data, and the latter being generally concerned with qualitative information regarding potential avenues. With a

view to managing expectations, Mark's initial foray into project planning therefore led him to divide his antifouling research to tackle the *deposition problem* with a fast and slow route to cater to the qualitative and immediate industrial expectations, and the quantitative, systematic academic approach respectively. The marketing and communication phases would follow from the completion of the fast track.

While aware that he was a disruptive force for PDI at LBBC, Mark struggled with the concept of his identity. This confusion had mostly to do with the difficulties that peers have in accepting and understanding the nature of his job, and the outcome this has on their relationships. His membership of the varied communities of practice was still not regarded a fully legitimate and so his identity was not yet shaped by them (Wenger 2000). Other issues such as an unclassified employment grade, and being exempt from companywide bonuses due to his status as a KTP Associate, added to his identity struggle. Due to the ingrained practices from his academic background, Mark was initially reluctant to give the qualitative pathways much emphasis, but realized that the restructuring of his research would go a long way towards creating allies and supporters of his work so the innovation culture could be nurtured. Initial results were well received. The fast track methodology improved on the knee jerk investigations common to LBBC, and introduced the concepts and principles of systematic studies. As several key employees would need to be involved in the design and operation of the test rig, it is expected that the methodology might see adoption within the innovation minded workforce, and with careful guidance could improve the quality of collective conclusions. There had already been a surge in this type of thinking as Mark had been inundated with requests for studies relating to process within various other product vessels.

Enrollment of others centred on the construction of the test rig, initially by finding the person to produce a CAD diagram. This involved what seemed to be an easy persuasion of Kyle, who was willing to produce a new version of the 2D model as 3D, a clear enhancement of the reality of the emerging solution. However, as translation theory would suggest, nothing can be so easy and no sooner had Kyle agreed to become enrolled that he had divert his energies elsewhere for the time being. Thus, as Mark was starting to understand, assembling the parts of the test rig for finding a solution to the deposition problem would be both uncertain and sometimes contested (Elbanna 2008). As the energizer for the enactment for the test rig to solve the *deposition problem*, the proxy for PDI in LBBC, Mark must attempt to build a set of relations with both people and materials such as 2D and 3D diagrams, but this is a difficult process and translations can fail causing delays and set backs (Law 2009).

Nevertheless, it was still possible for Mark to continue to appreciate the importance of relationships, both human and non-human. For example, he could order the panels for the rig, arrange for coatings with others outside the company, and he could attend a social event with staff at a greyhound track! In such ways, his job – nature or otherwise - PDI and the innovation culture are being enacted as a result of the relational effects that combine the social and the technical (Law 2009). He could also select the position of the test rig on the workshop floor, allocating the space to conduct the test and collect data through measurement, a necessary trial of strength (Callon 1986). Mark's proposed route was still controversial so he needed to make the case for his representation stronger through measurement (Martin 2005), which will

enable further strengthening through inscription devices such as figures and graphs (Smith et al. 2000).

While progress on the *deposition problem* was being made, and its translation was speeding up, Mark was able to question some fundamental aspects of the operation of the dewaxing autoclave. Speculation was in progress, and through conversation with his community at the University, some different and more radical possibilities were surfaced. Such speculation in science has long been recognized as an essential part of reasoning, referred to as abduction, and seen as prior to induction and deduction. As Charles Sanders Peirce (1903) argued:

“Deduction proves that something must be; Induction shows that something actually is operative; Abduction ... suggests that something may be.”

Mark’s speculation on the *deposition problem* led him to consider other possibilities such as:

- Could wax deposition be the symptom of another reaction rather than a standalone problem?
- Was the geometry of the jacket more significant in creating temperature differences?

Such questions are abductive in the sense that they are a tentative presentation of possible truths and are new ideas that might work. In the words of Peirce, they become hypotheses ‘on probation’. In this way, abductive reasoning has also been

linked to creativity (Dyer 1986). Of course, to pursue these new ideas required the setting up of another road map, and one that would need a relatively slower journey. However, such hypotheses on probation carry ‘contextual meaning’ (Shotter, 2008: 33) with a good possibility of a radical change in the design of the dewaxing autoclave that would represent a form of double-loop learning for LBBC (Argyris 1993).

