An empirical assessment of the link between Industrial Upgrading and firm innovativeness in China

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Abstract

Industrial upgrading (IU), is the stepwise development of manufacturing capabilities from simple to more complicated tasks. IU has proven to be a highly effective approach for late entrants in catching up with incumbents. In essence, IU relies on a sequential and paced approach to organizational learning to develop progressively more complicated industry-established practices. Whether this systematic learning of operational processes would allow latecomers to eventually learn to exploratively innovate is yet to be investigated. We propose and test a series of hypotheses using path analysis on a sample of 535 Chinese manufacturers. Supporting the notion of the cumulative sand cone model of manufacturing capabilities, we show that firms indeed progress from lower rungs of manufacturing and design to higher rungs. Furthermore, the results suggest that IU has a positive association with exploitative innovations. In turn, such exploitative innovations partially mediate the effect of IU on explorative innovations.

Keywords: Industrial Upgrading, cumulative capabilities, organizational learning, innovation

1. Background

For many late entrants, the evolutionary process of catching up with incumbents begins with delineating the production of easy-to-produce items. From there, late entrants may sequentially add higher value-adding activities such as assembly of more complex parts, design of components, and the manufacture of complete product lines into their portfolio of operations (Gereffi & Humphrey, 2005). Labeled as industrial upgrading (IU), the approach allows firms to progressively build on their organizational knowledge by starting from simple processes and then progress on to more complicated ones. IU has allowed many manufacturers in newly industrialized economies (NIEs) to rapidly move from assemblers to full-range package suppliers for foreign buyers (Gereffi, 1994) while shifting to more profitable and technologically sophisticated manufacturing tasks. For example, in just over two decades, electronics manufacturers in Singapore were able to gradually and systematically accumulate human, infrastructural and financial resources to move up the value chain in that industry (Hobday, 1994).

IU can help enhance one's profitability, bargaining power and network position (Gerefi & Tam, 1998). Firms that implement IU are able to make products that carry higher margins. They are better able to negotiate the terms of their contracts with buyers. Furthermore, they may be more strongly linked to focal firms in the supply chain, and can thereby enhance their position towards better potential gains. As an example, Taiwan's Acer group has been able to take on an intermediary role between global flagships such as IBM and Dell and local suppliers (Ernst, 2001).

Despite its promises, IU is not a simple proposition (Gereffi, 1999). IU requires the continued development of new skills alongside mastery of existing responsibilities. Firms using

IU need to constantly improve their knowledge base by tapping into, developing and retaining skilled human resources (Ernst & Kim, 2002). Substantial financial and capital resources also need to be dedicated to accumulating, assimilating and internalizing new technologies. Moreover, upgrading becomes more difficult as one moves up the competitive "value ladder" and as products and processes become more complicated. More complex products and processes supporting them carry more causal ambiguity, requiring increasingly higher learning effort to understand and internalize capabilities to make them (Zollo & Winter, 2002). In sum, IU requires a multifaceted process of accumulating, internally disseminating and applying new knowledge. Underlying IU is therefore a heavy reliance on organizational learning (Gerefi & Tam, 1998) albeit in incremental steps.

Whether IU, as a "catching up" approach, is an effective means for developing higher value added tasks has been demonstrated by much extant research (e.g. Gereffi, 1999; Sonobe et al., 2004; Saliola & Zanfei, 2009). Moreover, one would expect for the incremental accumulation of knowledge that is the underpinning of IU to lead to incremental innovations. What is less apparent is whether IU enhances the firm's ability to develop more distant innovations. In other words, whether the faster accumulation of established industry know-how can act as genesis for explorative innovations (Daneels, 2002; Benner & Tushman, 2003; Jansen et al., 2006) has yet to be explored. If the accrual of established industry practices through IU allows for enhanced generation of innovations, given this rapid pace of learning, we could expect latecomers to introduce innovations and increase novelty of their products. However, literature is silent on whether such incremental learning leads to more explorative innovations. As such we ask: *Does industrial upgrading lead to explorative innovations?*

To explain the effect of IU and its impact on innovation, we apply the theoretical explanations of dynamic capabilities (Teece & Pisano, 1994) and organizational learning theory (Levitt & March, 1988; March, 1991; Crossan et al., 1999). More specifically we consider IU as a means to enhance an organization's knowledge base through incremental learning. Following recent construal on dynamic capabilities (Helfat et al., 2007) we explore how the development of operational processes as a result of a deployed dynamic capability (e.g. IU) allows for the development of new dynamic capabilities (e.g. developing innovations).

The contribution of our work is two-fold. First, we test how IU, as a dynamic capability through which firms can enhance their operational processes, allows for systematic learning of increasingly complex operational processes. Second, we detail how exploitative learning can lead to more explorative innovations. Past literature on the relationship between explorative and exploitative learning and innovation is mixed, with some previous work modeling them as dichotomous ends to a continuum (see Gupta et al., 2006 for an overview of literature on these two learning styles). Our work here provides support on how exploitative learning can lead to innovations of the explorative form.

The remainder of the paper is as follows. We first look at the literature and explanations related to the IU concept. We then justify and explain our primary theoretical basis, namely the dynamic capabilities perspective. Next, we develop a series of hypotheses on how IU is implemented and how it relates to innovation performance of the firm using dynamic capabilities to provide the framework and organizational learning to provide the particulars of the relationships among IU, exploitative and explorative innovation. We test these hypotheses using path analysis of survey results from 535 Chinese manufacturers. Lastly, we present the methods and analytic strategy and lastly discuss the results and present the conclusion to the study.

2. Theoretical Background

2.1 Industrial Upgrading

Industrial upgrading (IU) involves pursuing subsequently more valuable capabilities in order to improve one's relative competitive position within the value chain. IU may involve developing more value added processes, creating more value added products or performing higher value-added activities. IU is implemented through a sequential and paced approach to developing operational processes, by allowing for the organization to learn from each process. In manufacturing plants, upgrading involves moving from "cheap to expensive items [and] from simple to complex products" (Gereffi, 1999; p. 52).

Perhaps an early example of IU is that of electronics production in Hong Kong, which began with local firms subcontracting radio assembly tasks from Sony in 1959. Assembly of television tuners and other low-end electronics products followed soon thereafter. Eventually, higher end transistors and chip assemblies became part of the portfolio of these manufacturers (Tsui-Auch, 1998). Similar stories are common among footwear companies in Taiwan, apparel manufacturers in Hong Kong and computer firms in Singapore who have made successful strides into higher value products, processes or manufacturing tasks in their value chain (Chang et al., 1999; Ernst & Kim, 2002; Chu, 2009). Pavlinek et al. (2009) report on IU in automotive manufacturers taking place in Central European countries and Kessler (1999) explains the importance of IU in developing sustainable garment-specific industrial clusters in Mexico

Despite a multitude of success stories, literature on the extent of usefulness of IU beyond the implementation of industry proven practices is mixed. Some suggest that the founding assumptions of IU (such as low financial requirements for entry and low labor costs), upon which many latecomers developed their capabilities, limit how useful IU is in terms of developing higher value added activities such as the design and development of new products (Ernst, 1998; Palpacuer et al., 2005). They point to some mature implementers of IU who have failed in taking on a leading role in terms of innovation in their industry (Hobday et al., 2004; Chu, 2009), even though their operational capabilities are at par with global standards. Others dispute the limitation argument and point to the past and recent success manifests of IU, such as the vast number of Chinese manufacturing firms who are already shifting away from reliance on outside technology and moving towards internally developing higher value added activities (Sonobe et al., 2004; Xie & White, 2006).

