Role of Organization Structure in Innovation in the Bulk-Drug Industry

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This study explores the relationship between Organization Structure and Innovation in the bulk-drug firms of India. Structure variables include Horizontal Complexity, Formalization, Centralization, Concentration of Authority and Participation in Decision-Making. Innovation includes Number of Innovations and Perceived Innovation. Data was collected from employees of two leading bulk-drug firms of India. Qualitative analysis was done using content-analysis. Statistical analysis showed significant relationship between horizontal complexity and number of innovations. Negative and significant relationship has been obtained between Centralization and Innovation and between Concentration of Authority and Innovation. A positive and significant relationship has been obtained between Participation in decision-making and Innovation.

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Organization Structure & Innovations

Structure is directly under the control of organizational decision-makers to influence innovations. An organization's structure can best be studied by using perceptual measures. Hage and Aiken (1977), Daftaur (1988), Reddy (1997), Singh and Pestonjee (1988), among many others, studied and measured organization structure as a perceptual/ behavioural variable. The present research is partly behavioural in nature. The focus of the study is on how various components of an organization's structure could facilitate or inhibit innovations in the organization. The objective is to study the relationship between Organization Structure and Innovations in the bulk-drug firms.

Horizontal Complexity & Innovation

Pavitt (1994) posits that horizontal diversification presents key opportunities for new product de-

velopment, specially in large or R&D based organizations. Jacob (1998) studied the Indian advertising company "Mudra", and rated it high on innovativeness. He found it characterized by high horizontal complexity. Consistently positive relationship has been found between complex division of labour and organizational innovation (Hage 1999). Sharma (2000) found that the innovative chemical firms were characterized by high horizontal complexity. According to Troy, Szymanski and Varadarajan (2001) specialization and horizontal differentiation were factors on which generation and development of new ideas in an organization depend. Bommer and Jalajas (2004) found that the greatest innovations happen, where different functional units interact to develop products and processes that best meet the needs of customers.

Formalization & Innovation

Schultz and Schilling (1998) found that the more solutions to problems are codified into rules lower is the probability of discovering solutions that are not yet covered by existing rules. In a bureaucratic organization, formalized employee participation provides an avenue to attend to the ideas of employees; however there is a tension as the employees seek greater flexibility for informal problem-solving (Shadur, Kienzle Rodwell 1999). West (2000) emphasized that increased formalization and control system constrains innovation. Lewis, Welsh, Dehler and Green (2002) found that formalization discourages idea generation due to inflexibility that constrains creativity.

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Centralization & Innovation

Khandwalla (1995) posits that decentralization has positive motivational effect over employees. Jacob (1998) found that "Mudra", was highly decentralized. West (2000) supported that high centralization is a negative predictor of innovations. In his study Vedamanickam (2001) found positive correlation between decentralization and workplace innovativeness. Kanter (2004) also found that innovative organizations were more decentralized. McNulty and Ferlie (2004) consider decentralization as a requirement for innovative organizations. Findings of Khandwalla and Mehta (2004) indicate that extensive decentralization helped innovations. To sum up; decentralization improves democratic decision-making, fosters responsiveness among employees, and enhances the ability of lower organizational levels to influence senior management (Samaratunge 2003); thus facilitates innovations.

Concentration of Authority & Innovation

Rothwell (1992) posits that greater empowerment and increased decision-making at lower levels of management reduces number of approvals required for a decision, which adds to the speed and efficiency of new product development. Dunphy and Bryant (1996) found that in self-managed-teams, team mem-

bers interact with each other rather than relying on higher authority for decisions. This increases the speed of innovation by speeding the decision-making process. Shavinina (2003) suggests that empowered multi-functional teams are more successful at innovating.m

Participation in Decision Making & Innovation

Participation has been found to increase organizational commitment and promote better interpersonal relationships among employees.

West (1990) defines "Participative Safety" as a sense that team members can participate in decision-making and can share ideas without fear, and considers it important for innovation. Participation has been found to increase organizational commitment and promote better interpersonal relationships among employees (Srivastava 1991). Khandwalla (1995) found positive correlations between participation in decision-making and organizational innovations in an Indian sample. Strauss et al (1998) say that participation fosters integration, information exchange and interaction within groups. For Shadur et al (1999), high participation in decision-making leads to greater organizational involvement. Mintrom (2003) suggests that more inclusive and participative decision-making process in organizations can promote innovations. Khandwalla and Mehta (2004) found that decisions in innovative-organic structures emerged through participation of those involved in and affected by the decision directly.