In effect, the new possibilities represented a significant challenge to the way the dewaxing autoclave had been designed for the last 40 years and therefore a very challenging struggle. He was suggesting a need to open the ‘black box’ (Latour 1987), but in doing so he was also setting up a slower route, the *internal jacket problem*, as well as continuing with the relatively quicker route, the *deposition problem*. He now had two detours for translation available, one relatively fast, and the other relatively slow.

Working on what he now saw as a ‘two pronged attack’, Mark knew he would have to assemble ‘bits and pieces’ for the translation of both routes. For the faster route, a pattern was already discernable, but he could now argue that the benefits of the solution were likely to be ‘short-lived’; sufficient for commerciality and even the requirements of the KTP, but fraught with uncertainty about eventual deterioration due to competing reactions and restrictive geometry. The slower route with its focus on the *jacket design* would require more time and resources, but with the prospect of an enduring solution to the problem. He regarded this route a potential ‘game-changer’.

Mark began excitedly to build the argument for the slower route. Firstly by doing a literature review on research into fouling within heat exchangers, so he could build a model to explain what was happening within the Boilerclave®. He informally began the enrolment of Howard and then began sketching the process. To the sketches, he could add calculations and information from the support of specialists, before presentation to Howard and Robert.

Mark now injected energy into the cycle of rhetoric to persuade others of the importance of the slower route (Latour 1987). Mark assembled key elements of his own expertise, expressed in meanings to persuade others, initially Howard and Robert, but also non-human elements such as diagrams with coloured patterns, graphs and photographs, to be displayed on screen. Having established sufficient grounds for enrolling interests for the *deposition problem*, he now sought to repeat this for the slower route, the internal *jacket problem* (Callon and Latour 1982). However, as a challenge to a long established feature of Boilerclave®, he was proposing generative learning (Senge 1990) which could easily provoke defensive responses from others (Argyris 1991).

In the presentation to Howard and Robert, the initial move was to revert to the faster route of wax deposition, but to place it alongside the revelation of a new participant, *scaling*, where thick deposits were observed on the heating elements. The problem was the behaviour of *scaling* related to surface roughness and concentration of contaminants in the boiler section - this was part of the internal *jacket* - which produced 'steady and self increasing growth', along with other effects of corrosion and 'foaming', recognized immediately by Howard as having 'happened before'.

Further, there were the effects of increased operating costs as a consequence of *scaling*. It was easy to establish some fast routes:

1. increase the frequency of boiler blow-downs
2. flushing the boiler sections
3. adding anti-*scaling* solutions

Both Howard and Robert were enrolled in what appear to be a sensible change and, having secured this step, Mark showed how *scaling* in the internal *jacket* and the *deposition problem* were linked. *Scaling* was shown to be likely, but not yet proven, to be acting as a buffer to lower heat; it was Mark's theory or better a theory on probation in abductive terminology (Peirce 1903) so more testing was needed. Howard, possibly accepting the fact rather than a fact being made, considered that a 'double whammy' had been found with links to recent stories of undesirable reactions in the dewaxing autoclave. The first part of the struggle was now complete and Mark could now suggest the testing of wax repellent solutions to line the interior of the vessel.

Were Howard and Robert still interested? Yes, 'super interested'. This enabled Mark to produce a final 'trick'. Produce four vials, each containing pellets of wax in various states of dissolution, and relate these to high definition electron microscope images of the same, which he used to raise doubts about the predominance of wax in the *deposition problem*. It was not just *wax*, but more so *the filler material*, leading Mark to conclude that *filler* becomes 'trapped' in the wax and cause *the deposition problem*.