How IU leads to the ability to develop more complicated operational processes has been the subject of much research. Several conceptual models from manufacturing and international business fields have attempted to provide explanations on IU as a successful approach to accumulating capabilities, particularly for the NIE of Far East Asia. For example, Kim (1980) suggests for a three staged model, where latecomers would start by adopting certain external technology, move on to its assimilation with other capabilities and eventually to its improvement. Wortzel and Wortzel (1981) suggest for a similar model but in five stages including basic production, advanced production and multiple marketing stages. Chu (2009), building on previous works from Hobday (1995), suggests that firms in search of upgrading can start with an OEM (original equipment manufacturer) mode, where as preliminary subcontractors they act as assembly subcontractors, move on to an ODM (own design manufacture) mode where they perform some production, assembly and logistics, and eventually reach to an OBM (own brand manufacture) mode where they replace the buyer by conducting R&D, manufacturing and marketing tasks.

International business researchers would suggest that IU is a particular case of the “flying geese” phenomenon (Kojima, 2000; Ozawa, 2005). In the flying geese metaphor, firm capabilities rise and fall from acting as frontrunners. Just as the position of geese flying in formation is not fixed for any length of time, so do the relative position of organizational capabilities change (Korhonen, 1994). As a capability is mastered and is no longer considered to be the leading edge of competitive advantage, it drops back while other capabilities advance to the vertex of the formation.

Manufacturing strategy researchers would equate IU to that of the cumulative “sand cone” model. In their seminal paper, Ferdows and De Meyer (1990) use a sand cone metaphor to suggest how firms can improve their capabilities by starting with a specific set of capabilities and building others on them as they expand their knowledge base. Since the original conceptualization of the “cumulative” model, others have provided significant anecdotal and theoretical support to the cumulative sand cone model (Noble, 1995; Safizadeh et al., 1996; Grossler & Grubner, 2006). Others find empirical support for the cumulative model in different contexts such as the airline service industry (Laprée & Scudder, 2004) in a developing country (Amoako-Gyampah & Meredith, 2007). Although opinions vary, there seems to be general consensus that some capabilities occur prior to others (Flynn & Flynn, 2004). More specifically literature suggests that quality and cost capabilities precede flexibility and delivery capabilities (Schmenner & Swink, 1998). Furthermore, ample evidence suggests that the different capabilities are inter-related and can act to reinforce one another (e.g. White, 1996).

More recently, Rosenzweig and Roth (2004) provide further empirical proof on the cumulative model. Building on previous theoretical works by Roth related to a Competitive Progression Theory (Roth, 1996b; Roth, 1996a), these authors suggest for the synergies and commonalities among processes to allow firms to accumulate competitive capabilities. Our work here follows a similar methodological and theoretical approach to that taken by Rosenzweig and Roth (2004). Like their research, we use a primarily theoretical justification to explain how a series of inter-connected and inter-dependent activities lead to performance. One distinction between our work and the work of these fine scholars is that while they look at capabilities, we focus on operational processes such as component assembly, parts design and final product manufacturing.

Our review of the literature suggests for a set of underlying assumptions upon which the success of IU is justified. First, there is an implied sense of purpose by the organization that pursues IU. Firms that take on the objective of upgrading their capabilities are motivated by a need for betterment. Second, and perhaps more importantly, literature suggests that IU is implemented as a result of expected changes in the environment, where there are diminishing returns to merely competing based on one's current capabilities. Third, literature and conceptual explanations of IU suggest that manufacturers at the lower rungs of the "value ladder" recognize the diminishing returns facing them if they continue to conduct business as status quo. Lastly, explanations of the IU concept, including the "sandcone" and "flying geese" metaphors highlight the importance of organizational learning. Without substantial an organizational infrastructure that can support learning, implementation of IU seems hardly feasible.

These underlying assumptions suggest that explaining IU requires a theory that places focus on how firms modify their capabilities in order to respond to ever changing environmental conditions. Moreover, any chosen theory should highlight the importance of accumulated organizational learning as a means to develop capabilities that allow for competitive advantage. Lastly, a suitable theory needs to appropriately emphasize how firms develop and use capabilities that can help in responding to continued external change. These assumptions lead us to the concept of dynamic capabilities (Teece & Pisano, 1994) and the rich theoretical stream supporting the concept (Ambrosini & Bowman, 2009).

2.2 Dynamic Capabilities

Dynamic capabilities are learned and stable patterns of collective activity through which an organization systematically generates and modifies its operating routines in pursuit of improved effectiveness (Teece et al., 1997). Dynamic capabilities allow firms to adapt, integrate and reconfigure managerial and organizational capabilities (i.e. their processes), technological, intellectual and complementary assets (i.e. their positions) and strategic alternatives made available to them (i.e. their paths) match the requirements of a changing environment. As related to IU, the dynamic capabilities perspective posits that the pursuit of subsequently more value added operational processes allows for developing technological and intellectual assets within the organization. Perhaps more importantly, IU increases the number of strategic alternatives (i.e. paths) available to a firm and allows for enhanced position of the firm through technological, intellectual property, customer base and relationships with its suppliers and customers (Teece & Pisano, 1994). As such, the concept of IU is a dynamic capability that allows for a firm to develop new and upgraded operational processes which can enhance its performance.

How well a dynamic capability performs can be measured by how well it enhances the firm's fitness; or how it can enable the firm to "make a living by creating, extending or modifying its resource base" (Helfat, 1997; p. 121). Fitness is improved when dynamic capabilities help develop processes that are mutually supporting of one another. Reinforcing complementarities among such processes allows for developing "bundles" of capabilities, which are more difficult to imitate by others. In terms of IU, by leveraging the learning from each process step to the next, the firm is able to enhance its understanding and therefore its evolutionary fitness.

Organizational learning is the primary means for developing IU. Teece and Pisano (1994) suggest that through repetition and experimentation organizational learning enables firms to understand the mechanics behind each process and therefore perform them more effectively. However, there are other benefits to organizational learning in general and to repetition and experimentation in particular. First, the two learning mechanisms allow the firm to reconfigure the knowledge generated into new patterns. Moreover, repetition and experimentation help identify new opportunities that can make the firm better respond to market demands (Eisenhardt & Martin, 2000). Lastly, the interplay between repetition and experimentation develops "knowledge evolution cycles" (Zollo & Winter, 2002) that allows firms to develop new approaches. New approaches can help the firm better respond to its environment. In other words, repetition and experimentation provide means by which dynamic capabilities enhance the firm's evolutionary fitness through better understanding and through better executing each operational process.

Reflecting the literature on dynamic capabilities, Figure 1 suggests that the deployment of dynamic capabilities (such as IU) can lead to an evolutionary progression within which multiple operational processes are developed. These operational processes can interact to enhance one another which may lead to ensuing dynamic capabilities (such as product innovations) which help to enhance the evolutionary fitness of the firm. In sum, as a dynamic capability, IU allows for the firm to modify its "bundle of resources, operational routines, and competencies" to better fit its survival (Zott, 2003; p. 98).

