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Effect of Environment and Leadership Style on Product Development, Value Creation and Open Innovation for Missions in Strategic Sectors like Defense, Space[1]

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Abstract

*A key issue in **Product Development** (PD) projects is defining which responsibilities should be kept in-house and which ones could be delegated to other organizations. Research and Practice clearly advocate that successful product innovations will be more value creating events, provided integrating customers into the product development (PD) process is managed effectively. Since applications of material/components/modules are critical, it is also equally important to create collaborative approach with other strategic partners (vendors/contractors) along with integration of customers' contributions throughout the product innovation and application process.*

The concept of open innovation has recently gained widespread attention in commercial sector but is non-existent in strategic sector like defence and space. It is particularly relevant now because many firms are required to implement open innovation especially in light of offset policy of Government. Despite difficulties associated with managing these activities, there is a need to identify critical factors for successful PD projects.

Through incidents based analysis, we also find additional support for change in leadership style especially in a dynamic/complex environment for joint value creation and incorporation of open innovation into an organization's PD activities in strategic sectors. Our findings are based on preliminary analysis of select incidents of the PD activities of an in-house developer and product development contractors, along with end-customers.

We evaluate the literature and assess whether open innovation is a sustainable trend rather than a management fashion.

On this, we present a conceptual framework that provides the foundation for discussing critical open innovation processes and their implications for effective management. We also attempt to understand efficacy of the framework in strategic sector like defence, space etc.

Introduction

Generally, strategic sectors like Defence, Space are managed through mission driven leadership. In a complex and dynamic environment, stream of new products development in these sectors are managed with a leadership style that is guided by collaboration amongst supply chain partners for leveraging joint knowledge, assets and innovation. In this context, understanding of the environment-leadership-strategy framework on product development, value creation and open innovation require better insights.

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Literature Review

Adopting a Resource and knowledge-based view, and assuming that the strategy's locus is primarily knowledge creation (exploration) and knowledge application (exploitation); studies have been conducted that suggest that the knowledge strategy is a managerial strategic choice that is related to the environment and leadership. Studies indicate that exploration and exploitation must be combined according to environmental factors by generating alternative knowledge strategies of ambidexterity or punctuated equilibrium. The environments characterized by high levels of both dynamism and complexity product development efforts pursue and reinforce both explorative and exploitative activities through a knowledge strategy of ambidexterity. (Revilla *et al*., 2010). Such actions are well researched in literature. However, the collective **creation** of **value** at firm-level has remained underexplored in management research. Drawing on social psychology and behavioural economics, some authors have analyzed impact of the mix of employee motives to cooperate and compare the collective **value** generated by three motivational systems: individual monetary incentives, benevolent cooperation, and disciplined cooperation. Aligning the motivational system with the mix of motives in the workforce allows firms to foster cooperation and realize the **value creation** potential of their resources (Bridoux *et al*., 2011). Such value creation across supply chain partners is lacking in-depth research.

Because firms catering strategic sector needs operate in increasingly turbulent and complex environments, they need to be more proactive and innovative. Networks are gaining in importance, especially for small and medium enterprises with limited resources of R&D. Co-operations along the value chain seem to be the only way to succeed with technologically challenging and promising but also expensive and risky product innovations. One of the key problems of these networks, however, is the question of how to plan, organize and control the innovation processes that are distributed over several partners. Theoretically derived and empirically proven success factors could help as much here as in the traditional success/failure discussion of new product development within firms. The factors like market potential, product advantage, and technological synergy, proficiency of technological or marketing activities are found to be key contributing factors. In addition, factors derived from recent network research (e.g. trust or dependence on partners) are also being found to be equally important (Rese and Baier, 2011). Such factors have also been categorized as Infrastructure, Process and Managerial.

The competitive strategy developed by Michael Porter emphasized rivalry, buyer power, and barriers to entry as forces that could enhance a producer's surplus. This theory does not account for external sources of value to a company, such as innovation communities, volunteer contributors and surrounding networks, including social networking web sites, open source software and the Wiki model of open contributions. The concept of openness requires shifting from ownership to value creation and value capture (Chesbrough and Appleyard, 2007). In this context, although Open Innovation has been a highly researched and debated topic in the last decade, many relevant issues remain largely unexplored so far. It has been found that some firms tend to leverage exploitative inter-organizational networks, characterized by strong ties and by the presence of several heterogeneous actors such as customers, suppliers and universities. Moreover, they establish dedicated units to institutionalize structured and formalized screening processes for managing Open Innovation projects. Other firms enter instead into networking relationships mainly for explorative purposes, establishing weak ties with public research centers or universities. They adopt more informal, ad-hoc structures and evaluation procedures, very often embedded in the already existing R&D departments. Such differences descend from a number of industry-level variables, i.e., R&D intensity, strength of the appropriability regime, turbulence and uncertainty (Buganza *et al*. 2011).