Innovation

According to Kanter (2004), innovation includes: effecting a new policy, which is creating a change of orientation or direction; creating a new opportunity, which means developing an entirely new product or opening a new market; devising a fresh method, that is, introducing a new process or technology for continued use; and bringing forth new structural change, which entails changing of the formal structure, reorganizing or introducing a new structure, or forging a different link among units. Number of innovations has been used more recently in a growing number of innovation surveys as the measure of innovation. These involve measures as the number of new products produced by a firm, and the new processes adopted during a specific time period (Souitaris 2002).

Perceived Innovation

In a study of 339 organizations, Bart (2004) measured firm-level innovation on a 10-point rating scale by asking respondents to indicate:

- How innovative they perceived their organization to be.
- How important innovation was to their organization.

The concept of perceived innovation that the present study measures is similar to Bart's (2004) measure of firm-level innovation. There is almost no other evidence available in documented form which studies similar variables, hence, it maybe considered as a relatively new variable in innovation literature.

On the basis of literature reviewed the following hypotheses were generated:

1 (a) Horizontal Complexity has significant relationship with Number of Innovations.

(b) Horizontal Complexity has significant relationship with Perceived Innovation

2 (a) Formalization has significant relationship with Number of Innovations.

(b) Formalization has negative relationship with Perceived Innovation

3 (a) Centralization has significant relationship with Number of Innovations.

(b) Centralization has negative relationship with Perceived Innovation.

4 (a) Concentration of Authority has significant relationship with Number of Innovations.

(b) Concentration of Authority has negative relationship with Perceived Innovation.

5 (a) Participation in Decision-Making has significant relationship with Number of Innovations.

(b) Participation in Decision Making has positive relationship with Perceived Innovation.

Research Variables

The independent variable in the study is Organization Structure, comprising four components (Horizontal Complexity, Formalization, Centralization, Concentration of Authority and Participation in Decision-making). The dependent variable is Innovation, comprising two components, Perceived Innovation and Number of Innovations. Operational definitions of research variables follow.

Organization Structure refers to the way in which work and workers are organized in a firm; with the help of formal rules and procedures; by dividing them according to their functional expertise; and by prescribing methods of functioning and roles that organizational members need to perform; and by investing the power to take decisions at desired organizational levels in the desired personnel.

Horizontal Complexity refers to the degree to which work in an organization is divided horizontally into departments, sub-departments, functional units and sub-units, on the basis of the different functions performed. Horizontal complexity is measured by counting the total number of departments and sub-departments, functional units and sub-units in the organization. This data has been collected from secondary sources. Out of the two organizations surveyed, horizontal complexity of the first organization was 34, and that of the other was 28.

Formalization is defined in the study as the extent to which employee behaviour and job/role specifications are regulated and standardized by the use of formal rules, procedures, and task defi-

nitions in the organization. Formalization has been measured by Hage and Aiken's (1977) "Formalization Inventory".

Centralization refers to the degree to which authority for decision making in an organization is concentrated at a single point or organizational/management level. It is measured by combining the scale for Concentration of Authority and the scale for Participation in Decision-Making.

Concentration of Authority is the extent to which the decision making power is concentrated at higher levels of the organizational/ management hierarchy and is measured by the "Delegation of Authority" scale, devised by Daftaur (1988).

Participation in Decision Making refers to the degree of participation of members from different hierarchical levels and functional units in an organization, in the decision-making process. It is measured by Hage and Aiken's (1977) "Scale of Personal Participation in Decision-Making".

Innovation refers to the generation and implementation of a novel and useful idea, introduction of a unique, new or modified product, process or system of working, or material used by the organization; new or improved techniques of production, a change in packaging of products, changes in business or HR strategies of the firm, changes in policies, entering new markets, or a change in marketing practices over a specific time period (7 years). This variable has been divided into two measures:

*Number of Innovations r*efers to the total Number of Innovations introduced by the organization over a specific time period of 7 years. It includes innovations happening at all levels of production, in any department or functional unit. This data was collected from employee interviews. Each innovation that employees mentioned was listed by the researcher verbatim. Employees were asked to indicate how each innovation added value to the organization; that is, improved existing level of functioning, organizational income, brand-name and the like. On the basis of this data and the operational definition of innovation at the three levels of production and overall, the researcher categorized responses as 'an innovation' and 'not an innovation'. For the "Number of Innovations" score, total number of innovations was added up. Repetitions were cancelled out.