---- Insert Figure 1 About Here ----

3. Model and Hypotheses

3.1 Dynamic Capabilities and Industrial Upgrading

We now develop the individual relationships of our research model as depicted in Figure 2. Consider the typical case of IU where a late entrant manufacturing firm in a newly industrialized country is attempting to improve its status by systematically adding more value added processes to its operations. Such a firm needs to take several progressive steps. We introduce four such hypothetical steps and label them for ease of reference. Our hypothetical firm may start first by partnering with a foreign firm (assumingly in an already industrialized country) and agree to perform basic tasks such as the production of low value parts and subassemblies supplied by the foreign firm. We label this step which is related to manufacturing with foreign supplied parts as IU-Step 1. As part of IU-Step 1 the late entrant may attempt to steadily reduce the percent of parts provided by its foreign partner. In the following step, the late entrant firm may rely on the foreign firm to specify parts that may then be manufactured internally. We label this step which captures manufacturing with foreign specified parts as IU-Step 2. Gradually, the late entrant may initiate the production of goods designed internally, which is captured in our model by IU-Step 3; (manufacturing with internally designed parts). Lastly, the late entrant may manufacture complete final products for the foreign firm through IU-Step 4 (manufacturing final products).

---- Insert Figure 2 About Here ----

In our hypothetical case, IU acts as the underlying capability upon which increasingly more valuable operational processes are added (Eisenhardt & Martin, 2000). By sequentially implementing each IU-Step (from Step 1 to Step 2, and so on) our hypothetical firm is able to acquire new resources, integrate them and recombine them towards developing more value-added activities. To effectively apply IU, our late entrant needs to implement more than just a multitude of operational processes. Rather the chosen IU-Steps (1 through 4 in our hypothetical case) need to be complementary and need to be introduced in a paced and sequential manner. This path dependence of the implementations is necessary because the benefits of IU rely on organizational learning mechanisms. Eisenhardt and Martin (2000) suggest for a set of learning mechanisms to play important roles in such a process. These include (a) repeated practice, (b) sequencing of learning and (c) pacing of experience. In the next few paragraphs we explore how these learning mechanisms help in successful implementation of IU.

Learning is enhanced through repetition (Upton & Kim, 1998). Repeated practice helps one to understand processes more fully by developing more effective routines in performing them (Rondeau et al., 2000). Furthermore, repetition allows for recognizing alternative ways to complete a task. For example, repeated practice in assembling parts ensures that they are completed with less error and can also surface ways to improve how the part is assembled.

Second, the order of exposure to experiences is another determinant of learning. Learning the basic processes first, allows for the firm to develop mastery of other steps sooner. Operational processes are often combinations of other simpler ones, some of which may be foundational and therefore must be learned first. Sequenced learning allows the firm to not only better understand more complex operations, but to also recognize how to rearrange the building blocks in order to develop new combinations. In our hypothetical case, sequencing the implementation of the IU-Steps allows for a thorough understanding of the fundamentals of operational processes, which in turn can help better understand more complex steps.

Lastly, pacing is important for learning to be effective. Experiences that are too slow may be forgotten, while those that come too fast may be overwhelming. In other words, either too slow or too fast paced experiences may lead to the organization's inability to convert them into useful knowledge. With too many factors changed all at once, firms are unable to make appropriate deductions from their experience, since the organization's "ability to ascertain cause-effect relationships is confounded" (Teece & Pisano, 1994; p. 547). In our hypothetical case, implementing each of the four IU-Steps as separately introduced processes allows for a thorough understanding of intricacies particular to each step. This in turn allows for the firm to convert the experience to useful knowledge that can enhance its performance.

This in essence is how IU can allow the latecomer to start with simple processes and gradually develop more complex processes. Given the sequenced and paced introduction of operational processes, repeated practice of each new process reinforces and can increase the effectiveness of others. For example, repeated interactions with foreign suppliers to procure parts allows for the firm to learn about global standards and expectations (Schmitz & Korringa, 2000) and therefore be better equipped to develop processes related to internal manufacturing of the same parts.

Given the arguments noted above, we posit that there is an association between conducting each of the earlier steps in manufacturing and the next higher level one. Therefore, as related to the process steps in our hypothetical case we posit that each preceding IU-Step is associated with the subsequent IU-Step:

H1a. Manufacturing with foreign supplied parts (IU-Step 1) and manufacturing with foreign specified parts (IU-Step 2) are positively associated.

H1b. Manufacturing with foreign specified parts (IU-Step 2) and manufacturing with internally designed parts (IU-Step 3) are positively associated.

H1c. Manufacturing with internally designed parts (IU-Step 3) and manufacturing final products (IU-Step 4) are positively associated.

The hypotheses above capture the direct effects of how each IU-step can be a stepping stone for developing the next IU-step. While sequencing is an important element, learning from one process may lead to the enhancement to another, even if the two are not sequentially attached. By cultivating inter-connected processes, IU allows for the firm's processes to be bundled to create superior value than when implemented separately. As such, we would expect for an association between the IU process steps, even if they are not sequentially connected. Therefore, as related to our hypothetical case, we posit that:

H2a. Manufacturing with foreign supplied parts (IU-Step 1) is directly and indirectly associated with manufacturing with internally designed parts (IU-Step 3) through manufacturing with foreign specified parts (IU-Step 2).

H2b. Manufacturing with foreign supplied parts (IU-Step 1) is directly and indirectly associated with manufacturing final products (IU-Step 4) through manufacturing with foreign specified parts (IU-Step 2) and with internally designed parts (IU-Step 3).

H2c. Manufacturing with foreign specified parts (IU-Step 2) is directly and indirectly associated with manufacturing final products (IU-Step 4) through manufacturing with internally designed parts (IU-Step 3).

3.2 Exploitative and Explorative Innovation

So far we have explored how IU allows for the development and enhancement of operational processes through repeated practice, sequencing of learning and pacing of experiences. In this section we propose that organizational learning and the development of the firm's operational processes can lead to other dynamic capabilities such as its ability to innovate. However, first we need to distinguish between the types of innovations that may be developed by our hypothetical firm.

Innovation has been categorized into many forms including radical versus incremental, architectural versus component and process versus product (please see Garcia & Calantone, 2002 for a review). In terms of familiarity with the organization's existing knowledge, innovation has been dichotomized into that of exploitative and explorative forms (Benner & Tushman, 2003; Jansen et al., 2006). Exploitative learning, which relies on applying familiar skills and existing know-how (Cardinal, 2001), develops exploitative innovations which "improve established designs [and] expands existing products and services" (Jansen et al., 2006; p. 1662). In contrast to exploitative innovations, explorative innovations require departures from existing skills and the application of new knowledge (Benner & Tushman, 2003). Whereas exploitative innovations are designed for meeting the needs of existing customers, explorative innovations are meant to attract emergent customers and markets (Daneels, 2002).

