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# SUPPLY CHAIN TRANSFORMATION IN APC IRELAND: LEAN THINKING, OPPOSING LOGICS AND BRICOLAGE

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## Abstract

*This paper presents a number of observations and findings from an ongoing study of supply chain transformation in a subsidiary of American Power Conversion (APC) located in the West of Ireland. The study is being carried out in a period of significant change within both the Irish economy and the APC Corporation. The research addresses the question of how innovation can contribute to the sustainability and development of the Operations function in a time of transition. To begin with, a review is presented of relevant research and theory in the areas of lean supply, innovative culture and information systems bricolage. Then the context and composition of the lean transformation team involved in the case study are described together with the research design. The work proposes to make a contribution in two areas. Firstly by providing empirical evidence of the role of innovation in an organizational transformation and the challenge of incorporating bricolage in the course of information systems design. Secondly to the building of theory by proposing that organizational innovation can be viewed as a dynamic process of tuning “opposing logics”. The paper concludes by suggesting that the study has significance in the context of Ireland’s objectives of moving to an innovation economy and of strengthening academic-industrial collaboration.*

*Keywords: Supply Chain, Lean, Innovation, Bricolage.*

# 1 INTRODUCTION

This paper reports on an ongoing study of the supply chain transformation initiative based in a subsidiary of American Power Conversion (APC) located in the BMW (Border, Midland and Western) region of Ireland. The study is being carried out within the context of a period of significant change within both the Irish economy and the APC Corporation. The remarkable development of Ireland's economy over the last two decades was initially driven by foreign direct investment (FDI) from North American multi-national corporations (MNCs) setting up manufacturing facilities to avail of low tax incentives, a young educated workforce and proximity to their growing number of European customers. However, this initially successful model is increasingly being threatened by the low cost economies of Eastern Europe, India and China. As a result, Irish enterprises rapidly need to build new sources of competitive advantage to sustain employment and standards of living. An important national study in 2004 outlined a two-pronged strategy to foster sustainable enterprises in the timeframe up to 2015 (Enterprise Strategy Group, 2004). The first area of focus is to build capabilities and capacity in:

- Expertise in international markets to promote sales growth.
- Research and development (R&D) to drive the development of high-value products and services.

The second area of focus aims to ensure that high-value manufacturing and supply chain operations continue to be an essential component of the country's business environment. This latter topic is the primary theme of this paper. Ireland is now entering a new era which requires a transition to an innovation economy (Porter, 2003).

APC, Ireland has two locations in the West of Ireland that serve the European, Middle East and Africa (EMEA) region. The Corporation has recently demonstrated strong financial performance and the ability to bring to market innovative product offerings through in-house R&D and strategic acquisitions. However, the company has stated in recent financial reports that it needs to transform its manufacturing processes by developing a lean customer-centric supply chain. The Corporation entered a major period of transition in the last quarter of 2006 with the announcement of its merger with Schneider Electric. With the continuing transfer of many of its products to offshore locations such as the Philippines and China, the Irish Operations functions are convinced that being a corporate leader in the area of process innovations is key to the long-term sustainability and development of the location.

The work proposes to make a contribution through the longitudinal study of an MNC Operations function that has major relevance for a national and regional economy in a time of transition. Furthermore, an important objective of the study is that it is carried out using a rigorous methodology to ensure that findings are pertinent to managers and practitioners (Saunders, 2006). The paper builds on a number of theoretical foundations including research in the fields of Lean Supply (Lamming, 1993; Womack & Jones, 2003), the opposing logics of innovation (Katz, 2004a; Tushman & O'Reilly, 2004) and information systems bricolage (Ciborra, 2002). Having set the scene, the paper now proceeds as follows. Firstly a literature review is provided on lean thinking, innovative culture and bricolage. Next the research approach is outlined and the scope of the research questions and data collection are described. Following this, the initial findings and analysis of the work are discussed. Finally the conclusions of the study are presented in terms of the implications for researchers, practitioners, and future work.

## 2 LITERATURE REVIEW

This section will place the study within established research and theory in the areas of lean supply, innovative organisations and information systems bricolage.

