

DISCONTINUOUS INNOVATION: A CHALLENGE FOR PURCHASING

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ABSTRACT

Purpose of this paper

This paper investigates the question: *What are the challenges to the purchasing function when faced with discontinuous innovation?* The paper defines discontinuous innovation, differentiating it from other forms of innovation, and discusses the challenges for the purchasing function involved in the discontinuous innovation process.

Design/methodology/approach

The paper reviews and analyses the existing literature on purchasing involvement in incremental and discontinuous innovation. Analysing existing research on early supplier - and early purchasing - involvement in new product development and innovation, we develop conceptual frameworks to further the understanding of, and radically rethink, the role of purchasing involvement in innovations of different degrees of change.

Findings

The typology highlights some important challenges for the purchasing function when faced with discontinuous rather than the more common incremental innovation challenge. In particular, our analysis of the literature suggests that both Early Supplier involvement (ESI) and Early Purchasing Involvement (EPI) practices need to be reconsidered when applied to discontinuous innovation.

Research limitations/implications

The paper is conceptual so does not rely on an empirical study conducted for the purpose of addressing our specific research question. Nevertheless, on the basis of analysis of the existing literature we suggest discontinuous innovation calls for a fundamental rethink of established ESI and EPI practices.

Practical implications (if applicable)

Purchasing functions are advised to widen their search and selection environments for completely new technologies, scanning outside existing supply relationships and supply chains. Purchasing should be involved particularly early in the sourcing process, before any specific project has even been formally started. Short-term supplier relationships or dalliances should be developed. Ask new suppliers for solutions instead of informing suppliers of well-defined specifications.

What is original/value of paper

The paper examines a well-established field (ESI) and an emerging related field (EPI). Focusing on the challenges of discontinuous innovation, we suggest that both ESI and EPI practices need to be fundamentally reconsidered when applied to discontinuous innovation.

Keywords: discontinuous innovation, purchasing, EPI, ambidexterity, absorptive capacity

1. INTRODUCTION

A plethora of research has evolved over the last 25 years concerning early supplier involvement (ESI) in new product development (NPD) (Johnsen, 2009). This body of research has demonstrated that suppliers are critical sources of innovation and that collaborating with suppliers as part of the product innovation process enables innovating companies to capitalize on suppliers' complementary capabilities and thereby improve innovation performance (e.g. (Petersen *et al.*, 2005; van Echtelt *et al.*, 2008).

Various organizational functions interact with suppliers as part of the innovation process activities, especially purchasing which can perform an important go-between function and facilitate ESI processes (Wynstra *et al.*, 2000; Lakemond *et al.*, 2001). However, although it is more than 30 years ago that Farmer (1981) explored the need for purchasing to be involved in NPD, in comparison with ESI far less research has evolved on the benefits and challenges of early purchasing involvement (EPI). Schiele (2010) has defined the scope of EPI research by studies analysing the role of purchasing as well as factors that lead to purchasing becoming part of NPD teams, such as the skill level of the purchasers and top management commitment (Atuahene-Gima, 1995; Nijssen *et al.*, 2002).

In addition to a gap in current research on purchasing, as opposed to supplier involvement, a complementary gap exists in research on product innovation that involves radical, discontinuous change. Recent research has begun to investigate the role and relevance of ESI in radical product innovation but the EPI research to date has focused predominantly on incremental NPD rather than innovation involving significant degree of change. This suggests a critical research gap because recent research on supplier involvement in NPD has begun to question the relevance of ESI in radical product innovation. For example, Song and Parry (1999), Ragatz *et al.* (2002), Primo and Amundson (2002) and Song and Benedetto (2008) have explored the role of ESI in projects characterized by high technological uncertainty. Although these studies show some disagreement, research is beginning to evolve suggesting that existing suppliers may be less important than new suppliers in conditions of technology uncertainty i.e. radical innovation. Bessant *et al.* (2005) and Phillips *et al.* (2006) explored the role of suppliers in *discontinuous innovation*; in other words innovations that fundamentally break with existing technological paradigms (Martin, 1984), suggesting that long-term stable supplier partnerships may have limited innovative potential; supplier "dalliances" (new unknown suppliers) rather than alliances are required. Their research suggests that conventional ESI practices may therefore be the wrong strategy if companies want to pursue discontinuous innovation. Very little research exists that have explored how discontinuous innovation may change the need for ESI and the role of purchasing in facilitating this process is more or less entirely unknown a represents and major research gap. In particular, it seems that there may be contradictory requirements for purchasing, and supplier involvement, when facing radically different innovation challenges.

