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great by
deeds, not by
birth"

-Chanakya

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Working Paper

IIMK/WPS/248/STR/2017/32

May 2017

Flexible Product Development and Firm Performance

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Abstract

While new product development is considered critical for profitable growth of firms, there are several risks of cannibalization, if not outright disruption of the new product by those of rival firms much before the former comes up with the next generation product. Even otherwise, smart firms tend to prolong the product lifecycle by means of strategies that achieve product variety in terms of aesthetics or incremental innovations or modular variety or variety of customer value propositions in the form of parallel business models. Though there are studies on flexible product development at both intra-firm and inter-firm levels in a spirit of collaboration between partner firms, there is paucity of literature on flexible product development in the context of co-opetition at an industry level. The current study attempts to synthesize various stand-alone perspectives into an integrated framework which can aid the optimal decision-making of firms w.r.t flexible product development initiatives. This is a developmental paper and many of its suggestions require rigorous testing through studies in a wider array of settings. The paper provides a snapshot of various related corporate practices of strategic flexibility in the form of flexible product development adopted by firms across industries and the respective success/failure stories, the lessons of which when learnt properly can go a long way in the strategic self-renewal of many an organization.

Key Words: Flexible Product Development, Product Variety, Modular Innovation, Architectural Innovation, Strategic Flexibility, Resource Leverage, Discovery-driven Planning

Introduction - Changing Competitive Environment and Shrinking Product Life Cycles

A new competitive landscape has been unfolding as a consequence of the forces of liberalization, privatization and globalization (Hitt, Ireland, and Hoskisson, 2001), particularly with respect to developing countries like India (Ramaswamy & Namakumari, 1999). The strategic discontinuities encountered by firms are transforming the nature of competition (Hitt, Keats, and DeMarie, 1998). The business environment has been characterized by shrinking product life cycles, low prices, plethora of choices to the customer, exacting demands of the buyers' market, blurring of industry boundaries, opening up of global markets, intense foreign competition in domestic markets, increasing rate of technological change and diffusion, increasing knowledge intensity resulting in the emergence of positive feedback industries (where returns continue to increase often by building knowledge), increasing focus on innovation and continuous learning, descalation of time frames for strategic actions, emergence of IT as a key resource that annihilates the barriers of time and distance, advent of the new information highway (the internet), changing career dynamics and employee expectations etc (Hitt et al, 1998; Mische, 2001; Ramaswamy & Namakumari, 1999). The degree and complexity of the constantly changing environment is driving firms, both large and small to seek new ways of conducting business to create wealth (Stopford, 2001).

In the global and electronic economy, market space is no longer confined to specific geography and clear-cut industry boundaries. The industry demarcations are now blurred and quickly disappearing, and geographical and physical barriers have been bridged by technology. Today, organizations reside in a multi-dimensional space and construct that includes physical and virtual spaces and transcend traditional boundaries. They face an ever-changing variety of physical and virtual competitors. Thus, companies no longer compete in the traditional ways

for market share or industry position, but rather for market space that either exists in multiple domains or is waiting to be created (Mische, 2001). Expanding world-wide competition, fragmenting markets, and emerging technologies force established firms to create new sources of wealth through new combinations of resources (Guth & Ginsburg, 1990). To navigate effectively in this new competitive landscape, and to build and maintain competitive advantage requires new ways of doing business.

With the changing dynamics in the new competitive landscape, firms face multiple discontinuities that often occur simultaneously and are not easily predicted. Faced with escalating complexity in the business environment, firms must develop new strategies and new ways of organizing to deal with this exceedingly complicated landscape. It requires that they use the latest technology, continue to develop new technology, actively participate in global markets, structure themselves to gain advantage in these markets, develop and maintain strategic flexibility, and build a long-term vision that allows managers to balance short-term performance with long-term needs (Hitt et al., 1998). To gear up to the afore-mentioned global challenges, organizations need to be flexible enough to the changes in the business environment, both in the proactive sense and in the reactive sense to achieve strategic organizational renewal, on a sustained basis. Indeed, competitiveness in such challenging times will demand among other things, flexibility, especially on strategic dimensions (Momaya, 2002).

Strategic flexibility

The dynamism, uncertainty and unpredictability in the new competitive landscape require substantive changes in many firms to be competitive. Perhaps the most important attribute that firms must achieve to operate or navigate effectively in such a new competitive landscape is that of strategic flexibility (Hitt, Keats and DeMarie, 1998).

Broadly speaking, a firm's strategic flexibility stands for "not putting all of one's eggs in a single basket" (Ansoff, 1965) or "the ability to keep options open or exercise flexible options" (Bowman & Hurry, 1993) or "the capability to switch gears" (Hayes & Pisano, 1994) or "degrees of freedom of managers in high technology product markets to coordinate products, manufacturing processes, markets, distribution channels, and competitive boundaries that are in a state of continuous flux" (Evans, 1991). Indeed, it is the capability of a firm to proact or respond quickly to changing competitive conditions and thereby develop and / or maintain competitive advantage (Hitt et al., 1998).