### 2.1 Lean Thinking

Lean is a supply chain term defined as the “enhancement of value by the elimination of waste” (Womack & Jones, 2003). According to Lamming (1993 p 32), the term originated from a major automotive-industry study, the International Motor Vehicle Program (IMVP), based in MIT during the period 1986-1990. Because of where it originated and the influence of Kiichiro Toyoda, it is commonly known as the Toyota Production System (TPS). The process contains many Japanese terminologies such as muda (waste) and poka-yoke (mistake-proofing). Despite being referred to as a “philosophy” by some promoters, an analysis of the techniques suggest that the methodology is an umbrella for many standard Industrial Engineering practices tied together as an integrated organisational process. The promoters of Lean thinking insist that it is not the latest quick-fix program but requires a five-year commitment for an organisation to effect the desired transformation (Womack & Jones, 2003). Such a relatively long term investment can provide significant stability in these turbulent times for manufacturing facilities. It also requires a critical organisational transition from top-down directives to bottom-up initiatives where managers become coaches and employees become pro-active. While interestingly, Womack and Jones do not directly discuss the area of innovation management, Tidd et al. (2005 p p 488) propose Lean Thinking as a competitive advantage; in particular the practice of kaizen as a method of continuous incremental innovation over a long period. The analysis by Lamming (1993 p 128) of innovation in the lean production of new American automobiles concludes that the half-hearted commitment by senior management and transient project managers resulted in many basic problem not being resolved early on in the development. He then contrasts this situation with the successful Japanese project leader (shusa) who typically enjoyed almost “superstar” status. Significantly, the latest “thinking” from Womack and Jones (2005) has shifted the focus from Lean Supply to Lean Solutions and widened the concept to the process of consumption. However some researchers such as Christopher and Gattorna (2005) argue that fundamental changes in the environment of global competition and trends such as outsourcing require organisations to develop supply chain strategies that are aligned to “appropriate value propositions” and customer market segments. In their taxonomy, shown in table 1, “Lean” is just one four types of supply chains and they recommend a “horses for courses” approach to supply chain design that is cognisant of both human and economic factors.

Supply Chain Type	Customer Segment Type
Fully Flexible	Innovative Solutions -demand: erratic
Agile	Demanding/Quick Response -demand: uneven and requiring rapid response
Lean	Efficiency/ Consistency -demand: largely predictable
Continuous Replenishment	Collaborative -demand: very predictable

Table 1. Supply Chain Strategies (Christopher & Gattorna, 2005)

The area of supply chain management is still proposed as a major source of competitive advantage (Christopher, 1998b). However, the discipline is faced with new challenges such as “reverse logistics”(Stock, 1998) and “greening”(van Hoek, 2002) driven by legislation and consumer attitudes together with the demands for agility by the trend towards “mass customisation” (Christopher, 1998a).

## 2.2 Innovative Culture

One of the main challenges for an organisation that is committed to innovation is the creation of an innovative culture. This task is also being spoken of as the challenge of generating an organisational “climate” with the increasing evidence of its positive link to innovation effectiveness (Leavy, 2005). According to Zien & Buckler (2004) successful companies create a culture where everyone participates in innovation and where it is seen as the fundamental way to provide value to customers. Seven principles emerged from their studies across twelve MNCs in the USA, Japan and Europe. Research by the Institute of Work Psychology (IWP) in the University of Sheffield has classified twelve areas that need to be addressed in order to grow a culture of innovation (Birdi, 2003). Basadur’s (2004) comparative study of creativity and Employee Suggestion Schemes (ESS) between Japanese and USA companies found that in Japan “employee creativity is managed through deliberate structural means, not to effect direct economic outcomes, but to develop motivation, job satisfaction and teamwork”. In contrast the schemes run in most USA organisations followed Taylor’s view of the “economic man” who is only motivated by money: the result was a failed model where only a minority got involved. Nemeth (2004) proposes that creativity begins with a questioning attitude and the ability to “look outside the box”. Indications from recent research in psychology is that teams can stimulate creativity and problem solving by being open to dissenting voices and minority viewpoints that in normal circumstances would be rejected or ridiculed and that “cult-like” corporate cultures stifle creativity. The importance of the motivation of technical professionals is of paramount importance as evidence suggests that it is better to have a team with A-rated motivations and B-rated capabilities than vice-versa (Katz, 2004b). Herzberg’s (2003) seminal work on motivation found that people are “motivated by interesting work, challenge, and increasing responsibility”. Good management and working conditions will help to ensure that they do not become dissatisfied but this will not meet their deep-seated need for growth and achievement. Table 2 summarises some themes from research on the creation of an innovation culture and climate.