Traditionally, industrial firms developed new technologies for their own products internally. Thus, most companies pursued relatively "closed" innovation strategies, meaning limited interactions with the outside environment. In recent decades, these strategies have begun to change as firms across industries. In light of these developments, in 2003 Henry Chesbrough coined the term "open innovation" (Chesbrough, 2003) to describe innovation processes in which firms interact extensively with their environment, leading to a significant amount of external knowledge exploration and exploitation. In addition, firms increasingly maintain knowledge outside their organizational boundaries over time, and this dynamic perspective points to interorganizational relationships as an extension of firms' vinternal knowledge bases (Grant & Baden-Fuller,2004). Despite its growing importance, many firms experience severe challenges in actively managing the processes of open innovation. The firms had to overcome major challenges at the beginning of their open innovation initiatives and there are major inter-firm differences in how open innovation is successfully managed (Lichtenthaler, 2011). In this regard, Open Innovation Alliances (OIAs) differ substantially from traditional, closed alliances in many aspects, including their strategic scope and scale, governing mechanisms, and member composition, it is important to understand and assess the potential value inherent in these new modes of collaboration, especially in context of strategic sectors (Hen *et al*. 2012).

Based on limited literature review on the subject, one may summarize key research variables for successful attainment of vision/mission are environment factors (simple/static, complex/dynamic), leadership (firm focus, network specific), product development (in-house, hybrid, outsource), value creation (firm level, supply chain level) and innovation (close and open).

Conceptual Framework

In order to study the subject, a conceptual framework is being proposed in the study. It has 'attainment of mission' as dependent variable with measurement on 1-5 scale (1 being no attainment and 5 being 100% attainment). Independent variable is assumed to be Environment (which may lie between scale of 1-5 where 1 is characterized as simple and static policy environment and 5 being complex/dynamic). Mediating variables like leadership style (firm focus, network focus), product development (in-house, hybrid, outsource), value creations (firm level, Supply chain level) and innovation (close and open) are also adopted for conceptual framework. The schematic conceptual framework is shown in Figure 1.

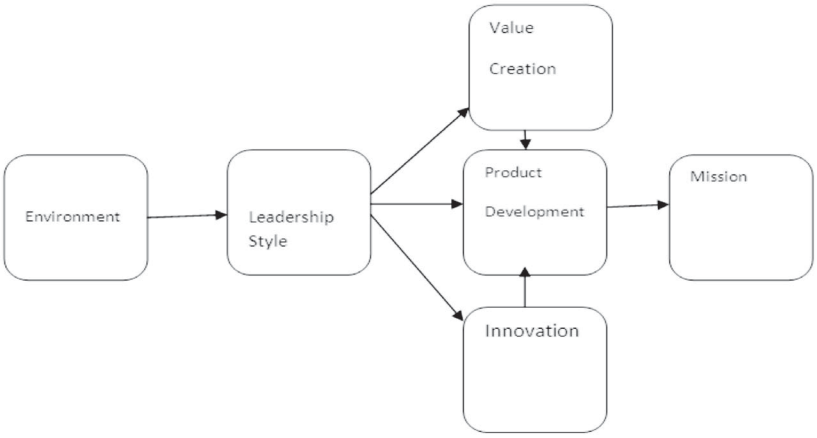

Figure 1: Conceptual Framework of Effect of Environment, Leadership on Value Creation, Product Development, Innovation and Mission

Methodology

In this study we have taken a few incidents in one of Indian Defence Public Sector of India which is supplier of strategic material for end-use in strategic sector like space and defence. An explorative qualitative research methodology uses incidents in past 10 years to understand linkages amongst the variables. Mission is linked to supply of semi-finished steel products for use in launch of different version of Indian satellite launch vehicles. The case study methodology is used to handle the exploratory component of the research. The purpose of the case study is aimed to evaluate the frameworks developed.