Creating and maintaining competences in dynamic market environments requires the flexibility to acquire / access and deploy assets in new ways appropriate to changing circumstances (Sanchez in Volberda & Elfring, 2001). Thus, in dynamic product or resource markets, strategic flexibility – the ability to change or stretch (Hamel & Prahalad, 1994) a firm's strategic uses of resources and capabilities (Sanchez 1995; 1997a) or exercise their potential fungibility (Mahoney & Pandian, 1992; Penrose, 1959; Teece, 1982) to maximize the value extracted from them (Danneels, 2007) – becomes critical to a firm's success in competence-based competition. Strategic flexibility has been characterized as depending jointly on a firm's resource flexibilities and the co-ordination flexibilities of a firm's managers in imagining new configurations and uses for current and new resources (Sanchez, 1995a). In this view, the

flexibilities of a firm's resources and managerial co-ordination increase with the number of alternative uses to which a firm can apply its resources and capabilities, and decrease with the cost and time required to change from one alternative use to another. Taking a related view, Volberda (1996a, 1998) proposes that a firm's organizational flexibility increases with the variety of actual and potential managerial capabilities the firm has, and with the rapidity with which the firm can activate its alternative managerial capabilities.

Strategic flexibility is a proactive and reactive organizational potential (Hitt et al., 1998), created by a flexible configuration of resources and broad strategic schemas (Volberda, 1998), whereby a firm can incorporate (create and exercise) various strategic options (Sanchez, 2004) for possible extension of firm's domain of competence and corresponding opportunity set (Covin & Slevin, 1991), for maintaining a dynamic fit between organization and environment (Volberda, 1998). Strategic options are the perceived opportunities to create value in the market. Eapen (2009) defines flexibility as the ability to select, defer, abandon, expand, switch, and optimize among alternatives that drive current and future decisions.

Such a strategic flexibility can be exercised on multiple fronts in the context of leveraging various resources e.g., human resources, financial resources, information technology, general resources (Volberda, 1998; Hamel and Prahalad, 1994). However, in this paper, our focus is restricted to a firm's flexible product development and allied practices in the context of a firm's attempts to renew itself on an ongoing basis.

Strategic renewal

Strategic renewal can be broadly defined as the activities a firm undertakes to alter its path dependence (Volberda et al., 2001). This definition is in tune with the definitional framework proposed by Sharma and Chrisman (1999) where strategic renewal refers to the corporate entrepreneurial efforts that result in significant changes to an organization's business or corporate level strategy or structure, and renewal activities reside within an existing organization, and are not treated as new businesses by the organization. Strategic renewal involves the creation of new wealth through new combinations of resources (Guth and Ginsberg, 1990). As such, the process of strategic renewal is applicable to all organizations of varying ages and sizes. To accomplish this, firms need to escape the competence trap by remaining in a dynamic capability building mode and continuously renew themselves by exploring opportunities arising in their environment (Teece et al., 1997).

Research Gap

Notwithstanding the literature on performance of firms and organizational change initiatives, there has hardly been any study investigating the links between various new product development practices of a firm and its market performance as well as financial performance (Zhou and Wou, 2010). These researchers have made rudimentary predictions that strategic flexibility strengthens the positive effects of new product development capability on exploration. However, detailed indicators of a firm's new product development, financial performance and market performance have not been included in these few elementary studies. This paper takes inspiration from the work of Balasubrahmanyam¹ et al (2013) that elaborates on various financial flexibility practices of a firm and their linkages to its performance on the dual fronts of market and finance. Our paper is an attempt to plug this research gap by streamlining various facets of flexible product development of a firm and linking them to its

strategic renewal in terms of its market performance and financial performance at a conceptual level.

Methodology

The paper takes the form of a theoretical discussion of few major practices of flexible product development that a firm can choose to exercise in its attempts to bring about strategic self-renewal on a sustained basis. As such, it entails an elementary assessment of the pertinent literature and streamlining the thoughts underlying various practices of flexible product development of a firm and associated concepts thereof.

New Product Development

Building on the conceptualization of new product development developed by researchers (Bedeian, 1980; Hunt, 1972), Volberda (1998) extended the concept of flexible product development to embrace (i) the hardware (like machinery and equipment) and the software (knowledge, techniques, and skills) used in the transformation of material or informational inputs into various outputs (either goods or services), as well as (ii) the configuration of the hardware and software. This conception of technology is applicable to all kinds of organizations, not just industrial or manufacturing.

Flexible Product Development

Based on literature review, we make an eclectic approach towards identifying related practices of flexible product development practiced by various firms. In the process, we attempt to identify the concepts underlying such practices in the following section.

(i) Product Development Stretch

Despite their fungibility, NPD practices are often not fully leveraged; i.e., they are used only in limited ways (Thomke and Kuemmerle, 2002). This lack of value extraction means missed profits for the firm, and for societal welfare at large it means that many benefits of technological progress are foregone (Danneels, 2007). Hamel and Prahalad (1993; 1994) refer to creative unbundling and rebundling of resources in the context of resource leverage apart from ‘core competence’ of a corporation. On the same lines, Danneels (2007) talks about de-linking and re-linking in the context of leveraging NPD practices. Delinking involves viewing NPD in its own right, as distinct from its embodiment in products; and re-linking involves applying the FPD to new products that address new customers (Danneels, 2002). Dougherty (1992: 78) mentioned the example of laser technology, which ‘underlies a wide range of products, such as fiber optic networks or cutting tools, which can be marketed to a wide variety of customers, from banks to surgeons.’

