The Importance of Relationships and Networks for Successful Radical Innovation

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INTRODUCTION

The corporate importance of new products is well documented (e.g. Craig and Hart, 1992). This importance has encouraged a great deal of research activity looking at the activities for developing and launching successful new products (e.g. Hart et al 2003). A review of the literature highlights significant amounts of research on continuous improvement; however, research on radical innovation is more scant (Christensen & Overdorf 2000, Danneels 2004). This is incongruous with the impact that radical innovation can have upon mainstream markets due to its paradigm-shifting characteristics. Hamel (2000), McAdam & McConvery (2004) and Perks and Wong (2003) all argue that businesses need to conduct more radical "Business Concept / Strategy Innovation" as the market becomes more welcoming to industry revolutionaries and less receptive to incumbent business, due to social-change, globalisation, economic changes, technological upheaval and deregulation. Hamel goes on to argue that to ensure success, companies must revolutionise their basic strategies by redefining the market space, redrawing the industrial boundaries and ensure that their services and products are radically reconceived (not just developing new products or services). The barriers to radical innovation are also the most challenging to understand and overcome – being based not just on creativity and the knowledge of workers, but also on the ability to manage the long-lead time from inception to production and the ability to develop and manage complex relationships, both internal and external to the organisation.

Prior research in the new product development (NPD) field has shown that the project and organisational requirements for radical and incremental new products vary (Booz, Allen & Hamilton, 1982). The extant literature on NPD emphasises the role that cross-functional coordination and integration play in securing successful new product outcomes (Griffin and Hauser 1994, 1996; Cooper 1979), and particularly cross-functional integration that extends beyond company boundaries to include key suppliers, users and/or collaborating partners (e.g., Ragatz, Handfield and Scannell 1997; Jassawalla and Sashittal 1998 ; Athaide, Meyers, and Wilemon 1996). This is particularly true for radical innovations, which call for stronger working partnerships between participants, who may well have to work harder to enforce closer cooperation for the launch of radical new products than for launching incrementally new products to the market place.

A recent literature review on innovation and networks confirms the linkages between effective use of networks and innovation success and identifies that further work is required particularly to distinguish between different sorts of innovation (Pittaway et al., 2004). Veryzer (1998) argues that the managerial and organisational competencies and tools required for radical new product innovation may well be different to those required for incremental innovation. Rice et al (2002) argue that the relationship between suppliers and customers change considerably as a result of discontinuous innovation. All of these studies provide support for the idea that relationships and networks are an important consideration in the development of radical new products.

Relationship marketing has emerged as one of the dominant paradigms of marketing (Baker, 1995; Kotler, 1991) and is defined as the set of marketing activities oriented towards establishing, developing and maintaining relational exchanges (Morgan and Hunt, 1994). It is concerned with dyadic and multilateral relationships as well as networks of relationships (Eiriz and Wilson, 2006; Håkansson and Snehota, 1995).

Research into business relationships has been conducted for many years (Ford, 1980; Håkansson, 1982; Dwyer et al., 1987). Business activities between organisations occur through an interactive process between suppliers and customers (Pelton et al., 1999; Ford, 1997; Czepiel, 1990; Turnbull and Valla, 1988), rather than by active sellers attempting to manipulate passive buyers. The ultimate aim of these relationships is the delivery of win-win outcomes for participating partners. Ford et al. (2003) argue that companies should continually assess their actions, intentions and relationships with competitors, facilitators, customers, suppliers or development partners to maintain effective networks and ensure survival.

The present work is concerned with how organisations develop and manage the complex networks and relationships involved in developing and bringing radical new products to market in a mature industry; the automotive industry. The study adopts a multi-disciplinary approach (identified as imperative by Danneels, 2006) through the involvement of researchers from engineering, design, and business. The aims of the research are: to understand the relationships and broader knowledge networks that exist within the UK automotive industry; explore whether different relationships are utilised in developing les radical versus more radical innovations; to explore whether intermediaries (Trade Associations or public sector) are significant players in innovation networks and how they support companies; to examine how companies keep aware of, and ready for, the impact of future technology requirements; and to identify how new entrants develop the relationships necessary to move into a new market.