Attribute	Characteristic and Reference
Identity	Treasure identity as an innovative company (Zien & Buckler, 2004). Make Innovation the norm (Peebles, 2003).
Employment	Ensure innovation is a job requirement (Birdi, 2003). Hire people with a range of abilities, interests and backgrounds and involve peers heavily in the selection process (Leavy, 2005). Never forget the individual (Zien & Buckler, 2004).
Responsibilities	Remove control while retaining accountability (Herzberg, 2003). Empower employees (Birdi, 2003).
Creativity	C = K x I x E: Creativity requires Knowledge, Imagination and Evaluation (Basadur, 2006) . Look outside the box (Nemeth, 2004)
R&D	Not all the smart people work here. (Chesbrough, 2003). R&D is everyone’s business and Problems are “golden eggs” (Basadur, 2004)
Suggestions Schemes	Look for simple focused solutions (Tushman & O’Reilly, 2004) to real problems (Drucker, 2003). Use to develop motivation, job satisfaction and teamwork not make money (Basadur, 2004).
Learning	Give people room to grow , try things out and learn from mistakes (Leavy, 2005). 7-3 formula : expect to make wrong decisions 3 times out of 10 (Tushman & O’Reilly, 2004). Train for creativity and Innovation (Birdi, 2003).
Management	Place people and ideas at the heart of management philosophy (Leavy, 2005). Managers are “symphony conductors” not army generals and strategy flows from bottom up (Tushman & O’Reilly, 2004). People do not resist change : they resist being changed (Basadur, 2004).
Motivation	People are “motivated by interesting work, challenge, and increasing responsibility” (Herzberg, 2003). A-rated motivations and B-rated capabilities are better than visa-versa (Katz, 2004b)

Table 2. Some attributes of an innovation culture

### 2.3 Opposing Logics

Katz (2004a) presents the problem of “opposing logics” between operating and innovating organizations and in particular, mixing the need for operational efficiency in the present while at the same time trying to innovate successfully for the future. Furthermore, according to Katz, the main issues facing innovation managers are not in the technical area but overseeing the complex interplay and motivation of the people involved. Others propose that increasingly companies must develop ambidextrous organizations that can simultaneously operate for short-term efficiency and long-term innovation (O'Reilly & Tushman, 2004). Leavy (2005) argues that “much about managing innovation is paradoxical” and that “finding the balance between innovation and efficiency is a dynamic challenge” with oscillation patterns that are difficult to control. Table 2 presents some of these paradoxes and opposing logics discussed in the literature on innovation.

Innovation Paradox/Opposing Logic		Reference
Open Innovation	Closed innovation	(Chesbrough, 2003) vis-à-vis (Cooper & Kleinschmidt, 1993)
Manufacturing Lead	User Lead	(von Hippel, 1998) vis-à-vis (Ulrich & Eppinger, 2000)
Mindful	Mindless	(Swanson & Ramiller, 2004)
Learning Organisation	Gatekeepers	(Allen, 2004)
Long-term Strategy	Quick Wins	(Browne et al., 2000)
Present Efficiency	Future Innovation	(Katz, 2004a), (Leavy, 2005)
Bricolage	Planning, Methods and Models	(Ciborra, 2002)
Innovation	Imitation	(Porter, 1998)
Ambidextrous	Focused	(Tushman & O'Reilly, 2004) vis-à-vis (Treacy & Wiersema, 1993)
Lean Perfection and 5S	Winging-it	(Womack & Jones, 2003) vis-à-vis (Kelley, 2001)
Radical	Incremental	(von Hippel, 2005)
Creativity	Conformity	(Levitt, 2003)
Individualist	Structuralist	(Slappendel, 1996)
Outsourcing	Business Resilience	(Milligan & Hutchenson, 2006)
Creativity	Time-Pressure	(Amabile et al., 2003)
Innovator	Laggard	(Rogers, 2003)
Analytical	Interpretive	(Lester & Piore, 2004)
Control	Drift	(Ciborra, 2000b)