Flexible product development competence leveraging is a combination of the exploitation of an existing NPD competence and the exploration of FPD competences to serve new customers. Honda provides a classic example of technology leveraging, as it applies its NPD know-how and production facilities related to combustion engines to cars, lawnmowers, generators, motorcycles, and so on (Nevens, Summe, and Uttal, 1990). As another example, Canon exploits its expertise in optics and lens grinding to serve markets as diverse as photolithography,

cameras, and copiers (Nevens *et al.*, 1990). While Kodak fumbled and faltered in its shift from traditional photography to digital photography, Fujifilm looked further than simply moving to digital photography. Fujifilm used its expertise in handling various chemical elements and engineering atomic-scale particles to enter new and growing areas like films used in LCD panels for computers, television sets, and other electronic devices and thereby moved from a film company to a high-tech chemical company by leveraging its core competences learned from film (Muehlhausen, 2013).

Based on numerous studies conducted by A.T.Kearney, using a database that encompasses firms that account for 98% of the world market capitalization, Deans and Kroeger (2004) have examined 29,000 firms over 14 years in addition to interviewing CEOs during various briefings and have found that strategic stretch in the form of successful, profitable, value-building growth is always possible in any industry, in any region, in any phase of the business cycle. With such a huge database of real-time corporate examples of strategic stretch in one's armour, organizations should leave no stone unturned in leveraging their technological resources by exploring and exploiting various strategic stretch options through exercising their FPD practices. However, it is worth noting that strategic flexibility and resource leverage practices go much beyond NPD resources. It is, therefore, the smart orchestration of resources, both technological and non-technological, that would pave way for the firms in extending their frontiers of businesses (Balasubrahmanyam⁴ in Chatterjee et al, 2013).

Thus, we can see that resource leverage entails extraction of additional value from under-utilized resources and creation of new strategic options by way of such a creative unbundling and rebundling of both firm-specific and firm-addressable resources. Such a task encompasses

exploration and exploitation of different resource configurations by a firm across various possible functional, cross-functional, cross-unit, cross-hierarchical and cross-value activities (undertaken in a spirit of perpetual corporate entrepreneurialism) in its attempt to achieve a dynamic fit (encompassing fit and stretch) between the organization and its environment.

(ii) Exploration of Alternative NPD Competences:

When the traditional companies have been adopting compressor-based NPD competence for making refrigerators, Godrej & Boyce has employed a dual business model comprising traditional compressor-based refrigerators on one hand and peltier cooling-based technology in its portable cooling solution ‘Chotukool’ targeting the blue ocean markets of the rural markets in emerging economies like India (Balasubrahmanyam² et al, 2011; Dhanaraj et al, 2011). In a similar vein, Embrace has taken to Phase-Change Material-based technology in making world’s most affordable portable infant-warmers for Bottom-of-the-Pyramid (BOP) markets as against the traditional expensive incubators used by corporate hospitals (Radjou et al, 2012). The example of Tata ‘Swach’ employing novel boundary-spanning technologies comprising particulate technology, nanotechnology and chemical technology is a case in the point (Balasubrahmanyam³ et al., 2011). There are many emerging technologies such as 3D Printing, Genetic Modification, Cloud Computing, Augmented Reality, Vertical Farming and Synthetic Biology that can help firms in coming up with products that are better, cheaper, faster and smarter and enhancing their technology flexibility (Barnatt, 2012).

(iii) NPD Process Flexibility via Flexible Manufacturing Systems

There are several business examples wherein alternative process technological innovations have resulted in substantial cost reductions or ‘cycle time’ reductions (Mische, 2000). For example, Gujarat Ambuja Cements, the lowest cost cement producer in the world, has taken recourse to unconventional alternative raw materials (husk and crushed sugarcane in lieu of coal wherever possible; paper bags in lieu of jute bags), alternative logistics (shipping in lieu of road and rail), and a wide variety of other energy-efficient and resource-conserving technological process innovations in its stunning success in the cement industry (Vedpuriswar, 2005). Other technological process innovations can come from Agile Manufacturing, Computer-Aided Design, Computer-Aided Machining, Computer-Integrated Manufacturing, Robotics and Multi-Purpose Machinery in the form of Flexible Fabrication Systems that bring down the costs, cut down the cycle times, improve quality and reliability and thereby improve the overall customer value proposition that an organization can offer to their markets (Volberda, 1998).