Addressing this gap in current research, this paper investigates the question: *What are the challenges to the purchasing function when faced with discontinuous innovation?* We explore the role of purchasing in discontinuous innovation, discussing the existing literature and identifying differences between the role of purchasing in incremental innovation and its role in discontinuous innovation.

The paper begins by defining innovation, identifying the differences between radical, discontinuous and disruptive innovation. The paper reviews the existing literature on the role of purchasing in innovation (including EPI), focusing on organizational challenges, especially the relevance of ambidexterity, and constructs a typology identifying the role of purchasing in

innovations of different degrees of change. The paper concludes by outlining conceptual and managerial contributions and a future research agenda.

2. RADICAL, DISCONTINUOUS, OR DISRUPTIVE INNOVATION?

In order to develop an understanding of what is meant by the term discontinuous innovation and how it differs from disruptive and radical innovation, we conducted a review of the literature on innovation management. The review was based on peer-reviewed articles gathered from Proquest, a comprehensive electronic database covering to over 10,000 articles. ProQuest was selected for its high quality indexing and abstracting which supports precise searching, resulting in a high proportion of relevant hits. In line with recommendations proposed by Tranfield *et al* (2003), a review panel was established to define the scope of the study and support the process of study selection. A set of characteristics were identified to support the selection of relevant material and the retrieved articles were reviewed according to the quality review criteria identified by Pittaway *et al* (2004) to ensure the selection of high quality texts.

“Innovation is the introduction of a new product, process, system or device – to be distinguished from invention which is a new idea, a sketch, or model for a new improved device, product, process, or system.” (Freeman, 1992). The concepts of change and newness are therefore central to understanding innovation. However, the terms ‘product innovation’ and ‘(new) product development’ appear to be used interchangeably in the literature; often product innovation implies a higher degree of product change than NPD (Hart, 1996) but it is not a clear cut definition as innovation takes account of both small and large degrees of change.

Research into the management of innovation has focused on open innovation (Chesbrough 2003). In order to deal with today’s rapid changes in its external environment the innovation process has become collective and combinatorial (Coombs and Metcalfe, 2000) in character and emphasis has shifted towards firms’ external relationships as a means of accessing and acquiring new capabilities. Through increased collaboration and co-operation with other firms, the firm is able to access a further range of capabilities and create a ‘pool of resources’ (Loasby, 1994).

Discontinuous innovations should not be confused with, or considered being akin to radical innovations; the two are discrete and different. In developing an understanding of discontinuous innovation, Kassicieh *et al* (2002) imply discontinuous innovations stimulate the development of a new technological paradigm. Looking to other literature in the field, it is evident that discontinuous innovations involve a paradigm shift and in doing so are often competence-destroying (Olleros, 1986; Dowd and Walsh, 1998; Veryzer, 1998; Rice *et al*, 2000; DeTienne and Koberg, 2002; Kassicieh *et al*, 2002; Rothaermal, 2002) requiring firms to reconsider the knowledge and skills they have available to them and set about developing or acquiring new ones. Discontinuous innovations also require behavioural changes both within an organisation (Martinich, 2002) and also the market, which may be unfamiliar with the product and its application (Mascitelli, 2000, Veryzer, 1998).