For example, from the firm's perspective, while product extensions made to an existing product line are considered exploitative innovations, introduction of new products not sold previously by the firm are more exploratory innovations. Both explorative innovations and exploitative innovations are manifests of the firm's ability to innovate, which is in essence the dynamic capability that allows firms to modify and improve existing products and processes. In the next sections we propose that the development of the firm's operational processes through IU can lead to other dynamic capabilities, which can be manifest through explorative and/or exploitative innovations.

3.3 Industrial Upgrading and Exploitative Innovation

In this section we posit that learning accumulated through IU can lead to other dynamic capabilities that can result in exploitative and explorative innovations. We do so by using the works of Zollo and Winter (2002) who suggest that organizations enhance their understanding of a process through repeatedly experiencing it and through further articulation and codification of such a process. In our hypothetical case, we posit that IU helps increase the firm's experience of an operational process while allowing for it to better articulate and codify it. Through increased experiences, better articulation and better codification, IU helps the firm to better leverage learning and thereby develop other dynamic capabilities such as those manifest through explorative and exploitative innovations.

IU allows for the firm to develop experiences that are directly related to each process step. Experiences allow for individuals and organizations to recognize how to conduct a process more effectively. Perhaps more importantly, experience allows the firm to recognize the possible extension of the knowledge to other similar applications. As a result, accumulated experience can help develop new applications based on known processes. For example, by designing and manufacturing an increased number of the components used in a product, a firm can become better experienced with challenges involved in integrating a larger number of components into the process. In turn, such experiences may help the firm develop product and process improvements within the same product line.

IU allows for the firm to better articulate each process step. Knowledge articulation is another mechanism that can help firms with enhancing their learning. As organizational members articulate tasks that are delegated to them, they become more aware of the consequences of their decisions regarding such tasks, which may result in performance improvements (Zollo & Winter, 2002). In other words, by placing increased effort in articulating a task, organizations are able to better understand the causal ambiguities behind it and the results of its implementation. When such implicit knowledge is articulated through repeated interactions and purposeful discussions among an organization's personnel the organizations' level of understanding of the process at hand improves. All told, through articulation, a firm can gain a better understanding of its current capabilities which help with the development of new process and new product innovations.

IU allows for the firm to better codify each process step. Codification forces one to detail steps and hidden requirements of a process. Codification also allows for better replication and diffusion of existing knowledge. When organizational members use information to develop and use written tools such as procedure manuals and decision support systems, they are in essence applying knowledge codification. As such codification can be a useful tool in better implementing and coordinating complex activities. Through this detailing, a firm is not only able to better understand the current activities, but to also recognize what may be required for performing similar activities. As a result, codification helps firms to better apply their process knowledge towards extending the organization's learning, which may lead to the development of exploitative innovations.

In sum, increased experience, articulation of knowledge and codification of knowledge not only enhance organizational learning, but also open the opportunity to discover ways to improve a process or to enhance a product. These mechanisms allow for the firm to exploit its existing knowledge towards developing exploitative innovations. Based on these discussions, we posit that IU, as a dynamic capability, allows firms to focus on leveraging learning from their operational processes, which can lead to the development of exploitative innovations. We use the number of product extensions in the firm's main product line as a proxy for exploitative innovation and posit:

H3a-d. Each IU-Step (Step 1, Step 2, Step 3 and Step 4) is positively associated with product extensions in the main product line.

3.4 Industrial Upgrading and Explorative Innovation

In the previous section we explored the relationship between IU and exploitative innovations. In this section we explore how IU can be associated with explorative innovations. While the link between incremental learning and incremental innovations is an intuitively persuasive one, linking incremental learning to radical innovations is not as innate. Here, we justify the relationship between IU and explorative innovation by suggesting that the existence of both is manifest through organizational characteristics that are quite similar. In other words, we posit that firms that implement IU also carry characteristics that are manifest in explorative firms. As such, we expect for a positive association between implementation of IU and the development of explorative innovations.

First, the implementation of IU requires for the firm to maintain a positive learning orientation (Hult et al., 2004) suggesting for openness to new ideas and the acceptance of change as a natural consequence of business. Without a positive learning orientation the firm will have a difficult time implementing the list of progressively more complex processes and procedures required as part of IU. Second, implementing IU implies that the firm is open to internally generating and developing new knowledge. Without the willingness to develop and implement improvements internally, the firm would not be able to effectively benefit from modifying or adjusting any imported knowledge. Lastly, IU implies the need to develop individual skills and organizational knowledge to develop new processes. Without the willingness to train and develop its personnel the firm will have a difficult time in tackling more complex tasks. These elements, namely willingness to try new concepts (Verhees & Meulenberg, 2004), developing relevant skills and expertise (Amabile, 1988), openness to new ideas (Hughes & Morgan, 2007) and increased internal knowledge (Crossan et al., 1999) are factors that are manifest in firms that are open to exploration. As such, it seems that the implementation of IU may be positively associated with higher levels of exploratory innovation by the firm. We use the percent sales generated from new product line as a proxy for exploratory innovation and posit:

H4a-d. Each IU-Step (Step 1, Step 2, Step 3 and Step 4) is positively associated with sales from new product lines.

3.5 Partial Mediation Effect of Exploitative Learning

Research suggests for organizational learning to be inherently evolutionary (Lant & Mezias, 1992; Tripsas & Gavetti, 2000). Whereas outcomes of the learning process can be incremental, distant or even radical, the process of learning is accomplished in a stepwise manner. The fundamental process of learning (e.g. learning by doing and interpreting one's experiences) is based on the addition of small increments of knowledge to an already existing base of understanding. This is particularly reflective of how organizations learn. Organizational learning tends to be an iterative process of applying new knowledge to conduct behavioral change and then reflecting on what the outcome of such a change may be. The results of applying new knowledge is compared and contrasted to existing routines and behaviors. If the results are beneficial, then the organizational behavior is modified as appropriate (Edmondson, 2002). Our point here is that rarely do organizations change their routine behaviors in a rapid or radical manner. In fact, even in response to radical change, organizations prefer to make incremental adjustments to what is already known (Schwab, 2007). As Levitt and March note, organizations incrementally change their behavior toward those that are associated with success and away from those that are associated with failure (Levitt & March, 1988).

These insights about the effects of organizational learning on behavioral change suggest that the incremental learning may act as small stepping stones towards generating broader learning. In other words, exploitative learning may lead to explorative learning and similarly, exploitative innovations may contribute to the generation of explorative innovations. In the particular case of IU, by comparing and contrasting it to the firm's existing behavior, learning from exploitative innovations may help direct and guide what the firm learns from the IU process steps. As such, we posit that exploitative innovations (such as new product extensions in an existing product line) may not only be associated with explorative innovations (such as the development of new product lines), but may also act as a conduit for directing learning from the IU-Steps towards developing explorative innovations. In other words, we posit that exploitative innovations from the existing product line can act as a partial mediator between IU-Steps and explorative innovations in new product lines. We consider the relationship as partial mediator (James et al., 2006; MacKinnon et al., 2007), since some of the learning effects of IU-Steps may in fact be directly associated with explorative innovations. Hypotheses capture the direct and mediating role played by exploitative innovations by the manufacturer is our model:

> **H5a-d.** Increased exploitative innovations in the form of product extensions in a manufacturer's main product line partially mediates the relationship between IU-Steps (1-4; a-d) and sales from new product lines.