Brief Introduction to the Company and Products

Mishra Dhatu Nigam Limited (MIDHANI), a Mini Ratna Category I Status company is a Government of India enterprise under the Ministry of Defence situated in the historic Hyderabad city. The integrated metallurgical plant has one of the most unique facilities providing a truly Flexible Manufacturing System. An ISO 9001:2008 Company, MIDHANI manufactures a broad spectrum of special metals and alloys, including super alloys; titanium and titanium alloys; special purpose steels, controlled expansion alloys; soft magnetic alloys; electrical resistance alloys; molybdenum products and a host of other special products possessing special attributes tailor-made to suit specific customer requirements. Over the last three decades, MIDHANI has been catering to the critical requirements of a wide range of special metals, alloys and products for programmes of national importance in strategic sectors. These include rocket motor casings for PSLV & GSLV (Space); gun barrel forgings and other ordnance items for T-72 Tank, MBT Arjun & 155mm Howitzer (Armament); gas turbine materials for engines for MiG series of aircraft, for Kaveri Engines for Light Combat Aircraft (Aeronautics); nuclear grade steels for nuclear power plants (Atomic Energy) etc. The Company has gained the prestigious Source Approval of the Boeing Aircraft Company, USA, for supply of Titanium and Titanium Alloy products for their transport and Jet Aircraft programmes and has passed the quality assessment of Airbus Industries, France. “Self Certification” status has been bestowed on Midhani by Director General of Quality Assurance (DGQA) for supply of armament materials. The material produced by MIDHANI is many times an import substitute thereby fulfilling the objective of achieving Self-Reliance in Special Metals and Alloys in the country. MIDHANI is manned by a highly qualified and motivated team of technologists, engineers and workers. The rich knowledge-base of advanced metallurgy and the men who have created the same are the biggest asset of the Company which will stand the country in good stead in the years to come.

Incidents Based Analysis

The Space activities in the country started during early 1960s with the scientific investigation in space areas. The objective is to develop space technology and its applications o various national tasks. Accordingly, Indian Space Research Organisation (ISRO) has successfully operationalised two major satellite systems namely Indian National Satellites (INSAT) for communication services and Indian Remote Sensing (IRS) satellites for management of natural resources; also, Polar Satellite Launch Vehicle (PSLV) for launching IRS type of satellites and Geostationary Satellite Launch Vehicle (GSLV) for launching INSAT type of satellites.

Giant rockets that carry satellites, robotic spacecraft and manned spacecraft in to the space are known as Launch vehicles or boosters. Launch vehicle consists of three or four stages. These stages are assembled on top of one another, sometime a cluster of rockets called “Strap-On Motors” encircle the first stage of a launch vehicle. After lifting off from the surface of the earth a launch vehicle takes anywhere between ten to thirty minutes to place a satellite / spacecraft in its required orbit. Steel required for such launch vehicles require special shapes

coupled with equally complex and special chemical, physical and mechanical characteristics.

The components which are simple in nature may be available from the market (both domestic and international). Sourcing such material has not posed great challenge for leadership to sourcing and or producing. Innovation efforts of such material also have not posed risk of the project. In complex and dynamic environment, when sourcing became difficult, leadership in the sector was found to be net-work specific. Efforts were made to leverage private, private-public and public sectors' assets, knowledge and innovation. Such net-work based relationship encouraged value creation by capital and revenue advance to all types of industrial sectors including Midhani. This value creation also helped Midhani to develop special steel for launch vehicles. Later similar steel was also supplied for attaining of mission of other companies in strategic sectors. Innovation for such specialized products involved leveraging innovation of at-lease 5 more organization in open innovation style. Rings and Plates were tested started from raw-materials to intermediate to final stages in micro-details to ensure end use requirements. This also required net-work based behaviour of leaders through out-sourcing assets and innovation. Product development were guided by leadership style which not only created internal motivation systems like financial incentive and participative systems, but also helped in collaborating with other strategic alliance partners in the areas of forging, finishing and inspection. This collaboration was also found to be extended to innovation, resembling features of open innovations.

Research Findings

Using conceptual framework and incidents based case study of Midhani, it is evident that leadership style is greatly influenced by changes in environment. Leadership was more in-ward looking when environment was simple and static. With changes in environment, dynamism and complexity increased. It forced leaders to think beyond their organization's boundaries. It encouraged leaders for specific net-work relationship for contract manufacturing, collaborative innovation and joint value creations for attaining mission of timely launch. The findings may be tabulated in a 2*3 contingency table. Depending upon type of environment, leadership may change its style to effect on innovation, product development and value creation for successful attainment of mission.

Conclusions

Current understanding on Environment-Leadership-Strategy-performance is largely for simple/ static environment and firm-specific. The explorative research attempts to enlarge this understanding to complex and dynamic environment, where role of leadership style goes beyond own to network partners of supply chain. This helps in building joint value creations, product development and innovation. Such knowledge/system based strategy will help in attaining success both in simple and complex environment.

Table 1: Contingency Table of Environment, Leadership Style, Internal System, and Effect on Mission

Environment	Leadership Style	Internal Systems	Effect on Mission
Simple/static	Firm Specific Drivers	In-house Product, Value and Innovation	Mission attainment only in stable environment
Dynamic/Complex	Network Specific Drivers	Net-work based Product, Value and Innovation	Mission attainment not only in stable but also in dynamic/complex environment

The paper does not claim validation of conceptual framework though incidents based research.

For the same, there is a need to collect more cases and perception of strategic leaders in the sectors. For generalization, further extension to other industrial sectors will also be desirable.

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