Perceived Innovation portrays employee perception of how innovative they consider their organization in the present and in the past, at the three levels of production: input, throughput and output. The measure also includes employee perception of the organization's overall approach to innovation and innovative activity.Perceived innovation has been measured using a scale designed by the researcher and validated for the purpose of this study.

Test Instruments

Test instruments used to measure variables under study include four rating scales and a semi-structured interview. The questionnaire for survey consisted

of four rating scales. The first scale measures formalization. The second scale measures centralization and the third one was designed by the researcher to measure 'perceived innovation'.

Formalization was measured by Hage and Aiken's Formalization inventory, cited in Miller (1977: 284-86). The scale consisted of 15 items, each to be rated on a 4-point rating scale, where 1-definitely true, 2-true, 3-false and 4-definitely false. Item nos. 6, 7, 9, 10, 11, 12, 13, 14, & 15 were reversed. These items were not negatively worded, but a high score on them indicated low score on formalization. The Criterion Validity of the scale has been given, the criterion measure used was 'Alienation'. Formalization is positively related to '*alienation*'. The greater the degree of formalization in the organization, the greater the liklihood of alienation from work. Dissatisfaction with work is high in organizations where jobs are rigidly structured. Strict enforcement of rules was strongly related to work dissatisfaction. Social relations are also disturbed when rules are strictly enforced. Significant positive relationships were found between routine work and rule manual, job description and specificity of job descriptions.

Centralization was a combined measure of Concentration of Authority and Participation in Decision-Making. Hence the score for centralization was computed by combining the mentioned variables.

Delegation of Authority scale, authored by Daftaur, cited in Pestonjee (1988: 233-34), was used to measure Concentration of Authority. It is a Likert-type, 5-point rating scale, where it is: 1-never, 2-seldom, 3-sometimes, 4–often, 5-always. Lower the score of an individual, higher the centralization score, and vice versa. Only 1 item was reversed although it was not negatively worded. Cronbach's alpha coefficient of reliability =.95

For Scale of Personal Participation in Decision-Making Hage and Aiken's scale cited in Miller (1977: 287-89) was used. It was a Likert-type 5-point rating scale, where 1-never, 2-seldom, 3-sometimes, 4–often, 5-always.

The Criterion Validity measure used here was that of 'Autonomy'. Organizations, in which decisions were made by only a few people at the top, relied on rules and close supervision as a means of ensuring consistent performance by the workers. These organizations were also characterized by a less professional staff. The presence of a well trained staff is related to a reduced need for extensive rules. Organizations that are highly autonomous tend to have a non-participative internal decision structure. Greater the autonomy, larger is the executive's span of control.

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Perceived Innovation was measured by a scale designed by the researcher. It assessed how innovative employees perceive their organization to be, and also judged employee attitudes regarding or-

ganizational approach towards innovative activity. It consisted of 20 items, to be rated on Likert-type, 5–point rating scale, varying in intensity from 'strongly disagree' at 1 to 'strongly agree' at 5. Each item was written in both English and Hindi. Test-retest reliability was .86. Internal consistency validity, calculated by the inter-item consistency method was .90.

Interview Schedule

Questions in the interview schedule were semi-structured and open-ended and covered all different relationships studied in this research.

Sample

A stratified random sample of 130 employees from two *bulk-drug* (pharmaceutical/chemical) organizations was selected for data collection. Employees represented four management levels (senior, middle, junior management & supervisory staff). 100 subjects were from a leading firm in Mumbai, out of which 60 were subject to detailed interviews. 30 subjects were from another leading firm in Mumbai, out of which 18 were interviewed. In all, 78 employees were subject to in-depth interviews and all 130 employees were subject to questionnaires. The sample consisted of employees from across R&D, Production, Engineering & Technology, Marketing, Quality Control, and Purchase departments.