LITERATURE REVIEW

Innovation

A robust and constructive relationship between a company's continued market success and its tendency to innovate underpins the considerable literature in NPD and innovation (Hart 1993). The literature covers a multitude of disciplines associated with innovation and NPD, including: Engineering, design, economics, management and marketing. Hill and Jones (1998) suggested that: "In many ways innovation is the single most important building block of competitive advantage … giving a company something unique that its competitors lack" (Hill & Jones 1998, p166). Tidd and colleagues (Tidd et al, 2001) contend that "unless organisations are prepared to renew their products and processes on a continuing basis their survival chances are seriously threatened." (p 12). However, not all products are successful. During Markides' (1998) examination of production innovation, it was calculated that approximately 38% of products failed to progress from original ideas to successful products.

The literature has highlighted different types of innovation, which can be situated upon a continuum from product modifications and improvements through to radical innovations. Bessant and Grunt (1985) argued that innovation has tended to follow the typical pattern of radical innovation followed by a series of incremental innovation (Cosier & Hughes 2001). In other words, innovation experiences "alternate bursts of acceleration and steady development … [until the] … incremental innovation becomes more dominant as the industry matures." (Zairi 1995 p 33).

A review of the literature highlights that most attention has been focussed upon incremental innovation, where the products undergo a gradual change and developmental process. Continuous innovation is concerned with improving standards under current market conditions rather than altering the rudiments of competition. On the other hand, radical or discontinuous innovations create new industries, products or markets (Herbig, 1994; Meyer et al 1990). Radical innovation is an aggressive style of NPD based upon new rules to command external competitive behaviour and improve or strengthen existing internal processes (Zairi 1995). The technological advances are so significant that older technologies cannot compete regardless of any scale, efficiency or design improvements (Tushman and Anderson 1986).

What makes synthesis of this research particularly difficult is that the terminology used is not consistent. The research into more radical innovation use such terms as, "radical", "discontinuous" and "revolutionary" to describe what seems to be essentially the same concept. To some extent, the terminology used seems to depend upon the myriad of disciplines being researched. For example, the academics within the discipline of marketing tend to use the word "radical" to describe what engineers refer to as discontinuous innovations. Other words have also been used to describe what is essentially the opposite of incremental innovation, such as "non-linear" and "revolutionary" (Thomond & Lettice 2002, 2003). Even within the same research, authors have a tendency to move between terms when discussing their research findings. This is clearly seen in the work of Rice et al., (2001, 2002) and Liefer et al. (2000) and supported by others, e.g. Craig & Hart (1992), who argue that the terms are interchangeable.

Other researchers have also described innovation using terms such as sustaining and disruptive (e.g. Christensen, 1997), who advanced the concept of innovation by unpacking the attributes of impact and newness. Since new innovations do not always have a significant impact, Christensen differentiated between disruptive (discontinuous) and sustaining technologies. He argues that "Sustaining technologies … improve the performance of established products, along the dimensions of performance that mainstream customers in major markets have historically valued," [Christensen 1997 pg xv]; whereas "Disruptive technologies bring to a market a very different value proposition than had been available previously. Generally, disruptive technologies under perform established products in mainstream markets.

But they have other features that a few fringe (and generally new) customers value." [Christensen 1997 pg xv].

Thus, sustaining technologies improve the performance of established services, products or support traditional business models that are critical to maintaining, sustaining and enhancing a company's share of the mainstream markets (Baden-Fuller and Pitt 1996, Hill and Jones 1998). This definition seems closely aligned with those presented regarding incremental innovation. In contrast, disruptive innovation forms the basis of future technologies, services, products and industries (Tushman & Anderson 1986) and "restructures marketplace economics, displaces current products, and often creates entirely new product categories" (Rice et al 2002, p330). Even though these technologies may initially under-perform existing products, they ultimately undermine existing established products. They are paradigm shifting and enable the introduction of alternative business models to fundamentally change the way industries function. This is backed up by Zairi (1995) who argues that discontinuities assist in the innovative processes of organisations by changing structures and methods and stimulating creative thinking.