4. Methods

4.1 Sample and Data

To test our hypotheses we used a survey collected by the World Bank on Chinese firms in manufacturing industry sectors including apparel and leather goods, consumer goods, electronic components, electronic equipment and vehicles and vehicle parts. A total of 535 responses were related to manufacturing and were completed in full with regards to each firm's manufacturing activities. The survey was conducted in two segments. The first segment was completed by senior managers of the firm during face to face interviews. This segment asked about the nature of the manufacturing business, its manufacturing task and types of innovation. The second segment asked general questions regarding the firm's financial profile, such as its revenues, operational costs, labor force and ownership structure. These were completed by the company accountant. By having two informants completing similar and different questions in the survey relating to our research objectives possibility of common method bias is minimized.

4.2 Measures and Controls

We used questions related to the type of activities that the firm has engaged in. To ensure that these activities are related to a possible IU strategy, we used questions that specifically asked about respondent organization's engagements with one foreign firm located abroad. We realize that learning from other firms is not restricted to those located abroad or to a specific firm. However, given the context of IU in explaining how latecomers can leverage organizational learning, evaluating the relationship as related to unique foreign firms provides a more apparent distinction than that of working with local firms.

We used a continual variable measuring the percent of parts supplied by the manufacturer (0-100%) to capture IU-Step 1 (Foreign Supplied Parts). We measured production with foreign specified parts (Foreign Specified Parts; IU-Step 2) using a dichotomous variable (2=manufactures foreign specified parts for the foreign firm and 1=does not). The third step of IU (Internally Designed Parts; IU-Step 3) was captured using a continual variable that measured percent of parts internally designed by the local firm (0-100%). The fourth IU process step (Final Product; IU-Step 4) was measured using a dichotomous variable asking whether the local firm manufactured final products (2=manufactures final products and 1=does not). Exploitative innovation was measured using the number of new products the firm has introduced since 1998 to its main product line (i.e., product extensions). Explorative innovation was measured using the percent of sales derived from new products in new lines of the organization's business in the year 2000.

Regarding controls, organizational size is frequently considered to have influence on firm level innovation and performance. Larger organizations may have more resources to develop new innovations, collaborate with outsiders or coordinate subcontracting decisions. We controlled for organizational size using sales for the previous fiscal year. We controlled for company age, since older organizations may have had more time to develop innovations. We controlled for industry sector since the speed of progress can be different for different industries. Lastly, to capture the effects of IU barring for the firm's R&D intensity, we controlled for level of R&D expenditure by the firm. Actual questions are included in Appendix A.

4.3 Analytic Strategy

In line with the methodological approach taken by Rosenzweig and Roth (1994), to test our hypotheses on this “cumulative model”, we developed a series of comparative path models. Our analyses were performed using Mplus Version 5.21. We chose this software package, since it allows for simultaneous assessment of normally distributed and non-normally distributed dependent variables in a single multivariate model (Muthen & Muthen, 2007). More specifically, two of our independent variables, namely IU-Step 2 and IU-Step 4 were dichotomous variables. In addition, to capture innovations in the main product line, the number of occurrences was used. Following suggestions by Finney and Stefano (2006), we applied the robust estimator WLSMV (Weighted least squares parameter estimates with mean and variance adjusted Chi-Square) (Muthen & Muthen, 2007). WSLMV is based on the Asympotically Distribution-Free (ADF) estimator (Browne, 1984) and makes no assumptions of normality; therefore “variables that are kurtotic have no detrimental effect” (Finney & DiStefano, 2006; p. 278) and can handle ordered categorical and dichotomous data (Muthen, 1984).

4.4 Validity Tests

While our results were provided from two sources within the organization, and all variables were objective manifests, we conducted Harman’s one factor test (Podsakoff & Organ, 1986), to verify bias due to method variance. The test indicated that only 18% of the variance was accounted for by the first factor, suggesting for minor concerns with common methods bias. Following more current methodological suggestions from Lindell and Whitney (2001), we verified the correlation among the variables in our data set (Table 1), indicating very low concerns with common methods variance.

---- Insert Table 1 About Here ----

4.5 Results

Table 1 includes means, standard deviations, reliability (alpha) and zero-order correlations for the latent variables of the study, and Figure 3 summarizes the significant relationships of our structural model. The fit indexes for the proposed structural model showed a very good fit ($\chi 2$ = 50.1; d.f. = 22; $\Delta\chi 2$/d.f. = 2.28; IFI = .932; GFI = .982 CFI = .928, SRMR = .042; RMSEA = .049). As mentioned previously, we controlled for the effects of firm size, firm age industry sector and R&D intensity. None of the control variables showed significance ($p<.05$). Below, the results of the predictions are explained in further detail.

---- Insert Figure 3 About Here ----

4.5.1 Industrial Upgrading Related Hypotheses

H1a posited for a positive relationship between manufacturing with foreign supplied parts (IU-Step 1) and manufacturing with foreign specified parts (IU-Step 2). H1b posited that there is an association between manufacturing foreign specified parts (IU-Step 2) and internally designed parts (IU-Step 3). H1c posited for a positive relationship between internally designed parts (IU-Step 3) and manufacturing final products (IU-Step 4). As shown in Figure 3, the results of the structural equation model reveal a positive and significant relationship for H1a ($\beta = .420$; $p<.001$), a positive and significant relationship for H1b ($\beta =.286$; $p<.001$) and a positive and significant relationship for H1c ($\beta = .064$; $p<.01$). Therefore Hypotheses 1 are supported.

Hypotheses 2 predicted for a positive relationship between non-subsequent processes of IU. Specifically, H2a posited that there is an association between manufacturing foreign supplied parts (IU-Step 1) and internally designed parts (IU-Step 3). H2b posited for a positive relationship between manufacturing foreign supplied parts (IU-Step 1) and manufacturing final products (IU-Step 4). H2c posited for a positive relationship between manufacturing with foreign specified parts (IU-Step 2) and manufacturing final products (IU-Step 4). As shown in Table 2, the results of the structural equation model reveal a positive and significant relationship for H2a (β = .186; p<.001) and a positive and significant relationship for H2c (β = .704; p<.01). H2b was not supported. Therefore hypotheses 2 are partially supported.

---- Insert Table 2 About Here ----

4.5.2 Hypotheses Linking Industrial Upgrading with Exploitative and Explorative Innovations

Hypotheses 3 predicted for a positive relationship between each of the IU process steps and the number of product extensions in the firm's main product line (i.e. exploitative innovations). H3a was not supported. Results suggest for a positive association between manufacturing foreign specified parts (IU-Step 2) and product extensions (H3b; β = .317; p<.01) Manufacturing with internally designed parts (IU-Step 3) shows a positive association with product extensions (H3c; β = .247; p<.001). Lastly, manufacturing final products (IU-Step 4) shows a negative association with product extensions (H3d; β = -.243; p<.05). Therefore H3 is partially supported.