(iv) New Product Developmental Boundary-Spanning (Diverse R & D):

In a spirit of resource complementation (Hamel and Prahalad, 1994) and diverse R & D (Horwitch & Thietart, 1987; Volberda, 1998), Rosenkopf and Nerker (2001) dwelt at length on a firm’s exploration initiatives in the form of boundary-spanning activities comprising NPD boundary-spanning and organizational boundary-spanning. Tata ‘*Swach*’, the world’s most affordable water filter embraces both kinds of boundary-spanning. In the making of Tata ‘*Swach*’, the Tatas have adopted an eclectic approach towards making a high-quality product through various boundary-spanning activities by enlisting the support of multiple companies under their group such as Tata Chemicals Limited (TCL), Tata Consultancy Services (TCS) and Titan Industries (TI); and outside their group that brought with them their diverse

technological or / and marketing expertise (e.g., TCS in materials technology; TI in special-purpose machinery; TCL Innovation Labs in nanotechnology; TCL in manufacturing technology for chemicals, fertilizers, and other consumer products such as salt; Design Directions in Industrial Design) to the table (Balasubrahmanyam³ et al., 2011). Other examples such as ‘mobile internet’ (Kim and Mauborgne, 2005), ‘smart toilet’ of Toto and ‘photo-CD’ of Kodak (Hamel and Prahalad, 1994) and ‘internet telephony’ of Vonage and Skype (Mullins and Komisar, 2009) stand as specimens for various technological boundary-spanning activities of respective firms. The case of Tata ‘Swach’ also exemplifies resource stretch (use of Rice Husk Ash as a key ingredient); use of alternative technology (as against other traditional water purification technologies such as reverse osmosis, ion exchange technology, resin-based technology etc); inter-unit R & D collaboration (with firms within the Tata group) and inter-firm collaboration (with firms outside the Tata group). This practice can entail leveraging multiple technologies from diverse domains or can embrace some of the emerging technologies as well.

(v) RPD & Flexible Product Development:

Chrysler’s operational excellence is supported, in part, by the use of the CATIA software product that allows it to test thousands of engines, suspensions, drive trains, and seat designs without incurring the expense and time of building physical models. In its endeavor to substantially compress the product development time (Mische, 2000). This capability provides Chrysler with the ability to virtually simulate an infinite number of permutations and combinations while reducing development time by at least six months and cost by millions of dollars. On similar lines, Millennium Pharmaceuticals uses upcoming technologies such as combinatorial chemistry, high-throughput screening and bioinformatics towards achieving

process automation and robotics, parallel processing of steps, and early screening of less-promising drug candidates (Thomke, 2001). Smith (2007) dwells at length on flexible product development right from agile engineering of software systems to other non-software products such as mechanical systems (via physical prototyping) and electrical systems (via programmable components such as field-programmable gate arrays) through modular product architectures and other flexible organizational practices. There are many studies in the context of rapid prototyping and rapid product development (Onuh & Yusuf, 1999).

(vi) NPD Based on Reverse Engineering:

Legally, reverse engineering is deemed as “a fair and honest means of starting with the known product and working backwards to divine the process which aided in its development or manufacture” (U.S. Supreme Court, 1974). Reverse Engineering is a process of measuring, analyzing, and testing to reconstruct the mirror image of an object or retrieve a past event (Wang, 2011). It is a technology of reinvention, a roadmap leading to reconstruction and reproduction. Swiegers (2012) dwells at length on bio-inspiration and bio-mimicry in chemistry via reverse-engineering from the nature. Generic drugs in the pharmaceutical industry, subject to regulation in the respective countries, serve as examples of business prospects of reverse engineering.

Much of the financial bonanza created by EMI’s invention viz., computerized axial tomography (CAT scan) ended up in the pockets of General Electric and other competitors that, once having figured out a way around or through EMI’s patents via reverse engineering, used their distribution clout and manufacturing excellence to squeeze EMI out of the market (Hamel

and Prahalad, 1994). Although subsequent court decisions have upheld some of EMI's patent claims, once the product was in the market it could be reverse engineered and its essential features copied (Burgelman et al, 2009).

However, obsessive benchmarking with competition and reverse engineering can prove costly sometimes as has happened in the case of redesign project of 'Taurus' car by Ford based on its primary benchmark viz., Toyota's Camry (Mische, 2000). The new analytical technologies, such as three-dimensional (3D) laser scanning and high-resolution microscopy, have made reverse engineering easier, but there is still much more to be learned (Wang, 2011). Firms, therefore, need to tread their path carefully whenever they attempt to reverse engineer competitor's products as "me-too" orientation may invite legal entanglements due to infringement of IP rights or may destroy the value proposition of such an imitating company might suffer damage of image in real terms or in the eyes of the customers. Nonetheless, a smart blend of analogs and antilogs, from within the industry and beyond the industry, can be a good starting point for any firm in its pursuit of new businesses (Mullins and Komisar, 2009) as against outright reverse engineering of a single product, by and large.