However, according to Christensen (1997), even though many organisations have successful records developing 'sustaining innovations', they may not have established track records for conducting successful disruptive innovation. In working to meet the demands of the mainstream market, many organisations find it difficult to explore potentially disruptive ideas. As a result, companies become disadvantaged due to limited capabilities, entrenched outlooks and confining structure, and hence, the creative thinking process is hindered (Christensen 1997, Hamel 2000, Overdorf 2000, Harborne & Johne 2003, Tushman & Anderson 1986). Hermann et al (2006) furthered these arguments by stating that the survival of companies was in jeopardy due to old technology-investments and resources, which hindered managers from adopting new technologies. According to Kanter (2001), radical innovation tends to result in significant changes to organisational routines and may also carry personal risk to the participants and leaders of incumbent businesses. Chandy and Tellis (2000) suggested that incumbent businesses are also subjected to constraints that do not apply to new entrants into the market-place. These constraints have resulted from the size of the company and its on-going organisational routines and bureaucracy. They also posited that radical innovation is used by new entrants when entering a market because the risk of not innovating is greater than that for incumbent companies. In other words, if new entrants do not innovate, then monetary targets and markets would not be achieved. Thus, incumbent companies focus upon cost reduction (process innovation) whilst younger or new companies are more likely to focus upon product innovation (Harborne & Johne 2003, Cohen & Klepper 1996).

Humble & Jones (1989) argue that radical innovation requires specialist staff and capabilities to develop projects outside of the current core activities of the business and its organisational structure, whereas incremental innovation is achieved through sustained toil and effort to improve every characteristic of the current process or product. This requirement for totally different competencies is also touched on by Markides and Geroski, (2005) who actually argue for large firms to create, sustain and nurture smaller start up firms who are more likely to have more entrepreneurial competencies, and then subsume them once the product is ready to expand beyond the original niche market

Govindarajan and Kopalle (2004; 2006), however, argue that "disruptive" is not a direct substitute for radical. Radical innovation refers to "the extent to which the innovation is based on a substantially new technology, relative to what already exists in the industry" (Govindarajan and Kopalle, 2006: 13). Whereas, disruptive innovation do this, but are also expected to under perform existing technologies, at least initially. It is clear that the definition of radical innovation encompasses disruptive innovations, but that not all radical innovations are disruptive. This research will focus on innovations that fit the radical innovation definition.

Relationship Marketing

The study of relationships has been undertaken utilising a number of different theories, such as transaction cost economics (Williamson, 1985), resource dependency theory (Pfeffer and Salancik, 1978), relational exchange theory (Dwyer et al., 1987) and models of business networks (Hakansson and Snehota, 1995). Social exchange theory provides a useful foundation for understanding business relationships because of its emphasis on the personal aspects of relationship development. Indeed, much of the language is very similar to that associated with personal relationships, such as marriage (e.g. Dwyer et al., 1987; Tynan, 1997). This stream of literature emphasises such concepts as trust, mutuality and co-operation (O'Malley and Tynan, 1999). Resource dependency theory has also been utilised to help explain the relative power between two entities based on the resources that they bring to the relationship (Emerson, 1962). It is based on the assumption that relationships are established as mechanisms that organisations utilise to gain access to the resources it needs to maintain its business. Its main contribution has been to explore the affect that resources have on the behaviour of firms involved in or initiating relationships, focusing on power and dependence. Both of these provide useful theoretical foundations for the present work.

One key stream of research on relationship marketing has been on the nature of business-to-business relationships, particularly those in the supply chain / channel management and networks (e.g. Ford, 1980; Håkansson, 1982; Johnston, 1986; Dwyer et al., 1987; Turnbull et al., 1996; Ford, 1997). Eiriz and Wilson (2006) conclude by suggesting that relationship marketing research needs to explore such key relationship variables as trust, commitment, adaptation, uncertainty, dependence and reciprocity (Dwyer et al, 1987; Wilson, 1995; Brennan and Turnbull, 1999; Cannon and Perrault, 1999). Other researchers identify other relationship variables such as integration (Sharma and Sheth, 1997), collaboration, co-operation, communication and conflict.