Table 3. Innovation paradoxes and opposing logics

### 2.4 Bricolage

Claudio Ciborra argued, using a number of case studies, that the innovative and strategic implementation of ICT applications has more to do with happenstance than careful planning and structured methods (Ciborra, 2002). He defines this phenomenon as *bricolage* which in contrast to the realm of “method, procedure, planning and control” is a world of “improvisation, hacking, practical intelligence and artistic embroidery”. Fernandes (2005) goes so far as to say that Ciborra’s work clearly highlights the need for organisations to accommodate this fuzzy *bricolage* as a source of

“strategic and competitive advantage”. The result will be to enable creativity and to utilise “resources like information together, in ways they were not originally designed to do”. A longitudinal study of the adoption of IS by Small and Medium Sized Enterprises (SMEs) concluded that bricolage was a useful concept and proposed a set of guiding principles “to enable IS bricolage to contribute to an organisation's strategic direction” (Ferneley & Bell, 2006). Having presented an overview of relevant literature, the paper will now provide a detailed description of the case being studied and the research approach being taken.

### **3 CASE DESCRIPTION**

The case study is based in APC, Ireland, a subsidiary of the American Power Conversion (APC) Corporation. APC designs, manufactures and markets back-up products and services that protect hardware and data from power disturbances. The explosive growth of the Internet has resulted in the company broadening its product offerings from uninterruptible power supplies (UPS) to the high-end InfraStruXure™ architecture in order to meet the critical availability requirements of internet service providers (ISP) and data-centres. This modular design integrates power, cooling, rack, management and services, which allows customers to select standardised modular components using a web-based configuration tool. The Corporation reported sales of \$2 billion in 2005, globally employs approximately seven thousand people and is a Fortune 1000 company. APC aims to set itself apart from the competition in three areas: financial strength, innovative product offerings and efficient manufacturing (APC, 2006). However, recent financial reports have stressed that the company needs to implement significant improvements in manufacturing and the supply chain (Results APCC 2005; Results APCC 2006). According to these published reports, the company must work to develop a “lean, customer-centric, ambidextrous organisation” in order to reach “optimal efficiencies in our processes”. APC has two locations in the West of Ireland that serve the European, Middle East and Africa (EMEA) region. The company announced a streamlining of its operations in Ireland in June 2006. The Manufacturing Operations site, based in Castlebar, employs approximately 150 people and a number of functions including sales, information technology, business support and research and development (R&D) are situated in Galway with a workforce of approximately 300. The widening of focus from the manufacturing of discrete products, such as UPS, to the delivery of customised InfraStruXure™ solutions provides both challenges and opportunities for the Operations function. Responding to the supply chain challenge, a Lean Transformation project was set-up in the Castlebar campus in February 2006 with a cross-functional team of twelve members drawn from Management, Engineering, Manufacturing, Materials Planning, Quality, and Logistics functions. The Lean project team set an objective to quickly deliver the message that Ireland is responding to, and leading, the corporate initiative and to provide a platform for the Irish subsidiary to obtain a reputation as an innovative location. Initial corporate feedback is that this project is “ahead of the curve” in terms of the other regions. A major requirement from corporate executives was that any innovations resulting from the initiative could be replicated in other regions. The Corporation entered a major period of transition in the second-half of 2006 with the announcement of its merger with Schneider Electric. The primary management information system employed by APC is Lotus Notes, a collaborative software system that manages its knowledge flows. It provides a tightly controlled environment for asynchronous group work; where collaborators can have different or independent work patterns.

### **4 RESEARCH METHOD**

Yin (1994) defines a case study as an “empirical enquiry that investigates a contemporary phenomenon within its real-life context” and where a “*how* or *why* question is being asked about a contemporary set of events over which the investigator has little or no control”. The present research, begun in early 2006, involves the author undertaking a longitudinal study of innovation management

in APC Ireland Operations division. The initial research aim was to consider the human and technological factors involved in the management and diffusion of innovation. To this end the following research questions were posed based on a preliminary literature review and discussions with APC management:

- RQ1: How well does APC Ireland Operations currently manage innovation?
- RQ2: How is a culture of innovation developed in APC Ireland Operations?
- RQ3: How is the diffusion of resulting innovations to the wider APC multi-national corporation (MNC) facilitated?