Building on our findings, we propose that radical innovations involve the development of a new technological paradigm that creates new knowledge and understanding and potentially new industrial sectors. This, in turn, has a significant impact on the firm in terms of establishing new competencies and skills that are appropriate for the technologies and innovations associated with this paradigm (O’Connor and Veryzer, 2001; Rice *et al*, 2000). As O’Connor and Veryzer point out, radical innovation:

“...creates a new line of business – new for both the business and the marketplace.”
(O’Connor and Veryzer, 2001)

In contrast, discontinuous innovations involve a paradigm shift - a move across to an existing technological paradigm. This does not require the development of new knowledge or skills but rather the application of existing knowledge in an alternative field or sector. For example, Danish medical devices company Coloplast hired an astrophysicist to help think about products of the future, which enabled them to apply a different mindset to help them identify how they could employ their existing capabilities in alternative ways (Bessant and von Stamm, 2007). For the firm this will involve acquiring the necessary competencies and skills and adjusting the mindset of the organisation to view its technological base in a new or different light. As Linton (2002) highlights: “*disruptive technologies are discontinuous, but discontinuous technologies are not necessarily disruptive*”

Continuing with this theme, we suggest that disruptive innovations are context specific particularly in terms of experience. In other words, although they are discontinuous they are only deemed disruptive when the adopter has no experience of the technology and must alter their behaviour or viewpoint in order to benefit from the technology (Veryzer, 1998). For incumbents, a discontinuous innovation becomes a disruptive one when they are unprepared and surprised by the emergence of an emerging discontinuous innovation, or lack the necessary experience to cope, requiring the necessary competencies and skills to either exploit or counteract this technology. This is supported by Tripsas (1997) and Rothaermal (2002) who reveal incumbents’ survival is more likely if they have the necessary complementary assets required to commercialise the innovation.

From further research into disruptive innovations, we contend that the focus of analysis is primarily the end-user or customer (Abernathy and Clark, 1985; Moore, 1991; Bower and Christensen, 1995; Christensen, 1997). We interpret from this that a disruptive innovation is not disruptive *per se* to the firm but more so to the customer and market, altering end-users perception of a product in terms of performance, value and their willingness to pay for added features. This has a knock-on effect on an industry or sector, as customer preference moves away from the current market leader towards the producer of the emerging disruptive innovation. For example, Dyson’s dual cyclone vacuum cleaner may not have seemed like a radical innovation in terms of new technology, but it disrupted the existing business model of vacuum cleaners, making vacuum cleaners with bags that need replaced when full, redundant. For incumbents, a discontinuous innovation becomes disruptive when they are unprepared and surprised by its emergence, or lack the necessary experience to cope, requiring the new competencies and skills to either exploit or counteract the innovation. This is supported by Tripsas (1997) and Rothaermal (2002) who reveal incumbents’ survival is more likely if they do have the necessary complementary assets required to commercialize the innovation.

In the Innovator’s Dilemma, Christensen (1997) proposes that the close linkages between organisations within the same value network may prevent firms from perceiving the threat of a potentially disruptive technology. This relates to the work of Abernathy and Clark (1985) which addresses the difficulties that firms face when changing their broader capabilities when confronted with discontinuous conditions. Phillips *et al.* (2006a) have adapted Abernathy and Clarks’ model in order to better understand the explored the role of suppliers in discontinuous innovation. Abernathy and Clark’s identification of *regular* innovation, in which existing competencies and relationships may suffice, indicates the need for customers and suppliers to work together (not necessarily equally) for continuous improvement. Where competencies must be replaced but existing relationships are considered able to support such change,

Clark's *revolutionary* innovation is present. *Niche creation* means finding new outlets for existing strengths. When a firm seeks to disrupt a marketplace, or must respond to another firm doing so, it may be necessary to replace both competencies and supply relationships. This is Abernathy and Clark's *architectural* state, the extreme case equating to discontinuous innovation; here Phillips *et al.* (2006a) propose the need for strategic dalliances' – in contrast to alliances, dalliances are short term, high diversity encounters amongst players in an emerging new network (ibid).