Trust is a basic feature in Relationship Marketing (Morgan and Hunt, 1994) and has been identified as important to the development and management of business relationship and networks (Håkansson and Snehota, 1995; Ford, 1997). Trust helps maintain commitment to a relationship (Ganesan, 1994; Geyskens et al., 1996), both of which are necessary for the development of an efficient, effective and productive relationship (Morgan and Hunt, 1994). In channel relationships, Geyskens et al. (1998) define trust as "a channel member's belief that one's partner is reliable, stands by its word, fulfils promised role obligations and is sincere ... and is motivated to seek joint gains". Furthermore, Hawes et al. (1989: p1) state, "Trust is a reciprocal relationship. A seller and buyer must trust each other in order for effective exchange to occur …". Smith and Barclay (1997) identify two key aspects to the development of mutual trust: trusting behaviours and perceived trustworthiness. Svensson (2006) refers to this as the dynamics of mutual trust.

Trust is often closely associated with commitment, an "implicit, or explicit, promise of relational continuity" (Dwyer et al., 1987). Commitment has been operationalised as willingness to invest, which comprises both financial investments and time and effort to maintain the relationship. An element of risk for the investing partner is involved, therefore a certain level of trust is required. Nevertheless, such investments can enhance the quality and longevity of the relationship and may even lead to further investments in the future (Handfield and Bechtel, 2002).

Anderson and Narus (1990) define co-operation as "co-ordinated actions to achieve mutual outcomes or singular outcomes with expected reciprocation over time" (p. 45). In the NPD literature, numerous terms have been used analogously to describe inter-functional contacts, such as integration, interaction, collaboration, cooperation, coordination, and teamwork. Integration and collaboration are often used interchangeably and are normally referred to as the coming together of diverse interests and people to achieve a common purpose via interactions, information sharing, and coordination of activities (Jassawalla and Sashittal 1998; Song, Montoya-Weiss, and Schmidt 1997; Souder and Moenaert 1992). Collaboration therefore implies groups or individuals working collectively with common goals, mutual respect and teamwork (Schrage 1990; Tjosvold 1988). Kahn (1996) conceptualises integration as encompassing both interaction and collaboration. According to Kahn (1996), interaction refers to information exchange or formal, transactional communication links, whereas collaboration entails the more informal, affective aspect of cooperative relationships. Mohr and Spekman (1994) also identify that successful partnerships exhibit higher communication quality and information exchange. Moreover, communication, in the form of formal and informal sharing of meaningful and timely information between firms (Anderson and Narus 1990), enables goal adjustment, task coordination, and inter-firm learning, hence enhancing channel partnerships. For communication to be effective, however, they must be bilateral (Jap et al., 1999). Communication and coordination are expected to be particularly important for radical innovation, because the uncertainty and unfamiliarity of radical NPD may increase the difficulty of project coordination and, thus, raise the likelihood of communication breakdowns.

Dependence is a central defining construct of buyer-supplier relationships (Håkansson, 1982). Ganesan (1994) identifies that relationships are more likely to fail when there is partner dependence is asymmetrical. This is because a misuse of power is much more likely to occur. The "exercise of power to gain acquiescence … destroys trust and commitment which decreases cooperation and inhibits long term success" (Morgan and Hunt, 1994: 35). Thus, it is important that transactions and goals are mutually beneficial (Hatton and Matthews, 1996).

Conflict is an inevitable part of any relationship (Dwyer et al., 1987), and can result in tension, hostility and bitterness (Morgan and Hunt, 1994) as well as a lack of satisfaction with the relationship (Frazier, Gill and Kale 1989; Anderson and Narus, 1984). However, some research has found that conflict can be positive if it is functional and leads to productive consequences. Mohr and Spekman (1994) identify that effective channel relationships have been found to demonstrate positive conflict resolution, including mutual problem solving and negotiation. They are also less likely to experience conflict if both parties have some influence in decision-making (Kim 2000, Schul et al, 1983). When business partnerships are based on trust, conflict is often then viewed as just another aspect of the business relationship (Anderson and Narus, 1990).

The age of the relationship is also likely to have an impact on the success of the NPD process because trust and expectations of relationship continuity have been shown to increase as relationships mature (Anderson and Weitz 1989), and that age enhances relationship quality (Kumar, Scheer,and Steenkamp, 1995).