To test for Hypotheses 4 and 5, we applied the SEM approach for test of mediation (James & Brett, 1984), and contrasted a single model that compared the proposed relationships with alternative models that included different paths from the independent variables to financial performance (Table 4) and tested for changes in Chi-Square. Our partial mediation hypotheses would be supported if the fit of the partially mediated model (model 1, Table 4) is not improved by the addition of direct paths from process steps of IU to explorative innovations, or by removing any of the hypothesized paths. As shown in Table 4, the differences between Chi-Squares of Model 1 compared to alternative models 2 through 3 were not significant. However, the difference between Chi-Square of Model 1 compared to alternative model 4 is significant ($p<.01$). Further, the fit indices of Model 8 appeared to be slightly better than the fit indices of model 1. Based on the rules of parsimony (Bollen, 1989; Hair et al., 2005), these results suggest that the partially mediated model, Model 8, best represented the data. The direct and indirect effects between the variables are presented in Table 3.

---- Insert Table 3 About Here ----

---- Insert Table 4 About Here ----

5. Discussion and Conclusions

The aim of this study was to investigate whether IU has an association with innovation performance of the firm in general and with explorative innovation in particular. We used the dynamic capabilities perspective to suggest how learning from progressively more complicated manufacturing tasks lead to the development of exploitative innovations. In turn, we hypothesized and showed empirically that firms using IU show an indirect association between IU and their explorative innovation performance. The empirical results suggest for an association between IU and exploitative innovation. Moreover, results suggest for an indirect association of IU with explorative innovations through exploitative innovations.

We believe our work here provides several contributions to the field. First, the results here provide empirical support on the validation of dynamic capability paradigm and their effect on the firm's innovation performance. Considering the lack of empirical support regarding dynamic capabilities (Ambrosini & Bowman, 2009), we believe this to be the primary contribution of our work. Our results confirm the assessments made by Eisenhardt and Martin (2000) that the "dynamic capabilities are best conceptualized as tools that manipulate resource configurations", where operational processes can be configured and arranged to provide difficult to emulate performance.

Our second contribution is related to the relationship between exploitative learning and explorative innovation. Literature on the relationship between exploitative and explorative learning can be segregated into three groups. Within the majority group the prevalent positioning is that there is a trade-off between exploitative and explorative learning, and that a focus on one would be at the detriment of the other (e.g. Benner & Tushman, 2003; Atuahene-Gima, 2005). The second group focuses on how the combination and interaction of the two forms of learning (otherwise labeled as ambidexterity) provide further benefits to the organizations (e.g. He & Wong, 2004; Auh & Menguc, 2005). A third and much petite literature stream focuses on the interplay and effects of exploitation and exploration on one another, suggesting that the two can have an influence in generating one another. Weick and Westley (1996), Homlqvist (2003) and Nonaka (1994) suggest for a dynamic relationship between the two forms of learning, where organizations may go through periods of exploration and exploitation. Holmqvist notes for a need to develop a "a theory of dynamics between exploitation and exploration, i.e. a theory that describes how exploitation generates exploration and how exploration generates exploitation" (Holmqvist, 2003; p. 99). There are but less than a handful of studies that have demonstrated how exploitation may lead to explorative learning using case analyses (e.g. Burgelman, 2002; Dixon et al., 2007), and we are not aware of any study that has tested the relationship using large scale empirical settings. We believe our work contributes to this stream of literature by suggesting and providing empirical support on how exploitative learning through IU and exploitative innovations may lead to more explorative learning and innovations.

In line with the above, we believe that our third contribution is to highlight the importance of process improvement as an exploitative learning that can enhance firm performance beyond what may seem myopic and incremental improvements. In their work related to process improvement projects within manufacturing plants, Laprée and Van Wassenhove (2002, p. 108) suggest that "[t]he real benefit of a process improvement project…. is not in its local impact on the few machines where it is implemented but in the transfer of knowledge to other areas of the plant or other products." Our findings fall in line with that of these scholars. The real benefit of firms implementing new processes and upgrading their skills is that they are able to transfer the ability to learn to other parts of their business and thereby allow for the learning abilities of a broader organizational entity to be improved. Moreover, these authors suggest that organizational learning rates vary considerably across firms (Laprée & Van Wassenhove, 2003). Here, we suggest that through managing organizational learning (i.e. by learning how to learn) firms can not only learn to improve their operations better, but to also derive increased exploitative and explorative innovation.

Practically, our findings can be of benefit to incumbents of and new comers to an industry. For newcomers this suggests that the sequential and paced approach to organizational learning can act as a potent means of "swiftly" catching up with incumbents. For incumbents, these findings provide a depiction that – while not comforting – are to be expected. Incumbents cannot rest on their laurels presuming that latecomers cannot be as good or better in terms of innovation, merely because they start by learning the basics. Rather, our findings here suggest that IU, as a systematic, paced and sequenced set of learning steps provides a potent tool that can provide an advantage to latecomers that goes beyond exploitative innovation and can assist in developing more exploratory ones. In other words, by learning how to learn, latecomers can more quickly adapt to their environment, thereby developing better evolutionary for than others.

6. Limitations

Earlier we noted parallels between our methodological approach here and the empirical studies performed in relation to the cumulative model in manufacturing strategy. One of the limitations of our study is similar to this line of research as well. In particular, our work does not allow for temporal distinction between the IU steps. In other words, the data available to us does not allow for investigating precedence between the IU process steps. This issue is similar to what Rosenzweig and Roth (1994) dealt with. These authors relied on substantive theoretical explanations and the rejection of alternative explanations to justify their propositions. Second, they compared their model in a path analysis (Norman & Streiner, 2000) using observed variables to alternative models to see if there was a more suitable fit. We did the same with our path analysis.

Our work here uses secondary data. Using secondary data in empirical research in general and operations and supply chain management in particular has been on the rise (Fisher, 2007; Roth, 2007; Carter et al., 2008), perhaps because of support from editors at journals such as the Journal of Operations Management (Boyer & Swink, 2008). We realize the concerns typically voiced regarding the use of secondary data. These may include incomplete data sets, errors in the data and inability to design the data set specifically for the purposes of the study underway (Brooks-Gunn et al., 1991; Shultz et al., 2005). Nevertheless, the current data set provided a rare opportunity to assess the effects of industrial progression in a developing country and thereby provide insights on how organizational learning, the development of dynamic capabilities and firm performance are inter-related. Lastly, our results are based on firms in a single developing country (China). How well these results apply to other developing and developed countries may be the subject of future research.