Quantitative Results

Table 1 shows a negative and significant relationship between centralization and perceived innovation. It shows positive and significant relationship between concentration of authority and perceived innovation and between participation in decision-making and perceived innovation. However, no significant relationship has been obtained between formalization and perceived innovation.

Table 1: Correlating Structure with Perceived Innovation

(N = 130) Variables	Pearson's Correlation
Formalization	r = .30
Centralization	r = -.28**
Concentration of Authority	r = -.30**
Participation in Decision-Making	r = .20*

**(p<.01) *(p<.05)

Table 2 shows a significant relationship between centralization and perceived innovation. It shows significant relationship between concentration of authority and perceived innovation, and participation in decision-making and perceived innovation. This indicates a significant difference in the perceived innovation scores of employees low in centralization, concentration of authority and participation in decision-making and those high in the same. However no significant relationship between horizontal complexity and perceived innovation, and between formalization and perceived innovation has been obtained.

In Table 3 all structural variables show significant relationship with number of innovations except concentration of authority. Some frequencies of horizontal complexity indicate a value of 0.

Therefore, "Fisher's Exact test" of significance from SPSS version 11.5 was used to compute the values.

Table 2: One˘Way ANOVA with Perceived Innovation N = 130; df = 1, 128

Variables	Levels	N	Means	S.D.	F-Ratio
Horizontal Complexity	Low	30	80.60	9.97	F = .08
	High	100	80.01	10.22	
Formalization	Low	36	79.75	10.97	F = .07
	High	94	80.30	9.84	
Centralization	Low	65	81.92	8.04	F = 4.09*
	High	65	78.37	11.65	
Concentration of Authority	Low	105	81.70	8.38	F= 14.25**
	High	25	73.60	13.85	
Participation in Decision making	Low	81	78.73	10.59	F = 4.32*
	High	49	82.49	8.93	

** (p<.01) * (p<.05)

Table 3: Chi˘Square with Number of Innovations N = 130; df = 2, 1

Variables	Levels	Low Innovation Frequency	High Innovation Frequency	Chi-Square (÷ ^{2})
Horizontal Complexity	Low	30	0	130**
	High	0	100	
Formalization	Low	13	23	4.77*
	High	17	77	
Centralization	Low	21	44	6.24**
	High	9	56	
Concentration of Authority	Low	27	78	2.14
	High	3	22	
Participation in Decision Making	Low	14	67	4.06*
	High	16	33	

**(p<.01) *(p<.05)

Qualitative Analysis

Data produced by interviews (N = 78) was analyzed qualitatively using content-analysis. Total number of innovations recorded during a period of 7 years in the

two bulk-drug organizations was: 490. 29 at input level, 331 at throughput level, and 130 at output level. A majority of the employees (78.20%) say that a high level of horizontal complexity facilitates innovations. 88% employees are in favour of negative relationship between formalization and innovation. A majority, 74.30% say that a low level of centralization leads to high number of innovations. 70.51% support a positive relationship between participation in decision-making and number of innovations.

Horizontal Complexity & Innovation

Horizontal complexity shows significant relationship with number of innovations (significant chi-square), but not with perceived innovation (F-ratio is not significant). When content analyzed, 78.20% employees said that a high level of horizontal complexity facilitates innovation. Hence, Hypothesis 1 has been partially supported by findings of the study. Hypothesis 1 (a) has been supported while hypothesis 1 (b) has not been supported.

Horizontal diversification presents key opportunities for new product development, especially in R&D based organizations.

Pavitt (1994) posits that horizontal diversification presents key opportunities for new product development, especially in R&D based organizations. Consistently positive relationship has been found between complex division of labour and organizational innovation by Hage (1999). According to the present researcher, complexity of division of labour enhances organizational learning, problem-solving and creative capacities of the organization; hence, is important for innovations. Troy et. al. (2001) posit that specialization and horizontal differentiation were factors on which generation and development of new ideas in an organization depend. Bommer and Jalajas (2004) found that greatest innovations happen, where different functional units interact to develop products and processes that best meet the needs of the customer. This is done through the effective use of sources internal to the organization. Even researchers who were in favour of flat structures for innovations, believed and found evidence that high horizontal complexity facilitated innovation.