(vii) Platform Development and Crowd-sourcing:

Cusumano (2010) illustrates several platform developers or complementors to an existing platform as strategies with larger business prospects across a longer time horizon than firms making stand-alone products. Whether it is the Salesforce.com that has AppExchange platform or Microsoft that has windows operating system or Wal-Mart that has its unique procurement system, all these examples stand for platform products serving as a fulcrum for many add-ons to be developed by complementors (Nambisan and Sawhney, 2008). Once successful, the network effects take the platform leader's revenues to get augmented multiple times with the

respective share of benefits accruing to all the ecosystem members (Iansiti and Levein, 2004). In an era of network-centric innovation and crowd-sourcing where total solutions are sought after by customer, the ecosystem principles and practices become more and more indispensable than any stand-alone product strategies by individual firms. In light of these trends, firms need to exercise their technology flexibility in playing a platform strategy or complement strategy, in accordance with their resources and capabilities. Yet again, across industries or domains, and across time, a firm's role can vary and therefore it has to exercise its technological flexibility towards finding an optimal fit between itself and the business environment (Volberda, 1998).

(viii) Leveraging Enabling or Assistive Technologies

Flexible use of enabling technologies or / and assistive technologies that tend to generate giant leaps in performance and capabilities of the user can increase the market share for a firm or even create a blue ocean market. For example, enabling technologies like telecommunication technologies, internet, P2P technology and groupware have leveled the field so that even smaller firms are able to compete in areas where they otherwise could not. The example of Skype that uses PCs, internet and P2P technology is a case in the point (Mullins and Komisar, 2009). So also, the disintermediating internet-centric business model of Dell beating industry incumbents like HP and Compaq in the PC industry also stands as a glaring business example of the times as to the range of quantum impact these enabling technologies can make in the respective industries (Hamel and Prahalad, 1994). Assistive technology items range from better designed pens, furniture, kitchen appliances, text-to-speech and speech-to-text software, screen enlargers that simplify the lives of the users who might have some disability or the other. The value innovation of Novo Nordisk in the diabetic drug market in catering to the unique

needs of the diabetic patients (some of whom are blind too) in removing the key pain point viz., syringes and needles and traditionally absent fool-proofing (or blind-proofing here) through its novel insulin delivery mechanisms in the form of Novo Pen and Novo Let (Kim and Mauborgne, 2005). Thus, assistive technologies substantially enhance value for the users, particularly the users with disabilities by alleviating and ameliorating their lives while enabling technologies provide support to small firms in their launching of disruptive businesses into the market.

(ix) Applied R & D

Industrial organizations, by and large, tend to gain from applied R&D that entails the spirit of Jugaad or bricolage aimed at addressing a specific problem faced by the firms. This is more so because of the longer time horizons and other uncertainties that a basic R&D entails (Radjou et al, 2012). Molecular genetics and genome research (Jacob, 1982; Duboule and Wilkins, 1998) and development of wind turbines in Denmark (Garud and Karnoe, 2003) bring out the predominant component of improvisational ‘applied R&D’ which often prove to be more effective than the engineering science-based technology-push model. This technology flexibility of ‘applied R&D’ comes in handy for firms in terms of reduced cycle times, reduced costs etc.

(x) Organizational Ambidexterity:

Govindarajan and Trimble (2010) highlight the conflict between the dual organizational activities of exploitation and exploration. This could be seen in the corporate examples such as Kodak with conflict between the two businesses of chemical film-based photography and digital photography (Gavetti et al, 2005). Xerox Corporation is yet another example of such a conflict between photocopying business and other path-breaking technologies at its PARC laboratory (Chesbrough and Rosenbloom, 2002). This is quite common in many established organizations that have been commercially successful with a particular product innovation because of which they tend not to see the disruptive innovations on the horizon. However, firms like GE Medical Systems are successful in handling a dual model with one of them catering to rich markets while the other targeting the emerging markets (Govindarajan and Trimble, 2012). Such organizations are said to be ambidextrous in view of their ability to pursue incremental innovations and radical innovations simultaneously. This technological flexibility to move between these two kinds of innovation becomes critical in view of the changing market dynamics.

(xi) Multi-Project Research Programmes

Firms often undertake multi-project research programmes for product development in a spirit of portfolio approach (Nobeoka & Cusumano, 1997). This entails creation of strategic core programmes in research, which are made up of various projects (Volberda, 1998). Using 17 examples including Honda, Chrysler and Toyota, Nobeoka and Cusumano (1997) in their study on concurrent, sequential design transfers and design modifications in comparison to new design development from the scratch, have found that rapid or concurrent design transfer help firms grow sales more quickly compared to other alternatives where, for example, firms develop new products one at a time or transfer designs slowly to other products in a sequential

manner. In a study on home appliances market, Worren et al (2002) have found that modular product and process architectures indeed are key enablers of strategic flexibility. Sanchez and Mahoney (2001), based on their several studies, also suggest that modular product and organization designs provide a fundamental framework for improving the adaptive coordination of firms in dynamic environments.

(xii) External R & D Collaboration

Initially, Eli Lilly, in collaboration with Icos, has developed Cialis drug, for Erectile Dysfunction and in due course of time, Eli Lilly has ended up buying Icos in view of the humongous business opportunities in the use of the drug's base chemistry to develop treatments for cancer and other medical conditions (Capron and Mitchell, 2012). The example of 'Tata Swach' the world's most affordable water filter also embraces this R & D collaboration between firms under the Tata group on one hand and a design firm 'Design Directions' (Balasubrahmanyam et al, 2011). There are many such external technological collaborative attempts in the form of strategic alliances with firms outside the business group of a firm. This can be called organizational boundary-spanning (Rosenkopf and Nerkar, 2001).