3. THE ROLE OF PURCHASING IN DISCONTINUOUS INNOVATION

As identified earlier there is relatively little research on EPI and hardly any research on the role of purchasing in discontinuous innovation. We begin this section by briefly outlining some of the major conclusions from extant research into purchasing and innovation, including EPI, before a discussion of the organizational challenges that stem from companies having to manage both, incremental and discontinuous innovation, rather than one or the other.

Burt and Soukup (1985) identified six points in the design process where purchasing should provide information and advice to engineering. In their description, purchasing does not only appear as a facilitator between NPD projects and supplier development ability, but they are also a contributor *per se*. For example, in the investigative phase, purchasing can provide information about cost, performance, market availability, quality, and reliability of components that suppliers can furnish. Thus, their unique knowledge of the supply market and the high level of interaction with other functions involved in NPD give to buyers a unique opportunity to facilitate the transfer of both supply needs and supplier needs. Crozier and Friedberg (1977) define such a boundary-spanning role as “marginal-secant” - “the position of an actor that is the stakeholder of different systems of action, playing the role of a go-between and interpreter” (p 86). They suggest that in a steady state of the environment, the importance of this role is low; however, when they faced uncertainty and discontinuity, such actors gain importance and power within the organisation. The concept of *absorptive capacity* developed by Cohen and Levinthal (1990) gives an interesting guideline to analyse this boundary-spanning challenge.

3.1. The Role of Purchasing in Development of Absorptive Capacity

A key challenge of innovation is to recognise the value of new, external information, assimilate it, and apply it to commercial ends. This corresponds to the well-known definition of *absorptive capacity* by Cohen and Levinthal (1990) i.e. the ability to appropriate external knowledge in order to transform it into new products. An important message here is that external collaboration does not work effectively without extensive internal effort. In order to gain competitive advantage from external resources, managers should “Ask not what your suppliers can do for you; ask what you can do *with* your suppliers” (Takeishi, 2001, p. 419). Zarah and George (2002) define absorptive capacity as a set of organisational routines and processes, by which firms *acquire, assimilate, transform, and exploit* external knowledge to produce a new offer. Interestingly, the process of acquiring, assimilating, transforming, and exploiting external knowledge resembles the stages of the innovation process: search, select, and implement, which in turn includes four sub-stages: acquire, execute, launch, and sustain (Tidd *et al.*, 2005). The absorptive capacity process is useful for our purpose as it focused specifically on internal functional requirements for managing external collaboration. The firm's absorptive capacity focuses, and depends, on individuals who stand at the crossroad of

the firm and the external environment. This is the reason why we consider that the absorptive capacity model is suitable for analysing the role of purchasing in the innovation process.

To perform their absorptive capacity, companies have begun to change their purchasing organization and developed organizational functions or roles such as “procurement engineers”, “advanced sourcing” or “new product buyer” (Schiele, 2010). However, it remains unclear whether these NPD-focused roles are also appropriate when innovation challenges switch from incremental to discontinuous innovation. In an incremental innovation context research suggests that 1) key supplier relationships be characterized by long term stable partnerships with known and trusted suppliers (Johnsen, 2009) and that 2) in the buyer’s project team we can usually find technical capabilities that assimilate supplier contributions due to the experiences in previous projects. In this case, as suggested in Figure 1, there is a limited role of purchasing in the process of acquisition and assimilation of external capabilities and a progressive role in the more operational process of transformation (i.e. the integration by the project team of the supplier knowledge) and exploitation (i.e. the ability to achieve the operational goal of the project in terms of *time to market* and target cost).