Two possible options to proceed, both requiring testing and reviewing:

1. Surface coatings that enable both the wax and filling to be removed
2. Reshape the geometry of the dewaxing autoclave to enable wax and filler material to discharge more effectively

On conclusion to the presentation, both Howard and Robert were enrolled in the faster and slower routes of translation three (Latour 1987). Wax was still the problem but now it was also seen as a *wax and filler deposition problem*. Mark could:

1. conduct practical trial in real situations
2. complete further tests on coatings, depositions and *scaling*
3. prepare guidance on water treatment for customer
4. enroll the design engineers in both routes

In agreeing to both routes, Howard and Robert were also agreeing as owners of LBBC to extending PDI to others, both within LBBC but also beyond and so becoming part of this network. They also, along with Mark, could enroll others to adopt roles within the network and play a part in the projects of *scaling, wax deposition and filling* and even *jacket design* (Mahring et al., 2004). PDI now was becoming more stable and durable within LBBC as more participants were willing to join his community of practice to explore and exploit the opportunities emerging (Wang and Chugh 2014).

## **Conclusion**

We began this chapter by pointing to the importance of family-owned businesses to the UK economy but how, due to the predominance of informal processes of EL, PDI in such firms seemed to be of less importance. It was also argued in much of the literature, that the route to PDI lay in becoming more like large organisations. However, this would present something of a conundrum in that advantages could be gained by not aping PDI processes of larger organisations.

In the case of LBBC, a long-established family business, EL is mostly about sustaining the business into the future. Indeed, as a family with parents and sister also board members, sustainability was considered essential and PDI had been highly desired. However, the conundrum had played in a number of ventures for PDI with other organisations, but also a series of missed opportunities. There was a sense of being caught on the horns of an exploration/exploitation dilemma but in the light of a recent strategic review, from which the values of long-term security and sustainability emerged, the decision was made to tilt the position towards PDI through the KTP with Leeds University. This led to the appointment of Mark who, with his doctorate qualification in chemical engineering, was bound to create a disturbance to LBBC's life composed of different but long-standing communities of practice, requiring an ability to engage with a struggle for the making of PDI.

Dictionary meanings of the term struggle points to verbs and verbal phrases such as:

- Contend with an adversary or opposing force
- Contend with a task, difficulty or problem

- Strive for existence and identity
- Advance with violent effort, e.g. through the snow

From such a list of terms, we can point to the various ways by which Mark sought to enhance PDI and thereby influence EL. One of the main conclusions of this chapter is for the necessity of disturbance and struggle in EL to shift the balance towards PDI as exploration which retaining the importance of incremental learning in exploitation.

The struggle began from the moment Mark arrived when his very presence, for some, became the source of confusion or ambiguity, or even worse, as non – person. That is, despite being very well qualified for PDI, he was an outsider who had not yet established a legitimacy to practice. There were adverse and opposing forces at work and Mark's first struggle, as a fact-builder, was to find a way of arguing not only for the importance of the project but also for his own existence.

A crucial move in this first phase was to find ways of working with others' interests to advance his own. This enabled Mark to learn about the lives and problems of others so that they could learn what he could do for them. The pattern that followed, in the form of a server to host a website for the storage and evaluation of idea for PDI, made visible to all how EL was occurring. Although relatively small, such learning with a real presence, could then be shared with others. Struggling with a problem to be solved to help others was a quick way of creating interest in PDI. Therefore, we conclude that the foundation for PDI has been built on the establishment of a mutuality of interests and EL which works with current issues and problems.

Mark eventually demonstrated enough expertise to move the project forward. However, it was not enough to work with problems; he also had to redefine problems in new ways. In order to do this, he could not just expect the project to work without his efforts. However, such efforts need a response from others so that they make efforts too. As the case suggests, an innovation culture has to be constructed through a relational process in conversations requiring rhetoric, argument and the energy of a good story. EL is situated in such conversations and those seeking to make advances for PDI need to see themselves as relational leaders (Cunliffe 2011).