(xiv) Internal R & D Collaboration

R & D collaborations can happen even between different units of the same firm (inter-unit and intra-firm) or between different organizations falling under the same business group (inter-

business and intra-group). The world's most affordable water filter 'Tata Swach' is an example of different companies under the same business group of Tatas is a case in the point. Tata Consultancy Services, Tata Chemicals Limited and Titan Industries of the same Tata group have collaborated by bringing in their respective technological skills to the table (Balasubrahmanyam et al, 2011). There are many such real-time business examples of intra-firm (and intra-firm) and intra-group (and inter-unit) R & D collaboration towards developing next generation technologies and products. Here also, we can see the concept of boundary-spanning conspicuously present in terms of inter-unit or / and inter-organizational collaboration.

Performance Indicators of Strategic Renewal

(i) Market Performance

This construct can be operationalized by three sets of questions that captured the perceived rate of growth (absolute, relative to largest comparable competitor and relative to the total market) of each of the company's market shares in exploitative innovations, intermediate products and exploratory innovations on a three-year horizon (Jansen et al. 2005; Benner / Tushman, 2003; Hamel & Prahalad, 1994; Minter, 2002; Covin & Slevin, 1991; Morris & Sexton, 1996; Stetz et al. 1998). These questions can be developed in harmony with the first and the third principles of self-renewing organizations viz., the principle of managing internal rates of change (to match or exceed the pertinent external rate of change) and the principle of synchronizing concurrent exploration and exploitation (Volberda & Lewin, 2003).

(ii) Financial Performance

This construct can be operationalized by nine questions / items that captured the rate of growth in total annual sales revenue, net annual profit, return on investment, earnings per share, return on equity, free cash flow, economic value added, market value added and people value added (Covin & Slevin, 1989; Zahra, 1991, 1993; Zahra & Covin, 1995; Wiklund, 1999; Antoncic & Hisrich, 2000, 2001; Lehn & Makhija, 1996; Dess et al. 2003; Schneier, 1997; Brealey & Myers, 1996).

Though the foregoing metrics of organizational performance are relevant for a firm's strategic renewal, in view of several facets of uncertainty in the complex and dynamic business environment in which firms operate, risk-adjusted performance measures (e.g., dynamic certainty equivalents such as projected cash flows multiplied by the respective probabilities of risk entailed, are preferred to the conventionally used static projected cash flows etc) would go a long way in making a better assessment of the organizational performance (Vedpuriswar, 2002). All the foregoing metrics of a firm performance do provide a better picture of the extent of strategic renewal that the firm undergoes, year after year, provided they are duly adjusted for various factors of risk that affect them. Indeed, this is the way to risk optimization which is way ahead of risk minimization, risk control or risk management.

Discussion and Implications for Organizations

Authors contend that, given the indicators of a firm's strategic renewal on the dual fronts of market performance and financial performance, firms that exhibit strategic stretch by judiciously adopting various practices of flexible product development, tend to survive and renew themselves in due course of time, regardless of the strategic discontinuities in the

business environment. Otherwise, myopic firms that adopt stereotyped technological practices keeping in mind the current market performance and current financial performance, tend to suffer reversals of fortune, when the environment changes in terms of competitors' unconventional moves or vagaries of the market forces that cause fluctuations in the risk profile in a firm's corporate portfolio or global trends that bring about disruptive technologies or novel business models or new ways of doing business that can wipe out the business of industry incumbents. Besides this, authors notice that, mere traditional technological process innovations aimed at cost-cutting or efficient manufacturing or the like tend to assume the status quo of business and industry. Though they are helpful in a static scenario, they are less likely to be of help in a dynamic environment. Environmental dynamism varies from industry to industry, however. Being constantly geared up towards various environmental uncertainties is quintessential for all firms that are ambidextrous viz., smart in leveraging exploitative (incremental / sustaining) innovations while building on exploratory (radical) innovations, both at the same time.

Indeed, a smart firm always strikes a blend of numerator management (augmenting revenues), denominator management (cutting costs) and multiplier management (leveraging various economies of scale, scope and diversity) (Hamel and Prahalad, 1994; Mische, 2000; Foss and Christensen, 2001) rather than relying solely on managing just one of the three approaches. It is here that discreet practices of technology flexibility that come to the rescue of a firm, regardless of the market and environmental uncertainties. Thus, one can see the long-term utility of a judicious mix of corporate practices of technology stretch, technological boundary-spanning, exploration of alternative technologies and so on. While some of these practices help the firm in exercising its flexibility with its existing resources at its disposal and thereby leverage them optimally, some others are intended to remain unconstrained in expanding

existing businesses or launching new ones, notwithstanding the apparent resource constraints or paucity of funds or market aberrations or competitive actions faced by the firm at any given point of time.

While these practices of flexible product development can be put to practice, firms can learn from the lessons garnered from the effects of these practices on their market and financial performance and accordingly go about revising / refining them, in due course of time.