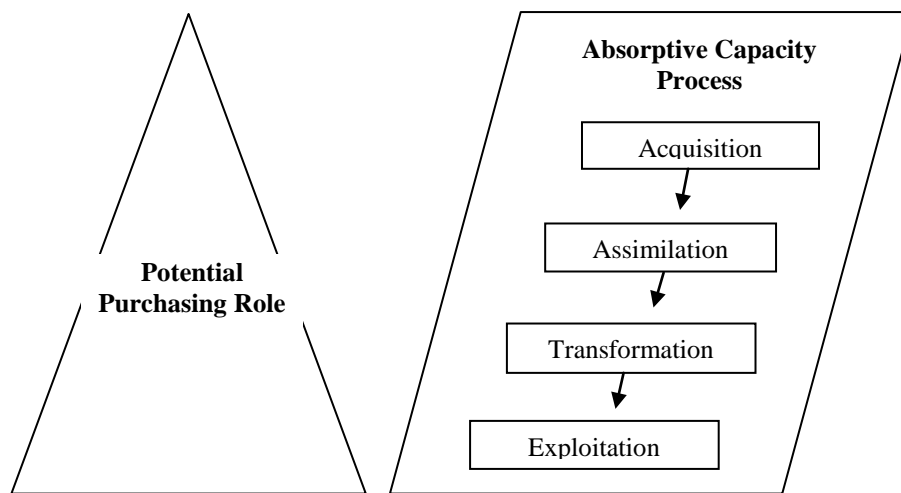


Figure 1. Purchasing’s potential absorptive capability role in incremental innovation context

In a discontinuous innovation context, emerging research (e.g. Bessant *et al.*, 2005; Phillips *et al.*, 2006), leads us to propose a reverse distribution of the role of purchasing within the absorptive capacity process. In this situation the existing supply base has limited innovative potential. As suggested by Bessant *et al.* (2005) and Phillips *et al.* (2006), discontinuous innovation changes the “rules of the game” and creates a need to look in unfamiliar “dark” areas and for companies to develop relationships with organisations from unfamiliar zones. Phillips *et al.* (2006a) propose that innovating companies seek to develop short-term supplier relationships, or “dalliances”, with actors that are located on the periphery or even outside the company’s usual perceived supply chain boundary. We can illustrate this idea as below where tier 1-3 suppliers exist within the existing (upstream) supply chain and where ‘unknown suppliers’ exist outside the existing supply chain periphery. The unknown suppliers could potentially provide critical sources of discontinuous innovation but are outside the company’s usual search and selection environment. As the company has little or no experience of collaborating with these potential innovation partners, they pose greater risk and cannot be managed the same way as existing long-term supply partners where trust has been built up over a long period of time.

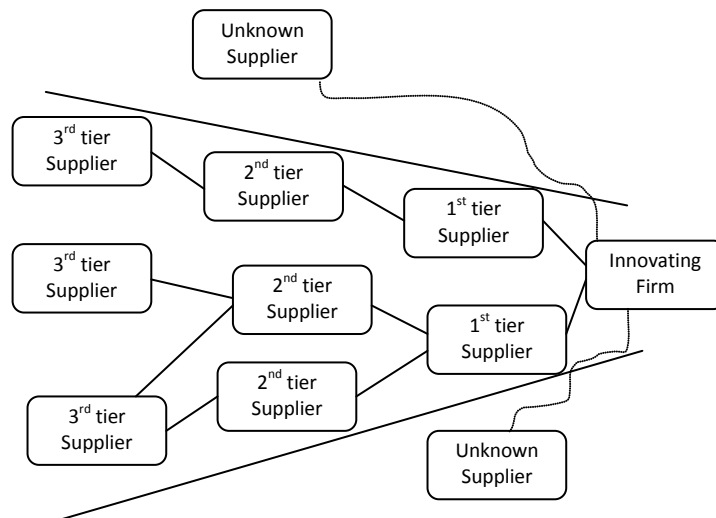


Figure 2. Distant sources of innovation: searching beyond the periphery

The idea of collaborating with new unknown suppliers is also supported by Primo and Amundson (2002) who suggest that existing suppliers may be less important under conditions of high technical novelty. This suggests that the purchasing role in the absorptive capacity process consists mainly in the activities of (new, distant) partner identification and the acquisition strategy (i.e. to define a fair contract and act in order to enhance the attractiveness of the firm to capture innovative suppliers). The role of purchasing during the *transformation* and *exploitation* process should be less important due to the novelty of the supplied functionality for the buyer's project team (Figure 3). In this situation research suggests that the supplier act mainly as a "black box" partner, and assume the role of leader in this phase requiring a highly interactive design process in order to challenge the customer's technical specifications (Karlsson *et al.*, 1998; Koufteros *et al.*, 2007).