Of course, working in and with relationships cannot be guaranteed to secure results quickly or as desired. At times Mark's struggle was for his identity, which challenged his understanding of his own expertise and traditions. However, part of the way of dealing with the tensions was to offer a both/and approach in the form of fast and slow tracks. This became an important source of personal learning for Mark which eventually enabled him to offer both incremental and generative possibilities to Howard and Robert. A crucial skill and way of talking in shifting the culture was to offer dual tracks and reconcile dilemmas. The arguments had to be two-sided (Billig 1996). In this way, Mark was able to avoid the possible defensive behaviour in the face of double loop learning, embracing positive attitudes that made radical innovations more possible (Hage 1980).

Finally, in unfolding this story of EL, we have shown the value of 'following the actors' in LBBC. While the principal actor may have been Mark, the story had to involve learning by others including Howard, Robert and other staff at LBBC but also the 'bits and pieces' (Law 1992) which could all make a difference in PDI (Latour

2005). This had to include his pictures, notes, University, sample vials and so on. All played their part in assembling the elements of PDI, but continued energy would be needed to sustain its further progress. By creating the disturbance through Mark's project, Howard and Robert had set off a dynamic, that was not without difficulty but carried the prospect and opportunities for a more ongoing and continuous EL (Voudrouis et al. 2011).

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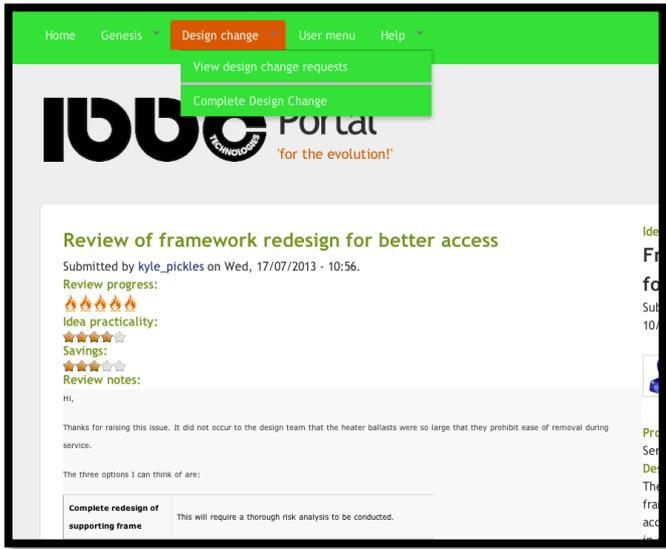


Figure 1.1 *The Portal*

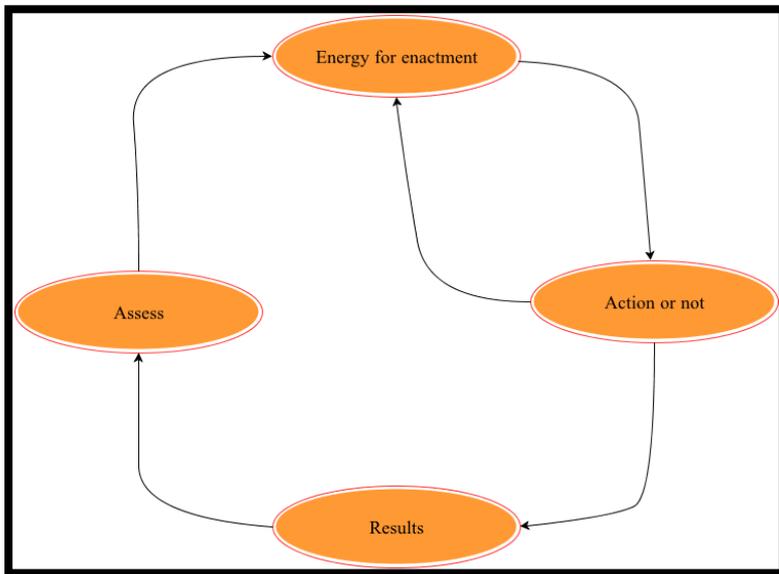


Figure 1.2 *The Cycle of Rhetoric*