CONTEXT

The UK automotive industry generates more than £20bn in overseas sales and is the UK's largest export sector. The industry is predicted by many to undergo radical changes, both technological and organisational, over the next decade, based on anticipated environmental and legislative drivers. The UK has set a national goal to move towards a reduction in CO_2 emissions to 20% below 1990 levels by 2010, which will lead to a significant proportion of new cars needing to emit zero CO_2. This has led to a focus on fuel cell technology. There have also been stringent targets on recycling and end-of-life initiatives, as well as introducing traffic management initiatives and techniques, which are likely to require the need for advanced electronics, "black-box" diagnostics systems and telematics. The Automotive Innovation and Growth Team (AIGT), created to assess the future of the motor industry in the UK, shows that both the government and the industry recognise the importance of disruptive technology and the need to be prepared. The findings from this discussion forum emphasised the benefits of mapping the key technologies that would underpin future vehicles and ensure that the existing supply chain is able to meet the demands (www.autoindustry.co.uk/automotive_unit/aigt)

Although there has been significant academic research on the automotive industry, this has tended to focus on incremental innovation initiatives such as continuous improvement and direct supply chain linkages, eg supplier improvement schemes (Perez & Sanchez 2003). Some related work on technology transfer and organisational learning along the supply chain, e.g. through supplier development, have been examined within the aerospace, defence and chemical industries (Bessant et al 2003, Bessant & Francis 2005, Reed & Walsh 2002) but with very limited reference to the automotive industry. The lack of focus on radical innovation in this industry and the environmental and legislative drivers affecting the industry make it a fruitful case study to look at discontinuous innovation. It is also interesting in terms of the networks to be studied as it will needs to encompass the complex interrelationships between companies, Trade Associations and public sector elements of the innovation system. Most recently in the UK this needs to include Regional Development Agencies (RDAs) and their public sector interventions.

METHODOLOGY

The project was undertaken in conjunction with eight project partners, with representation from a large global manufacturer, traditional and newer component supplier firms, an engineering consultancy firm, an industry trade association and a regional development agency.

This research was undertaken in a number of stages, the first being to determine specific technological cases for study. The tasks for this stage were to establish a list of historical, current and future technological innovations identified to be of strategic importance to the automotive industry and identify potential technologies for study from three different time periods to give the research a historically based perspective, information on currently available technologies (i.e. very recently introduced radical new products) and information on how relationships and networks are developing for a number of future technologies.

The choice of studying innovations from three different epochs was to provide a bench-mark to assess how relationships and networks have developed in the past and, therefore, how they may work in the future. This focus was to try to address an issue raised by Danneels (2006) who suggested research will be more valuable if it enables ex-ante predictions to be made. The future radical innovations chosen for study were based upon a review of publicly available documents (eg DfT/DTI "Carbon to hydrogen" roadmap for Passenger Cars" and the Foresight Vehicle Technology Roadmap), which provided a list of future technologies that were expected to start featuring in the industry over the coming years. In terms of the historical and current technologies, interviews were undertaken with the collaborating partners and other key industry contacts to develop and refine a list of technologies to study. The technologies identified for the three epochs were then presented to the collaborating partners during a focus group, and the outcome of the focus group was a list of key technology cases to study. Having identified the key technological changes, the second stage of the focus group used the same industry experts to help select the relevant case study companies, which included a mix of traditional automotive companies, suppliers entering the automotive market from other industries and new company start ups.

The third stage involved the main data collection, which was collected using in-depth interviews with senior level personnel (eg Technical Director, Managing Director and Chief Engineers) identified as appropriate by project partners and initial company consultation.

Each interview lasted approximately 1½ hours and was based on a semi-structured interview guide designed to explore: how aware the organisation was of technological issues facing them and the extent to which networks have either contributed to this awareness, or are being used in future planning, e.g. partnerships to acquire new technologies; how companies managed the development of the radical new products chosen, and the interactions with other stakeholders in getting the product to market; which required probing both supply chain relationships and broader network relationships, including both formal and informal communication channels. The interview data was supplemented with company documentation and written communications. The interview schedule was only used as a rough guide, enabling the interviewer to react to the individual situation, whilst following the stated themes and priorities of the research. The researchers reviewed the interviews during the course of the data collection to ensure that emerging themes were added to the schedule for subsequent interviews.