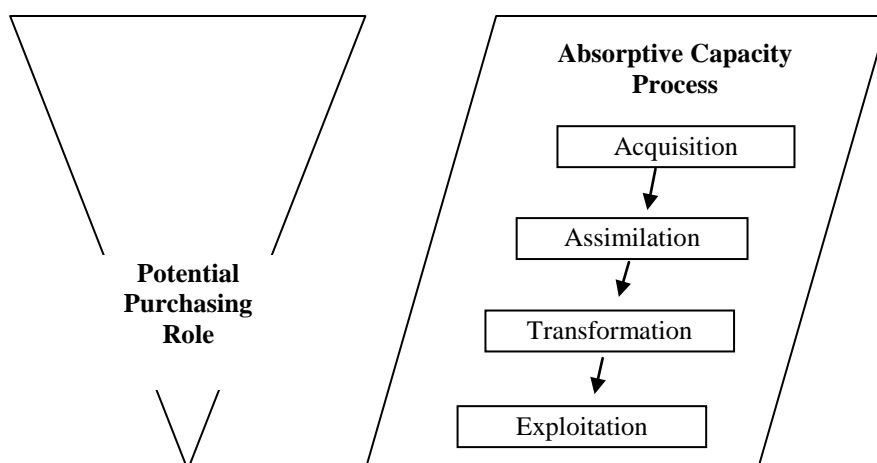


Figure 3. Purchasing's potential absorptive capability role in discontinuous innovation context

3.2. Organizing Purchasing for Discontinuous Innovation: the Ambidexterity Challenge

If at the project level we need to deal with different roles for the buyers involved in the project team contingent on the nature of innovation challenge (incremental or discontinuous), the question is also posed at an organisational level. Indeed, if the existence of a positive effect of ESI is becoming widely acknowledged firms seem to have a limited understanding of how to organize the inclusion of suppliers in NPD, especially in terms of the re-organization of the purchasing department (Schiele, 2010). Lakemond *et al.* (2001) provide an interesting contribution by identifying six configurations for involving purchasing in NPD mainly based on the degree of integration of the purchaser in the project ranging from “ad-hoc” to “formalized”. In their study, the main criterion explaining the choice of a specific configuration was project complexity in terms of the number and newness of technologies and size. Further contingent factors for the organisation of ESI include: the degree of responsibility delegated to the supplier (Le Dain *et al.*, 2010; Olausson *et al.*, 2009), the degree of task dependence (Lakemond, 2006) and the overall risk of the supplied component for the achievement of project objectives (Le Dain *et al.*, 2010). Others have suggested that the challenge of an “effective” organisation for ESI success is a matter of fit between the strategic management arena and the operational project management arena (Van Echtelt *et al.*, 2008). These two arenas are distinct yet strongly interrelated, so the effectiveness of a configuration for involving purchasing in NPD depends on the firm’s ability to capture both short-term and long-term benefits.