In order to address the first question, an innovation audit was carried out to provide some benchmark data and to develop some emerging concepts, ideas and insights. The second research question is the main focus of this paper. Using Yin’s taxonomy, the preliminary case study strategy is that of a TYPE 2 embedded (multiple units of analysis) single-case design. Recommended data collection methods involve maintaining a log book, reviewing documents and information systems, records, interviews, participant observations, artefacts and surveys in order to develop a database and body of evidence (Gillham 2000; Yin 1994). Members of a wider IS research team provided support to the researcher in the areas of methodology and technical expertise. For example, this supportive research structure is recommended by Slappendel (1996) to overcome limitations when viewing innovation in organisations from the interactive process perspective. The main phase of the initial data gathering was conducted from June to September 2006 and involved collecting evidence in a number of ways including:

- author’s case study log book
- documents (e.g. minutes of research meetings, industry publications, APC publications)
- records (e.g. storyboards, spreadsheet of Lean team contact details, suggestions spreadsheet )
- interviews (e.g. initial exploratory open interviews with lean team members to obtain an understanding of the project)
- direct observation (e.g. Lean notices and storyboards in Castlebar campus)
- participant observations (e.g. attendance at employee induction program, regularly spending time in the Castlebar or Galway sites of approximately one day per week)
- artefacts images (e.g. photograph’s of the “cell information board”)

The research design was initially formulated to take an inductive approach. The rationale was that first of all there was a need to spend time in the organization, observing and listening, in order to get a feel for the situation. This also would leave the door open to take a deductive approach later in the study when there was enough knowledge of the case to test an established theoretical framework. For example Saunders (2003) argues that such a multi-method approach is often extremely advantageous. Table 1 shows the profile and number of one hour open interviews carried out during this period.

<b>Location :Castlebar facility</b>	<b>Lean Team</b>
Position and number of interviewees	Plant/Senior Manager (2) Engineers (2) Team Leaders (3) Technicians (3) Planners (2)
Total number of open interviews	12

*Table 4. Data Collection: profile of interviewees*

This section of the paper has presented the context and methodology of the study and will now follow on with a discussion of a number of preliminary observations and findings.



## 5 ANALYSIS AND DISCUSSION

The case description, in the previous section, provided an overview of the context and emerging issues in which the study is being undertaken. The paper will now proceed to provide an analysis and discussion of the empirical data gathered to-date using the theoretical frameworks of lean thinking, innovative culture and bricolage outlined in the literature review. In terms of the business situation, the joint APC-Schneider Electric presentation on the strategic and business benefits of the merger will be used as an important reference and perspective (Schneider Electric, 2006).

### 5.1 Implications for Practice

APC has acknowledged the need for improvement in process innovation (delivery of products and services) and paradigm innovation (organisational models). This provides both challenges and opportunities for the APC Ireland Operations function especially in the context of the pending merger with Schneider Electric. The setting-up of the local Lean Transformation project and the embracing of Lean methodologies and techniques to support the corporate strategy were seen to be globally “ahead of the curve”. However, the location must be cognisant of the current movements in Lean thinking from a focus on production to the area of solutions and the process of consumption. Also, the review of the supply chain management literature suggests that Lean is one among a number of strategies and is particularly suitable for the customer segment that is focused on efficiency and consistency. APC’s large systems have shown impressive growth of 30% year over year driven by the demand for network critical ICT infrastructures. However these complex installations suggest the need for different supply chain strategies particularly due to the impact on gross margin of the SG&A expenses to support this growth with the resulting adverse affect on profitability. The merger business case proposes to “deploy best practices in large systems and services” and to “streamline and rebalance [the] supply chain” while capitalising on the APC’s small systems success.

The strategy of creating an innovative culture in the supply chain has a sound basis for two reasons: developing a sustainable competitive advantage for the Irish location and contributing to the “focus on innovation” that is emphasised by both APC and Schneider in the merger value proposition. However, a review of the copious literature on innovation results in the conclusion that there is no silver-bullet or neat positivistic formula to achieve this aim. Putting in place a culture or climate that allows innovation to flourish is a major test of the art of management and involves the “tuning” of many logics with opposing frequencies and unpredictable oscillations. However, therein lies an opportunity especially now that many organisations, in the wake of project failures, are revisiting the previous conventional wisdom that offshoring to the lowest cost location is automatically the best business decision (Ciborra, 2000a p 33). Porter contends that innovation is the ingredient that allows a firm to lower cost while at the same time enhancing differentiation and thus realize two competitive strategies that can be in conflict (Porter, 1998 p 20).