A firm can optimally exercise its flexible product development when it embraces 'real R&D options' which are usually embedded in projects or processes, where management has the on-going capacity to alter the R&D investment timing, amounts and/or ultimate project, or downsize or abandon the R&D (Paxson, 2003). This is akin to the spirit of discovery-driven planning (McGrath and Macmillian, 1995) or field-tested dashboarding (Mullins and Komisar, 2009) or expeditionary marketing (Hamel and Prahalad, 1994) that tend to take care of corporate inertia of direction, if any. These practices help firms in putting a check to various traps like 'familiarity trap', 'propinquity trap' and 'maturity trap' that many an organization tend to fall in due course of time (Ahuja and Lampert, 2001). All these practices basically involve conducting small-scale experiments and go about iteratively revising the strategic moves based on the market feedback gathered from each of such experiments. Such a resource leveraging prudence backed by pertinent smart practices of flexible product development can go a long way in a firm's smooth journey of strategic self-renewal, on an ongoing basis.

However, a befitting business model should accompany the NPD decision that a firm takes for greater prospects of business success at the marketplace particularly in light of several

technological breakthroughs such as Motorola's Iridium and Philips' CD-i commercially fizzling out (Kim and Mauborgne, 2005). Sometimes, even the so-called great technological breakthroughs might not even find an opportunity to enter the marketplace unless and until they get separated as spin-offs, in view of corporate inertia of direction in the form of myopic obsession with one successful product and its business model in the market at a given point in time as has happened with the technological breakthroughs at the PARC laboratory of the Xerox Corporation (Chesbrough and Rosenbloom, 2002). Conflict of interests between the existing and new business models apart from inappropriate incentive plans to employees can spell doom for new models often when the same organizational banner continues to own and monitor both the existing and the emerging business opportunities particularly when the same old metrics and incentive structures of the existing businesses are blindly extended to the new businesses as has happened with firms like Kodak (Gavetti et al, 2005). This is often accompanied by an oblivious mindset, rigid organizational structures and culture that tend to miss out on latent business opportunities of the technological breakthroughs that a firm's R&D units come up with as has happened with the Xerox Corporation (Chesbrough and Rosenbloom, 2002).

Besides these, more than any FPD initiative, it is the unique customer value proposition that is more important in many markets as can be seen from the examples like Blyth Industries in an otherwise mature or declining candle industry (McGrath and Macmillan, 2000). In addition to this, disruptive innovations in the form of affordable 'good enough' solutions (as against the so-called 'best' solutions that are expensive) such as Skype, Vonage, 'personal photocopiers' in some markets or market segments may also be taken into account. Other process innovations of organizations like Narayana Hrudayalaya or affordable innovations like 'Jaipur Foot' from

emerging economies like India tend to promote medical tourism by virtue of their compelling customer value propositions (Prahalad, 2010; Mullins and Komisar, 2009).

Moreover, in view of customers' seeking total solutions, smart organizations take cue from firms like Microsoft, Wal-Mart and eBay that embrace the principles of a business ecosystem and symbiotically promote their business ecosystem partners lest collapse their own businesses like Enron, Yahoo and AOL during nineties and electric car businesses prior to Better Place that have failed to take care of their business ecosystems (Kim and Mauborgne, 2005; Iansiti and Levein, 2004; Johnson, 2010). More than anything else, firms need to carry out technology due diligence and strategic due diligence on an ongoing basis in their attempts to develop and traverse an optimal roadmap to corporate growth via build, borrow and buy decisions in a spirit of real options, scenario planning and organizational sense-making both spatially and temporally (Andriole, 2009; Rosenbloom, 2002; Capron and Mitchell, 2012; Razgaitis, 2003; Lindgren and Bandhold, 2009; Maitlis, 2005). Only then can a firm come up with better or greater customer value propositions that can be compelling enough to entice new customers or at least retain the existing ones. In some contexts, novel schemas and novel interpretations coupled with the spirit of *Jugaad* can accomplish organizational objectives as can be seen from the unconventional uses of washing machines such as lassi-making and washing vegetables (Volberda, 1998; Radjou et al, 2012) or out-of-the box solutions like NASA's launching of 'Mars Explorer' first to a particular orbit of Venus wherefrom to Mars next, based on the momentum built and the eventual 'slingshot effect' based on the gravity of Venus (Seshadri and Maital, 2007). Smart firms, in pursuit of successful, profitable and value-building growth, embrace strategic flexibility in their strategic thinking and actions not just on the technology front, but on the multiple fronts of various key resources like business models, human resources, knowledge management systems, financial resources and production systems while

learning from success and failure stories of other firms both within and outside one's industry, which will go a long way in achieving the strategic stretch of any organization, in any industry, in any geography and in any phase of the business or technology life cycle (Volberda, 1998; Deans and Kroeger, 2004; Mullins and Komisar, 2009).