In total, eighteen in-depth interviews (some dyadic) were audiotaped and transcribed, so that interpretation was based upon full transcripts. The analysis strategy consisted of within-case analysis, followed by cross-case analysis and an iterative process of data interpretation, which was achieved through individual analysis by the three researchers, followed by group discussion and re-evaluation based on others interpretations. All analysis of the data collected was conducted using the key findings from the continuous improvement literature as a bench-mark against which the key themes arising from the research data were cross-referenced. This process identified a series of key themes and areas of interest.

RESULTS

In terms of the comparison between incremental and radical innovation, the data has highlighted substantive differences between the two in terms of the key relationship and process factors identified.

In many instances, new ideas were originated from the suppliers, who utilised the concept of technology push to market their new products. This is different to continuous/incremental improvement, where less radical ideas tend to originate from all members of the supply chain (Story et al., 2001), but fits with the arguments made by Markides and Geroski, 2005). This finding clearly suggests that car manufacturers should focus attention on their supply chain when attempting to identify future innovations. They should also work on keeping open, cordial relationships with these suppliers to ensure that the suppliers offer them first pick of important new product developments.

In contrast to less radical new product developments, where most products are developed following highly controlled processes, the radical new products investigated were managed in a way that tended to circumvent the traditional protocols or formal processes set up by organisations for the development of new products. This was done through utilising pre-existing relationships with individuals in the 'right' places to talk through proposals that were due to go to formal meetings. Many of the respondents describe a process of communicating with important influencers before any formal communication occurred - "open channels of communication before the meeting" (Manufacturer). This suggests that the development of radical new products relies much more heavily on informal communication rather than formal communication mechanisms. Given, that informal communications rely much more heavily on social interaction (Harris et al., 2003), this highlights the importance of relationships to the development of more radical innovations.

Radical new product development also seem to involve a much bigger, broader network of people than is usually found during more incremental innovation, because more people need to be involved to make it happen. It is also clear that the decisions that are made regarding go- and no-go decisions during the development process, right from the initial idea through to deciding to go to market seem to be much more about the relationships between the individuals involved, rather than the more specific criteria normally seen in incremental innovations (Stagg et al., 2002). Reputation plays a key role; "It doesn't matter where you are in the structure, reputation, my reputation, others reputations were absolutely key" (Consulting firm 1). "It's not what you know, it's not who you know, its who knows you" (Manufacturer). Reputation, networks and relationships all interplayed with personal trust, "There was clearly trust there because they were prepared to take risks based on what I advised." (Consulting firm 2). This was backed up by another consultancy firm (1), a traditional component supplier (2), and a new component supplier (1). These findings clearly fit with the research presented by Svensson (2006), who highlights the multidimensionality of trust. Much of the trust shown here fits with the dimensions related to ability, competence, and faith. To a lesser extent corporate trust is also involved, "they know when we say something's good they believe us" (Traditional component supplier 1), and this was based on an organisation having shown prior competence/ability to deliver what they promised. Again, these findings are different to those regarding more incremental new product development, which relies heavily upon following documented policies, procedures and practices and institutional trust. This shows the importance of people in the radical new product development process, suggesting that firms wishing to pursue more radical innovation should focus on staff retention, satisfaction (because satisfied staff are more likely to exhibit behaviours that lead to the organisation being successful, such as behaving in a trustworthy manner – which will then in turn be interpreted as the organisation being trustworthy), and training (necessary to keep levels of knowledge/credibility up).

Despite the fact that, as prescribed by continuous innovation literature, matrix structures were being utilised (which is supposed to overcome barriers to working together to develop successful new products (e.g. Larson and Gobeli, 1989), a key barrier to innovation that was identified for these radical products was that conflict still existed between manufacturing and the R&D department – such statements as "It cannot be done" (Traditional component supplier) were used to describe the reaction to many radical new ideas presented. This suggests that for radical innovations to be successful, organisations should focus significant attention on ensuring that any participants in the process have bought into the multi-disciplinary culture. In addition, a key external barrier that was identified was one based upon a more individual level jealousy, which created a "Not invented here" syndrome (Consulting firm 1). A number of respondents went even further to articulate how important understanding the barriers were to ensure that discontinuous innovation succeeds. "Importance of defining barriers to implementation and how to overcome these …. If you can define the barrier you are getting somewhere. When you don't know what the barrier is, you know you are out in the dark". (Manufacturer) This suggests that organisations undertaking radical innovation should work much harder at developing relationships between the different departments to improve cross-disciplinary communication and understanding.