Employees interviewed expressed that in specialized areas of work, experts become better experts over time, skills develop and mature and a strong focus over one's specialized area gives rise to creative breakthroughs, and creates avenues to try out new and different practices. Hence, there was greater possibility and interest for research and development. Also a greater number of ideas arise and can be chosen from. These ideas would be brighter, richer in content and more focused; because they come from experts and specialized domains. There is also more efficient coordination of specialists for innovative tasks in organizations showing elaborate and clear departmentalization. When each function was separately operating, it was easier to coordinate and organize work.

Formalization & Innovation

Chi-square test shows significant relationship between formalization and number of innovations. Correlation value does not show significant relationship between formalization and perceived innovation, so does ANOVA (F is not significant). Hence, hypotheses 2 (both a & b) have been supported by findings of statistical analysis. Qualitative analysis supports quantitative. Content analysis shows 88 % employees supported a negative relationship between formalization and innovation. Researchers like West (2000) and Lewis et. al. (2002) emphasized that increased formalization and control system constrains innovation due to inflexibility. Many researchers found negative relationship between formalization and innovation, others failed to find any relationship.

Increased formalization and control system constrains innovation due to inflexibility.

Centralization & Innovation

Correlations show a negative and significant relationship between centralization and innovation indicating that lower the level of centralization, higher is the level of perceived innovation and vice versa. One-way ANOVA and chi-square are also significant. Content analysis supports this finding, showing that a majority, 74.3% employees say that low centralization leads to high number of innovations. Hypothesis 3 (a) & (b) has thus been supported. Dessler (1986) found that with decentralization, management capacity for processing and monitoring information increases, and load for information processing on top management is reduced. As a result better and focused attention can be given to work, and this facilitates innovation. With an increase in decentralization, there is an automatic increase in flexibility allowed in the organization. Rothwell (1992) says that decentralization plays an important role in rapid and successful new product development, and increased empowerment at lower levels of management reduces number of approvals required for a decision. This finding has been supported by employee interviews. Employees say that empowerment, especially at lower management levels facilitates innovations. This is because lower level employees are directly associated with the manufacturing plant, machinery and labour; hence, are most aware of day-to-day problems. If lower levels in the organization are empowered, it would speed up decision-making and save time which is wasted in processing an idea.

The level of centralization, higher is the level of perceived innovation and vice versa

Khandwalla (1995) found that decentralization had a positive motivational effect, hence contributed to innovations. Shavinina (2003) found that innovative organizations had low level of centralization, and emphasized that formation of empowered teams in such organizations helps innovation. To sum up, decentralization facilitates innovation by improving democratic decision-making, fostering responsiveness among employees, and

enhancing the ability of lower management to influence senior management through empowerment decision-making (Samaratunge 2003).

Evidence from interviews with senior management indicates that decentralization allows an organization to rapidly and easily respond and adapt to different and changing environmental conditions, resulting from market competition. This helps innovation since decision-making is faster. It can be regarded as a stimulating factor for encouraging employees to take control of their tasks. With decentralization comes greater job satisfaction, greater flexibility in one's performance of duties, and greater opportunities of doing things in new and different ways.

Most employees across other management levels also report that low level of centralization facilitates innovation. They said that with decentralization, there was greater autonomy and flexibility in taking decisions regarding one's part of work. Employees were free to prioritize and time their work. For every decision they did not have to wait for long or depend completely upon senior levels. As a result decision-making and implementation was speeded up. There was greater motivation to work, this led to organizational commitment. According to employees interviewed, decentralization was positive for both, initiation as well as implementation of innovations. This interview data supports literature and findings.

Participation in Decision-Making & Innovation

Higher the level of participation in decision-making, higher is the level of perceived innovation.

Positive and significant correlation between participation in decision-making and innovation indicates that higher the level of participation in decision-making, higher is the level of perceived innovation. Findings of one-way ANOVA and chi-square are also significant. The content analysis supports findings of correlation. 88.46% employees supported a positive relationship between participation in decision-making and innovation. Hence, hypotheses 5 (a) & (b) have been completely supported. According to West (1990), participation in decision-making in an organization engenders participative safety in its employees; a sense in individuals that they can participate in the decision-making process and can share ideas without fear. Participative safety according to him is important for innovation. Bartol and Martin (1991) found, that involving employees across the organization in development of ideas often positively influences their willingness to help implement the ideas. Dunphy and Bryant (1996) found that as a result of high participation, the decision-making process is speeded up. Participation in decision-making decreases reliance upon higher levels in an organization and this helps innovations. Strauss et. al. (1998) found that where there were high levels of participation in decision-making, there was greater information sharing and interac-