Schiele (2010) resumes the challenge of EPI by stressing its dual role: to support the process of innovation while maintaining cost and integration responsibility over the entire product life cycle. This duality suggests a classic *exploration* and *exploitation* paradox of organisation introduced by March (1991). He (*ibid*) suggested that exploration and exploitation are self-reinforcing, and because they compete for scarce resources, they tend to crowd each other out. So the challenge of *ambidexterity* is difficult for a function as intimately connected to the exploitation process as purchasing. Early ambidexterity models suggested that a structural separation of exploration and exploitation activities enables firms to pursue both simultaneously. Structural separation is necessary because individuals who have operational responsibilities cannot explore and exploit simultaneously, as dealing with such contradictory frames creates operational inconsistencies and implementation conflicts (Benner and Tushman, 2003; Gilbert, 2006). In a purchasing context, we can observe a possible distinction between a department called ‘advanced (or forward) sourcing’ and another department called ‘strategic sourcing’ (Calvi, 2000). The advanced sourcing team is integrated into all NPD projects while the strategic sourcing team has a stronger commercial focus and a connection with internal customers. Is this classic organisational response the best solution to the exploration and exploitation paradox? For O’Reilly and Tushman (2004) the effectiveness of organisation depends on the nature of the innovation effort sustained by the exploration process; discontinuous innovation requires a different organizational arrangement than incremental innovation. For example, BMW has divided its “advanced sourcing” department in two: one dedicated to support the NPD process and another dedicated to the scanning of their supply market for innovations.

In contrast to the authors who advocate the separation of exploration and exploitation, Gibson and Birkinshaw (2004) suggest that ambidexterity is something that should be present in the mind of each employee rather than being incorporated into the structure of the organization. They assert that ambidexterity is achieved by building an organizational context at the business unit level that emphasizes both performance management and social support. They assert that structural separation between exploration and exploitation units can lead to harmful

isolation, and frameworks that are based exclusively on organizational structure are top-down by nature. This is in line with the work of Phillips *et al.* (2006b) which highlights the difficulties of ambidexterity and the difficulties of building entrepreneurial activities within established firms where activities need to be integrated, to some degree, with the rest of the organisation. Instead they identify “intrapreneurship” (Buckland *et al.*, 2003) as an alternative to spin-outs or new venture group models.

Based on our analysis of the literature on the different roles of purchasing in incremental and discontinuous innovation, and the challenges posed by the different innovation context, we propose the following typology:

Table 1. Challenges for Purchasing in Incremental NPD vs. Discontinuous Innovation: A Typology

	Incremental		Discontinuous
<i>Early supplier & purchasing involvement (timing)</i>	Early involvement of key suppliers and purchasing function is critical i.e. during concept or feasibility development within NPD project		New suppliers bringing new, possibly disruptive, technologies could be involved before NPD project is even begun. Purchasing needs to be involved very early in sourcing process.
<i>Sourcing and supplier selection</i>	Search in existing supply chain: favour partners where trust has been created over long time		Search outside existing supply base Attract new unknown suppliers from other industries. Innovative capabilities of suppliers are particularly important
<i>Purchasing role in absorptive capacity process</i>	Purchasing contribute to the transformation and exploitation process		Purchasing contribute to the acquisition and assimilation process
<i>Supplier approval as part of innovation process</i>	Existing preferred suppliers should continuously be evaluated and approved on efficiency and ESI contributions.		New suppliers should bypass the standard supplier approval process in order to fast track their involvement
<i>Trust and commitment</i>	Long-term supplier relationships with trust, demonstrated by sharing of sensitive information.		Short-term supplier relationships, limited to duration of project Limited sensitive information shared. Easy to break off relationships
<i>Interdependence</i>	Partners must co-operate if their goals are to be achieved; other party is important business partner		Need for opportunistic behaviour; little need for interdependence
<i>Communication</i>	Open and multi-interface		Information-sharing limited to project
<i>Purchasing communication with suppliers</i>	Giving suppliers clear instructions through functional specifications		Asking suppliers for solutions
<i>Knowledge management and intellectual property protection</i>	Company possesses internal technology expertise and wants to control intellectual property		Supplier is undisputed technology expert and wants to control intellectual property for other customers.