Managerial Implications

NPD being a platform resource that a firm possesses, every attempt should be made to leverage such a resource towards optimally managing the diverse portfolio of projects that a firm undertakes in its endeavor to fructify its strategic renewal goal, on a sustained basis, in a spirit of real options. A smart firm will achieve 'more for less' or strives to make a greater bang for the given buck or the same bang at a lesser buck or ideally greater bang for a lesser buck (Hamel and Prahalad, 1994). Technological smartness on the part of firms as evinced in their practices of technology stretch, technological boundary-spanning and exploration of alternative technologies along with complementary business model flexibility, apart from other kinds of strategic flexibility (e.g., HR flexibility, IT flexibility, flexibility of operations etc), can go a long way in the scintillating odyssey of a firm's strategic renewal, over time. Firms need to explore the utility of these practices and exploit them by striking a judicious blend of leveraging as many firm-specific and firm-addressable resources as possible. Learning happens from iteration to iteration, possibly on a smaller scale in the beginning phases and proactive firms learn incessantly from all such experiments and leverage the lessons that these experiments impart, in due course of time. Wherever possible, smart firms like General Electric Medical Systems pursue dual business models in parallel (e.g., GE's expensive and inexpensive ECG machines and ultra-sound scanners). Whenever a firm faces difficulties in this regard, prudent firms trigger spin-offs for new technologies or parallel business models under a different corporate banner as has been done by Xerox Corporation (though in a belated manner) to

handle conflicts of interest for various stakeholders including employees and customers in an attempt not to jeopardize the overall business interests of any corporation.

Social Implications

‘There is no dead resource whatsoever in this universe’ might be an old saying, but its truth remains the same, as ever (e.g., RIM’s use of the seemingly defunct pager technology). So also, ‘not putting all of one’s eggs in the same basket’ finds its exemplars in our day-to-day lives as well. Resource conservation and judicious leverage of resources, as reflected in the exercise of various practices of technology flexibility, help firms in augmenting the business prospects of many corporate entrepreneurial endeavors and shoring up their corporate fortunes on one hand while increasing the employment prospects of the nation on the other hand. Firms can benefit from such takeaways of technological resource prudence from other benchmark firms, both intra-industry and inter-industry, while setting their own benchmarks for other firms, in due course of time. Thus, in a spirit of constant learning, firms can display higher levels of resource-smartness in their day-to-day activities in their attempts to create new wealth, both for themselves and for the society at large. Disruptive and affordable technological innovations such as portable infant-warmer of Embrace; portable ECG machines and ultrasound scanners from General Electric have far reaching consequences particularly in the BOP markets of the emerging economies. Recycling of a dead pager technology by RIM is an eye-opener to all stakeholders of the society. All these examples prove the truth in the maxim: ‘Where there is a will, there is a way’. Indeed, the society can be sanguine about various affordable and functional solutions within their reach. In fact, even the rich customers from the West have started taking recourse to such affordable solutions from the emerging economies (e.g., Narayana Hrudayalaya).

Contributions of the Study

This paper attempts to provide a snapshot of various corporate practices of flexible product development that can go a long way in the strategic self-renewal of many an organization. It endeavors to streamline thoughts and varied perspectives of various practices of technology flexibility from all the related strands of literature eclectically chosen from resource leverage, strategic flexibility, dynamic capabilities and strategic renewal. It is an eclectic work drawing from the works of several academicians and practitioner perspectives. However, it is a developmental paper and it triggers discussion on this scantily addressed theme of linking technology flexibility to the organizational renewal of a firm, on the dual fronts of market performance and financial performance in a greater detail.

Limitations of the study and Directions for future research

The study is just a preliminary attempt to link the corporate practices of a firm's flexible product development to its strategic renewal. As such, this is a developmental paper and many of its suggestions require rigorous testing through studies in a wider array of settings.

Conclusion

Notwithstanding the merits of various practices of flexible product development, there has been a dearth of literature on their contributions to strategic renewal of firms. This paper attempts to provide triggers for greater discussions and subsequent investigation of the impact of a firm's practices of FPD initiatives on the strategic self-renewal prospects of the firm. Firms can learn from various analogs (positive benchmarks) and antilogs (negative benchmarks) from other firms within the industry as well as those outside the industry in terms of the best practices of flexible product development. Several real-time corporate examples like the ones cited in this

paper do serve this purpose very well, for any organization that is keen on learning first from the lessons of its predecessors or competitors within the same industry or counterparts in other industries. Apart from such analogs and antilogs, a firm can learn from its own iterative experiments on a small scale, in a spirit of discovery-driven planning of its technology-related activities, in arriving at a better blend of technology flexibility practices. While such a technology flexibility is likely to be helpful in leveraging its technological resources, firms cannot afford to ignore strategic flexibility practices related to other non-technological resources such as business models, human resources, knowledge management systems, information technology, product-market combinations and so on. It is only such an eclectic approach to optimal orchestration of resources or resource leverage that firms stand to gain a lot than merely from technology flexibility practices alone. Moreover, a firm can face risk not only on the technology front but also on the market front, apart from a wide variety of other sources such as operations, technology and human resources. All of those non-technological risks also need to be taken into account while a firm arrives at an optimal blend of flexible strategies in an interlinked manner in its attempts to bring about its strategic renewal on a sustained basis. Such a holistic approach to strategic flexibility in terms of leveraging various resources that offers an integrated perspective to firms and bring about various synergies associated with such a corporate focus and consistency in NPD initiatives.

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