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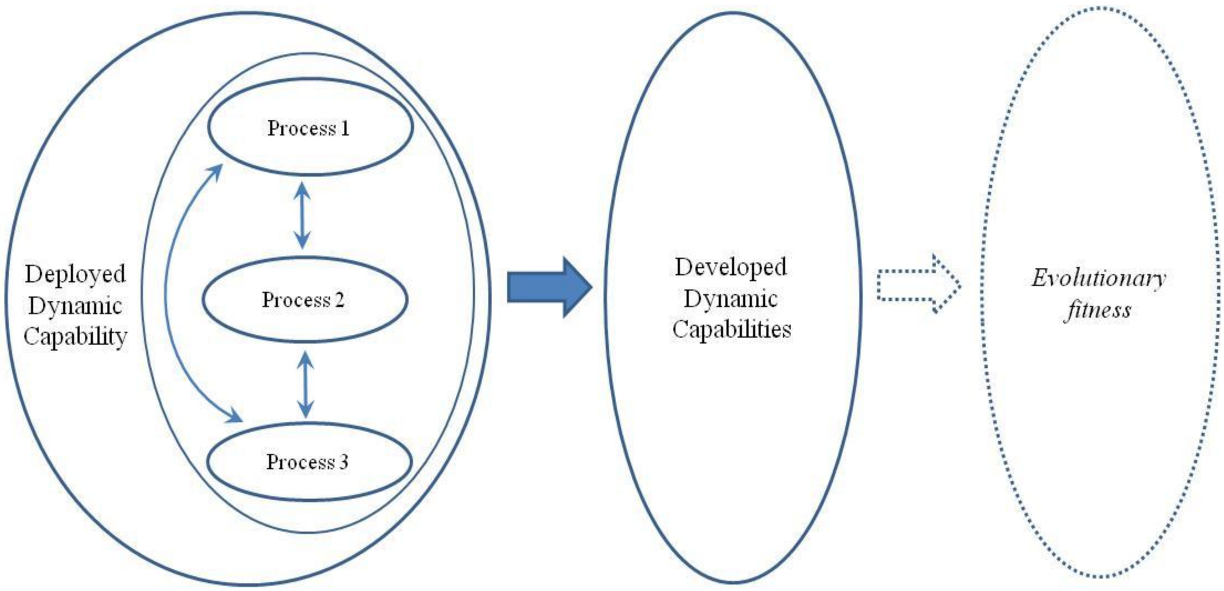

Figure 1 – Conceptual Model
(Based on Helfat et al. 2007, Figures 1.2, 3.1 and 3.3)
Dashed elements are not tested in the empirical model

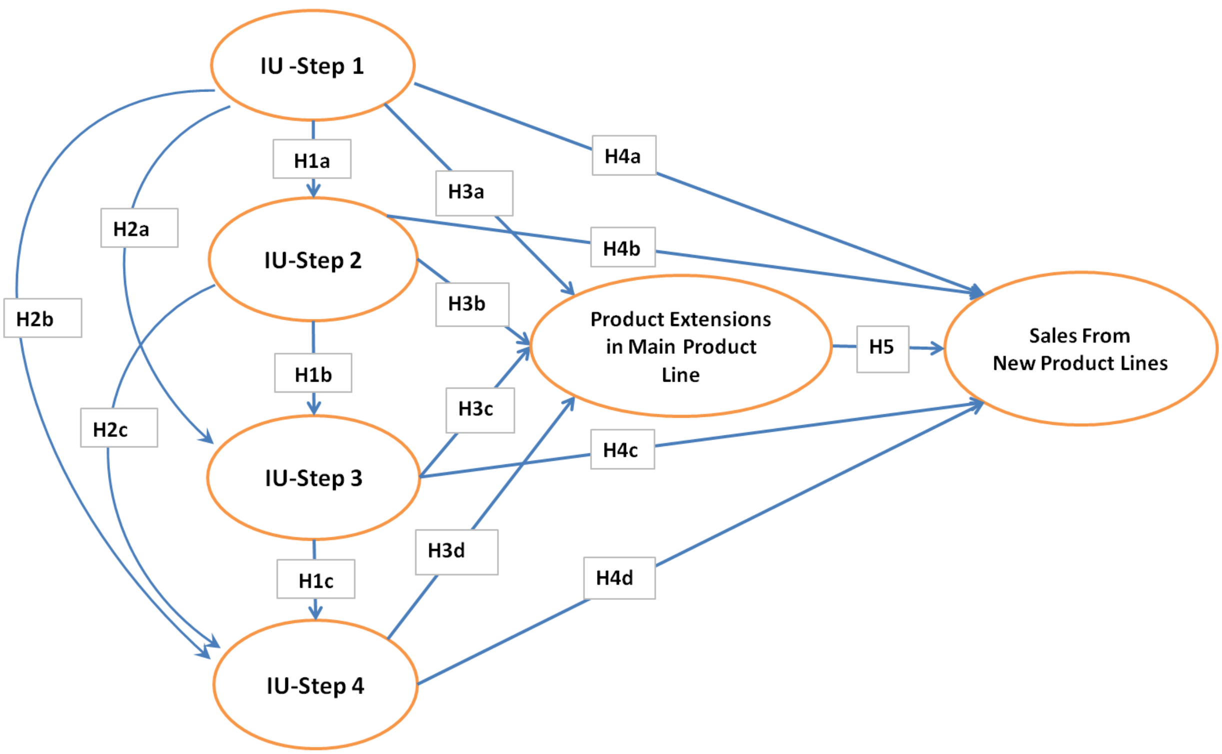

Figure 2 – Proposed Model

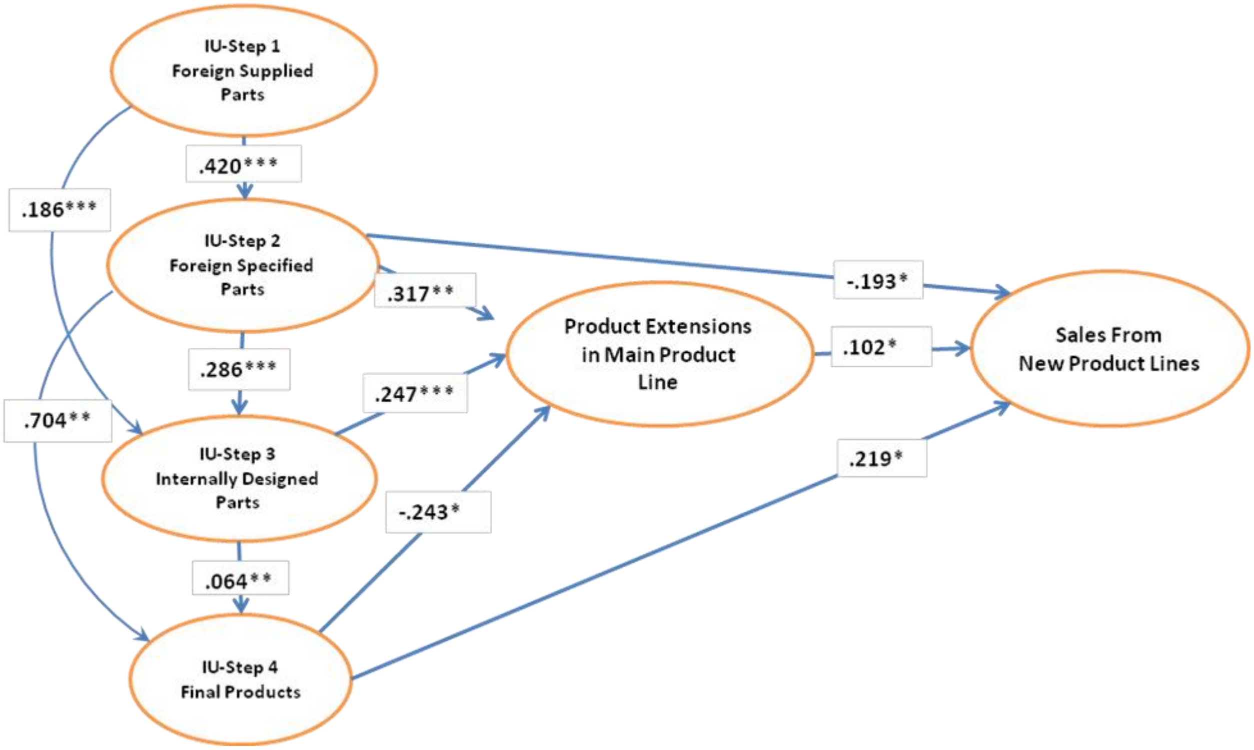

Figure 3 – Structural Equation Modeling Results
(Controlling for company size, company age, industry type and R&D intensity)