The one key similarity between continuous and discontinuous innovation could be seen where pre-existing relationship were involved, i.e. between current suppliers and customers (manufacturers). Some suppliers were considered partners, with the manufacturer spending time nurturing and developing a good working relationship, whereas other suppliers experience a very different relationship, with the manufacturer taking a much more antagonistic role, using "bullying" tactics to persuade suppliers to meet their demands. What is interesting here is that manufacturers display a range of relationships, from clear functional partnerships to power based relationships (Emerson, 1962) using their position with regard to resources and control to push a second firm to produce a product to meet their demands. This is based on them wanting to ensure that they remain more powerful, i.e. have a choice of suppliers for the delivery of the new product. This power play by manufacturers runs completely counter to what true relationships are supposed to be about: trust, co-operation, and mutuality, and is likely to have damaging effects on their inter-organisational relationships (e.g. lower satisfaction). It is also unlikely to deliver win-win scenarios as stability of relationships is regarded as a prerequisite for economic rewards (Weitz and Jap, 1995). However, work by Backhaus and Buschken (1999), in their study of German car suppliers, identify stable relationships, despite levels of dissatisfaction based on asymmetric power relationships, that do deliver benefits to both parties. These findings also seem in contrast to the work by Fearne and Hughes (1999) who found that exchange of innovative ideas and solutions provides increased motivation for partners to remain within a relationship. In the automotive industry, it seems that in some cases ideas are exchanged but only to demand that a supplier develop a solution, which allows two partners to continue working together and having a relationship, but does not seem to provide the same motives to stay in the relationship as Fearne and Hughes seem to be discussing. In both cases, the manufacturers seemed to take a very patriarchal role, using patronising attitudes, e.g. "Patted them on the head" (Manufacturer). The key link between whether the relationship was nurturing or antagonistic seemed to be clearly linked to relationships between individuals within the organisations. This suggests that supplier organisations should work to develop more positive relationships with the manufacturers that they think are likely to be their most productive partner.

Many of the new ideas or new opportunities developed by new entrants were only successful through luck/being at the right place at the right time, or through opportunities and introductions via industry intermediaries (such as SMMT). Typical quotes included: " … sometimes you almost need luck or naivety" (Traditional component supplier 2) or "We were at SAE (conference) and by chance GM Senior Technical Manager … was quite intrigued by the work". (New component supplier 2). New entrants to the marketplace and the supply-chain entered the marketplace either by working with existing suppliers to add credibility and / or working with intermediaries, such as industry bodies, to develop contacts. The findings of the research also show that these intermediaries (such as government, Regional Development Agencies (RDAs), industry bodies and independent consultancy business) have an important role in the development of radical innovations. They provide an important source of information to Small and Medium Enterprises (SMEs), under-funded individuals or even larger companies. They identify sources of funding, expertise and networks, set-up events and shows, which aid exposure and networking opportunities. This suggests that suppliers looking to come to market with radical new products may well be more successful if they seek support from intermediaries.

This situation sometimes enabled new entrants to completely by-pass the existing Tier structure (where manufacturers only talk to Tier 1 suppliers, Tier 1 talks to Tier 2 etc). This is in contrast to the findings of the continuous improvement literature, which suggests that these types of products are developed within the tier structure. This tends to suggest that the typical hierarchical structure that is fine for continuous improvement may well be inappropriate for progressing radical innovation. This finding, in conjunction with the one above regarding the different relationships between some suppliers and manufacturers, suggests that new entrants who chose to work with existing suppliers should be careful to pick those that have more positive relationships with the manufacturer.