An attribute that stood out during the initial observations and interviews with the Lean team was the way in which the group used collective skills and resources to implement changes and effect quick-wins. An example of this was the development of an information system called the “Lean Manufacturing Info Point” using software development skills within the team rather than taking the established route of submitting an MIS proposal in the Lotus Notes database. This approach of using whatever expertise and materials that are available in an innovative manner is a characteristic of bricolage. One consequence however is a predictable tension between the ad hoc IS development that meets the local needs with the stringent corporate control system that is integral to Notes. The real possibility that such an opposing logic could stifle innovation was also recognised. Interestingly the section of the merger presentation that focuses on the complementary management skills between APC and MGE (Schneider Electric’s power protection subsidiary) emphasises APC’s expertise in the area of information technology.

## 5.2 Implications for Research

Wolfe's (1994) review of the abundant growth in innovation literature concluded that it had made little contribution to the understanding of innovative behaviour in organisations and his evaluation of the results as being "inconclusive, inconsistent and characterized by low levels of explanation" unquestionably raises serious issues for any researcher venturing into the field. One of his recommendations was that more careful attention must be given to the "personal, organisational, technological and environmental contexts" of the innovation phenomenon being studied. Observations and reflections presented in this paper suggest that viewing innovation within its dynamic environment through the lens of oscillating paradoxes and opposing logics could provide fruitful insights for both practitioners and researchers. This is of particular relevance for the study of innovation in such an efficiency driven milieu as a supply chain. For example, Pettigrew & Fenton (2000) have examined innovative forms of organising through the lens of complexities and dualities. Furthermore it is suggested that the present trend to juxtapose "culture" and climate" in the lexicon of innovation research requires further debate for no thesaurus will suggest climate as a synonym for culture. The empirical evidence provided here of bricolage in IS innovation proposes that this phenomenon must be included in the design of large cross-organisational information systems and the software applications that service them. In particular, this study supports the argument that many of the processes embedded in databases such as Lotus Notes facilitates tight control and robust procedures but often at the expense of agility and responsiveness. It is also proposed that this longitudinal study will address a major gap identified by Igoe (2006) that "whilst there is much support *theoretically* for the pursuit of initiatives" in the study of MNC subsidiaries there "is a dearth of evidence as to the implications of initiative-taking upon subsidiary development" in the Irish context. However, it is recognised that the work has limitations due the present early phase in the longitudinal time-frame and the lack of reference to the theoretical literature on MNC subsidiaries. Furthermore, additional interviews and evidence gathering is required on the theme of innovation in the Irish Operations supply chain beyond the current focus on the "Lean team".

## 6 CONCLUSIONS

This paper has presented a number of observations and findings from an ongoing study of supply chain innovation in a subsidiary of the APC Corporation located in the West of Ireland. The study has aimed to meet the focus on rigour and relevance outlined in the conference theme. Rigour was pursued in two ways: building on established research and theory in the area of lean supply, innovative organisations and information systems implementation together with a detailed presentation of the research design, methodology and limitations. The work claims relevance by proposing to make a contribution in a number of areas:

- Understanding of the role of an MNC supply chain during a critical period: a time of national economic transition and throughout a corporate merger.
- Explaining the role of innovation in contributing to the sustainability and development of an MNC subsidiary in this region.
- Building on Wolfe's (1994) suggestion for further research on Organizational Innovativeness (OI) by uniquely addressing the determinants of innovativeness in terms of *tuning*<sup>1</sup> the oscillations of paradoxes and "opposing logics".
- Providing empirical evidence of an organizational transformation and of information systems bricolage in the context of the case study.

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<sup>1</sup> Tuning in this usage is taken from PID (proportional- integral-derivative) control systems theory. While the underlying mathematical concepts and algorithms are quite complex, the process of tuning the feedback loop to keep the process running smoothly is regarded by many as an art. Feedback control theory has also been applied in the social sciences.

The work is at the early stages of a longitudinal study and will be developed further through continued close involvement in the case, additional semi-structured interviews on the subject of innovation among the wider subsidiary population and by expanding the theoretical lens to such areas as “subsidiary specific advantage”. The authors are also optimistic that this work will make a worthwhile input to the research and debate on the role of industry-academic collaboration, which is increasingly being called for in Ireland’s evolving business environment.

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