4. CONCLUSIONS AND AVENUES OF FURTHER RESEARCH

This paper has investigated the question: *What are the challenges to the purchasing function when faced with discontinuous innovation?* We addressed this question by first of all defining discontinuous innovation in relation to radical and disruptive innovations. The paper discussed the existing literature on purchasing involvement in NPD and innovation and we put forward a typology identifying the role of purchasing involvement in innovations of incremental and discontinuous innovation. The typology highlights some important challenges for the purchasing function when faced with discontinuous rather than the more common incremental innovation challenge. In particular, our analysis of the literature suggests that both ESI and EPI practices need to be reconsidered when applied to discontinuous innovation. As these practices are generally very different from established ESI (see e.g. Petersen *et al.*, 2003, 2005; van Echtelt *et al.*, 2008) and EPI (e.g. Atuahene-Gima, 1995; Nijssen *et al.*, 2002) practices important conceptual implications are emerging, although Schiele (2010) also explored the dual role of purchasing in NPD (without going into details of discontinuous innovation).

Importantly, the timing of supplier involvement is likely to change; as purchasing plays a key facilitating role in ensuring supplier involvement this has important implications for the timing of purchasing involvement. We also suggest that for incremental innovation purchasing contribute extensively to the absorptive capacity transformation and exploitation process whereas for discontinuous innovation purchasing contribute more to the acquisition and assimilation process. This implies that for discontinuous innovation purchasing needs to play a key role in sourcing of new complementary technologies, often from outside existing supply chains. We expand on the challenges for purchasing with a more managerial focus in the following section.

4.1. Managerial Implications

The paper has identified that many companies have formalized the processes by which purchasers and suppliers should be involved in their (incremental) NPD projects. However, these processes may no longer be appropriate when the challenge switches from incremental to discontinuous innovation. Although models of best practice exist that define the rules of the game with respect to managing the innovation process, it is evident that even the best firms can stumble and fall, particularly when confronted with discontinuous conditions which may involve radically new or different technological capabilities or market linkages (Christensen and Rosenbloom, 1995; Christensen, 1997). Under such conditions operational routines and processes may fail and upstarts may seize the competitive advantage. Under “steady state” conditions close relationships and the development of strategic alliances are strongly propounded as a means of supporting the process of technological innovation (Lamming, 1993; Spekman *et al.*, 1998; Cavusgil *et al.*, 2003), enabling a continual flow of product and process innovation. However, discontinuous innovation requires “doing things differently” (Phillips *et al.*, 2006b); the process is highly explorative and experimental, involving “probing and learning rather than targeting and developing” (Rice *et al.*, 1998). Under such conditions the strong ties that support incremental innovation may break down and may prevent firms from sensing signals that may emerge from beyond their existing supply chain, in dark and unfamiliar selection environments (Phillips *et al.*, 2006a).

In conclusion, we suggest the following managerial practices for purchasing in discontinuous innovation:

- Search for completely new technologies and sources of knowledge and ideas outside existing supply relationships and supply chains.

- Prioritize innovative capabilities instead of low cost when selecting innovative suppliers from outside existing supply chains.
- Engage purchasing particularly early in the sourcing process, before any specific project has even been formally started.
- Develop short-term supplier relationships, limited to the duration of innovation project. Manage these relationships as important but not (initially) strategic partnerships. Therefore, share limited sensitive information and create limited interdependence. During this exploratory stage make sure it is easy to break off relationships so limit initial commitment and trust
- Ask new suppliers for solutions instead of informing suppliers of well-defined specifications. Consider bypassing the standard supplier approval process in order to fast track their involvement but continuously analyse potential risks of applying technologies unknown and untested within your own company and industry.

4.1. Further Avenues of Research

The literature review and the propositions indicate avenues of further research. There is clearly a need for further conceptual and empirical research on the role of purchasing within this context. The propositions and typology have been developed on the basis of existing research and we have included some purchasing aspects from existing research but there is clearly a need for much more research into this issue. Our future research plans are to explore empirically the propositions that are also captured in the initial typology with a view to provide rich examples of the process of managing purchasing, involvement in discontinuous innovation.

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