The present work has shown that Christensen's sustaining and disruptive concepts are incomplete and under-developed. From the case-studies in the present work, it was seen that many radical new innovations within the automotive industry are very disruptive internally but in the marketplace are classed as sustaining, making them very difficult to categories using Christensen's terminology. A typical example is the move from Indirect Injection (IdI) to Direct Injection (DI) in small passenger diesels. The switch over from IdI to DI caused massive internal disruption due to shutting down manufacturing lines, changing over production and machines etc, however, the end-user of the vehicle did not experience any disruption but simply benefited from increased fuel economy. Christensen's definition of 'disruptive' innovations is that when the new product enters the marketplace, they may initially under-perform the existing technology but with on-going developments (i.e. continuous improvement) they would eventually outperform the existing technology, which would be either completely killed off or displaced to a niche market. However, this does not take account of products that are complex and made up of many interconnected components. What we have observed is that they do not generally get into the end product (Car) until they perform at least as well as the current technology, therefore, would never be classified as ‘disruptive’, even though they can be very disruptive to the industry. It is also not the case that the existing technologies end up killed off or displaced. Instead we observe a phenomenon of the ‘Empire Strikes Back’. In other words, traditional manufacturing routes and suppliers suddenly provide alternative solutions when new entrants to the marketplace attempt to displace them. A typical example is the steel industry’s response to their customer’s considering more radical aluminium or plastic bodywork. They immediately informed the car manufacturers that they could supply lighter-weight, more crash resistant, stronger and more durable steels that would match the new product. This highlights the key role that existing relationships have on the innovation process and how difficult it can be for new entrants to break into the market. The pre-existing relationship of the steel supplier meant that they were ‘tipped off’ about a potential threat, which allowed them to respond and because of the existing relationship, they were given preference over the new, more unknown product and company. It seems, current suppliers are often given notice of potential disruptive innovations being developed elsewhere, which allows them to provide alternative solutions when new entrants to the marketplace attempt to displace them. This phenomenon is in contrast to Christensen’s theory, who argues that incumbents will either be displaced into niche markets or totally removed from the existing marketplace. This suggests that further work is required to develop a sound understanding of the phenomenon of radical/disruptive innovation.

RESEARCH CONCLUSIONS

The interviews have provided rich information on the relationships and networks used by organisations during the development of radical innovations that has been derived from respondents with a wealth of knowledge and experience regarding the radical innovation process within the automotive industry. The project’s multidisciplinary approach has added significant value in terms of being able to engage in rich in-depth technical discussions with interviewees, based on engineering knowledge, and an ability to then contextualise this within a wider knowledge of networks and business relationships, based on the business knowledge of the research team.

The findings show that there are substantive differences in the processes between incremental and radical innovation, with relationships being far more important for the latter. They identify the importance of personal relationships between individuals based on trust and reputation and the fact that, whilst formal processes still exist for these projects, they tend to circumvent these reporting procedures through the use of informal communication.

The present work has also shown that Christensen’s sustaining and disruptive concepts are difficult to use. From the case-studies in the present work, it was seen that many radical new innovations within the automotive industry are very disruptive internally but in the marketplace are classed as sustaining. Christensen also argued that when new products entered the marketplace they may initially under-perform the existing technology but with on-going developments (ie continuous improvement) they eventually outperform the existing technology, which would be either completely killed off or displaced to a niche market. However, what we have observed is that they do not generally get into the end product (Car) until they perform at least as well as the current technology. They also show that the prior existence of strong relationships mean that supplier firms are often given a warning of imminent technology changes and given an opportunity to respond, showing the importance of suppliers working towards the development of stable stage relationships with manufacturers.

One potential limitation of the study is the impact that environmental uncertainty could have had, based on studying product developments from different time periods. Environmental uncertainty describes the unpredictability of the environment within which businesses operate and could be presumed to negatively impact on relationship quality (Kumar, Scheer and Steenkamp 1995). Organizational and channel researchers have suggested that relationship partners face greater levels of perceived conflict and friction when environmental uncertainty increases (Achrol, Reve and Stern 1983) . Moreover, in highly unstable environments, the quality of the relationship between partners will exert less influence upon partnership outcomes as firms have less control over such outcomes (Kumar, Scheer and Steenkamp 1995). Therefore, potential differences identified could be related to differing levels of uncertainty encountered.

Future research should, therefore, focus on confirming the findings of this exploratory qualitative study, as well as delve deeper into how these relationships and networks develop. The small amount of dyadic data collected confirms the need to take a dyadic perspective to understanding these relationships, and it is also recommended that multiple perspectives are taken from within the firms being studied. The research has also highlighted the need to develop a suitable taxonomy to fully integrate all the different terminology that has been used to date and to aid the classification and research of different types of innovation to produce valuable insights for business.

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