tion within groups. It is more likely that these groups will work through difficulties associated with introduction of innovations and benefit from participation. Information and opinions about innovation and innovation process are worked out more comprehensively ensuring more effective outcomes. Participative and creative decision-making for innovations is more effective in comprehensively solving an informational conflict. This not only increases the chances of success of a particular innovation, but also increases receptivity for future innovations. Khandwalla and Mehta (2004) found that participation in decision-making helped those employees in problem-solving who were actually involved in and affected by a decision directly, this facilitated corporate creativity. The finding has been supported by similar responses of employee interviews.

Employees said when ideas come from various levels in an organization, and are then discussed in groups representing different specialized areas and levels of hierarchy it is definitely an enriching exercise for the purpose of innovations. In this way, not only does an idea become rich technically in content but its implications, marketability and other dynamics of implementation are also discussed in such participative environments. Ideas that are found weak are rejected, saving time, and decision-making and implementation is speeded up. Employees also expressed that participation led to greater organizational commitment and greater job-involvement and job-satisfaction among employees. Shadur et. al. (1999) found that participation in decision making led to job-involvement among employees. They found that participation in decision-making also leads to better interpersonal relationships and communication, not only horizontally across departments but also vertically across various hierarchical levels. Such factors help to spur innovations in a major way. As expressed by senior management, participation helps the organization to come up to, even lead the competitive standards of the environment, by helping innovations.

Conclusions

Measurement of innovation is a difficult and complex task with limited methods to account for. There is hardly any evidence in literature which measures the approach of an organization towards innovating, the encouragement it offers to innovation efforts, and the emphasis it lays on shaping and aligning its processes and structure to facilitate innovations. This element is critical to innovation, and the present research has made an attempt to address the same. Measures of innovation in the study include both perceptual and an actual measure. The perceptual measure of innovation, perceived innovation, the scale of which measures employee perceptions of innovations at the three levels of production (input, throughput, output), and of organization's approach towards innovation. The scale has been validated by inter-item consistency, and reliability has been obtained by the test-retest method. Both reliability and validity were found to be high. This scale is one of its kind, since it is difficult to find a documented counterpart in the literature available.

Suggestions for Industry

To increase innovations there is a need to increase participation in decision-making in both the organizations surveyed. It would be beneficial for them to incorporate a '*suggestion scheme*'. This would especially help lower level employees in the organization to shed their inhibitions and contribute their ideas without fear of evaluation, hence, engender *participative safety* (West 1990) in them. Subsequent participative discussions involving different organizational levels would be of help to spur innovations through '*brainstorming*' sessions. The process is likely to not only speed up idea generation and decision making, but would also encourage free-flowing communication between various organizational levels.

To increase innovations there is a need to increase participation in decision-making in both the organizations surveyed. It would be beneficial for them to incorporate a *suggestion scheme* .

Organizations surveyed should allow and encourage formation of '*informal networks'* within the organization. A firm could benefit by supporting such informal group activity. Cross, Nohria and Parker (2002) found that informal networks often provide the glue that holds together cross-functional process-improvement initiatives. The researchers state the example of one such type of informal network, known as the 'Community of Practice', which has been critical in reducing drug development costs and in the rapid introduction of new products in the pharmaceutical sector. Besides, such networks would also help increase job satisfaction and contribute to employee retention.

Incorporation of product-teams for new product development is another suggestion that is likely to spur innovations in organizations surveyed. As per observations made; although their strategy focuses on development of new products, yet they have not extensively worked as product-teams for product development. Product-teams are formed for specific assignments but not as a regular practice. Some initiatives for new product development have been shelved or lost mid-way. This maybe due to lack of executives formally designated to take the responsibility of such projects. It is suggested that the two organizations studied could best be structured as partial matrices. This would not require major changes in the already existing framework of the company. A more major structural change would be organizing as ambidextrous structures, which would require major administrative changes in the organization. Hence, it could be considered as a long term goal for the organization.

This study is partly behavioral in nature. The approach to the study of structure-innovation relationship suggested in the present research may be regarded as a basis for speculative thinking and future research. It provides a frame work for further study.

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