Table 1 – Means, Standard Deviations, Correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1. Size (Sales '000 – Control)	119.6	363.8									
2. Age (Years – Control)	13.4	14.6	-.073								
3. Industry Type (SIC – Control)	-	-	.137**	-.009							
4. R&D Expenditure (Control)	.051	.642	.019	-.031	.037						
5. Foreign Supplied Parts	13.7	25.1	.085*	-.111*	.067	-.023					
6. Foreign Specified Parts	1.46	.499	.100*	-.002	-.006	-.044	.326**				
7. Internally Designed Parts	9.25	23.2	.016	-.045	-.059	-.003	.301**	.277**			
8. Final Products	1.31	.463	.139**	.044	-.036	-.028	.298**	.514**	.285**		
9. Product Extensions in Main Product Line	12.1	17.3	.005	-.025	-.191**	-.020	.053	.069	.317**	.053	
10 Sales From New Product Lines (%)	34.9	17.4	.087*	-.098*	-.016	.056	.064	.029	.111*	.099*	.098*

n = 535, ** *p*<.01 (2 tailed), * *p*<.05

Table 2 – Direct, Indirect and Total Effects of Industrial Upgrading Process Steps On Subsequently Higher Process Steps

	Effect on Foreign Specified Parts			Effect on Internally Design Parts			Effect on Final Product		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Foreign Supplied Parts	.420***		.420***	.186***	.120***	.306***	-	.005***	.005***
Foreign Specified Parts				.286***		.286*	.704***	.018*	.722*
Internally Designed Parts							.064**		.064**

Note: Standardized Regression Weights are shown, ** *p*<.001, ** *p*<.01, * *p*<.05

Table 3 – Direct, Indirect and Total Effects of IU-Steps on Product Extensions in Main Line and Sales from New Product Lines

	Effect on Product Extensions in Main Product Line			Effect on Sales from New Product Lines		
	Direct	Indirect	Total	Direct	Indirect	Total
Foreign Supplied Parts	-	.132**	.132**	-	-.056*	.001*
Foreign Specified Parts	.317**	.066*	.383*	-.193	. 179*	-.013*
Internally Designed Parts	.247**	-.015*	.232*	-	.038*	.038*
Final Products	-.243*	-	-.243*	.219*	-.025*	.194*
Product Extensions in Main Product Line				.102*	-	.102*

Note: Standardized Regression Weights are shown, ** *p*<.001, ** *p*<.01, * *p*<.05

Table 4 – Comparison of Structural Equation Models

Model and Structure		χ^2	d.f.	$\Delta\chi^2$	ρ^a	IFI	GFI	CFI	SRMR	RMSEA
1.	FORSU → FORSP FORSU → DSNPI FORSU →MFGPI FORSU → EXPLT FORSP → EXPLT DSNPI → EXPLT MFGPI → EXPLT EXPLT → EXPLR	58.0	24	2.42	.000	.918	.979	.913	.0435	.051
2.	Model 1 and FORSU → EXPLR	57.6	23	2.51	.000	.916	.979	.911	.0440	.053
3.	Model 1 and FORSP → EXPLR	57.9	23	2.52	.000	.915	.950	.911	.0434	.053
4.	Model 1 and DSNPI → EXPLR	57.9	23	2.52	.000	.915	.979	.911	.0435	.053
5.	Model 1 and MFGPI → EXPLR	53.7	23	2.34	.000	.926	.981	.921	.0431	.051
6.	Model 1 and FORSU → EXPLR FORSP → EXPLR	57.4	22	2.61	.000	.914	.979	.909	.0437	.055
7.	Model 1 and FORSU → EXPLR FORSP → EXPLR	57.6	22	2.62	.000	.914	.979	.909	.0439	.055
8.	Model 1 and FORSU → EXPLR MFGPI → EXPLR	50.1	22	2.28	.000	.932	.982	.928	.0421	.049
8a	Model 8 with direct links between IU-Steps Only	217.6	25	8.7	.000	.531	.933	.507	.0884	.120
8b	Model 8 with no links between IU-Steps	376.6	27	13.5	.000	.145	.858	.108	.1240	.153
9.	Model 1 and FORSU → EXPLR FORSP → EXPLR DSNPI → EXPLR	57.4	21	2.74	.000	.912	.979	.907	.0437	.057
10.	Model 1 and FORSU → EXPLR FORSP → EXPLR MFGPI → EXPLR	50.1	21	2.38	.000	.930	.982	.926	.0420	.051
11.	Model 1 and FORSP → EXPLR DSNPI → EXPLR MFGPI → EXPLR	53.1	21	2.53	.000	.923	.981	.918	.0428	.054
12..	Partial Mediation (All Links)	49.9	20	2.50	.000	.925	.982	.921	.0420	.053

N =535, [a] less than, Model 1 is fully mediated. Model 12 is a partially mediated model. Others are alternative models. Model 8 is best fitting model. Alternative models 8a and 8b validate the need for including the (direct and indirect) links between IU-Steps. FORSU= Manufacturing with Foreign Supplied Parts, FORSP= Manufacturing with Foreign Supplied Parts, DSNPI= Manufacturing with Internally Designed Parts, MFGPI= Manufacturing Final Product, EXPLT = Product Extensions from Main Product Line, EXPLR= Sales from new product lines

Appendix

Survey Questionnaire:

Sales
Please provide the value of total sales for your plant (products and services, including exports) for the year 2000.

Age:
In what year was the plant established?

Research and Development Expenditure
Please provide the Total R&D expenditure at your plant for the year 2000.

Industry Sector:
Please circle one code of the following "industry sectors" and "subsectors" that applies to the company. (List of industries follows in the survey; not included here for parsimony).

Industrial Upgrading Steps:
Please indicate if your plant has engaged in any of the following activities with a foreign firm located abroad since January 1999:

1) Are parts used by your plant supplied by the foreign firm? IF YES, what share of material costs do these parts supplied by the foreign firm represent? (% of sales)
2) Your plant produces parts, subassemblies, or other inputs to production for the foreign firm. (Yes=2, No=1)
3) Your plant produces goods of your own design that are used as inputs in a foreign firm's production process IF YES, what share of revenues are generated by these in-house? (% of material costs)
4) Your plant manufactures final products for the foreign firm (Yes=2, No=1)

Product Extensions in Main Product Line: (Exploitative Innovations):
Within your main business line, how many new products have you introduced?

Sales from New Product Line: (Explorative Innovations):
What percent of total sales did new products in your new business line account for in 2000?