Precursors and ramifications of creativity on innovation in product design teams - A study on Indian information technology sector

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Abstract. Creativity and creative ideas rest at the heart of designing a novel product. Having said that, the understanding of the source and the process of these exquisite ideas that ultimately form the foundation of novel products is not very extensive. This study takes its lead from the design outlook at the organisational level suggested by Dave Ulrich. It goes one-step forward to grasp the mediating role of creativity between dynamics of the team and the competitive advantage it gives the product. Delving deeper, the aim is to understand the creativity in teams that design these novel products in terms of the product itself and the program to market such product. Exploring the influence of creativity on the strategic outcomes associated with innovation, this study empirically tests the impact of group dynamics, both within and outside these groups on the novel product and the program to market them. The study takes into account inputs from 206 employees in information technology sector in India. Maximum likelihood estimation has been used test the model by placing it in a structural equation. Upon analysis, novelty and meaningfulness come out as the dimensions that impact dynamics of teams. The novelty of a new product emerges as the resultant of divergent processes primarily impacted by factors outside of the team such as reward systems and the process of planning. In addition, the meaningfulness that comes with the new product is derived from a convergent process prominently affected by factors within the team - provisions and superordinate identity. Moreover, the newness of the market program is determined by the cohesion in a social setting, formalisation in the process of planning and risk taking likelihood. The study also indicates that the newness of the new product and its meaningfulness has a more profound mediating role in ensuring a competitive edge. Thus, it can be concluded that an organisation gains a significant edge in competition if it manages the dynamics of teams to foster creative novel products and programs to market them.

1. Introduction
An organisation’s degree of survival and its vitality depends on how accurately they cater to the changing expectations of the customers. Creativity resides at the heart of the initiatives of innovation at organisations (Van de Ven, 1986). Not only this, creativity also fuels novel ideas and is believed to be
synonymous with innovation (Amabile, 1988). It may also be believed that creativity is conceptual and lacks tangibility; nevertheless, it is critical (Barney, 1991). Having said that, research that dives deep into the depths of this concept is handful (Amabile, 1988). Digging deeper, it comes to realisation that creativity contributes to innovation in teams and is influenced by a combination of individual and environmental factors (Hargadon and Sutton, 1997). Research previously conducted study creativity as a consequential variable (Oldham and Cummings, 1996). However, this study explores the contributory role of creativity in innovation and strategy. As far as newly designed products are concerned, innovation is a result of successful creation, development and management of creative ideas. Research done in the past also establishes competitive edge of the product as a determinant of success of a newly designed product (Montoya-Weiss and Calantone, 1994) and is further related to growth and productivity of an organisation (Amabile, 1988). Thus, this study explores the mediating role of creativity in the competitive edge gained by an organisation and the dynamics at the team level. It also throws light on a framework in the organisational design context and the role of communication, design & development and decision-making dimensions at the organisational level. This study also develops an empirical model on the resultants of creativity in teams at organisational level in the information technology sector.

2. Literature Review
This study explores creativity in two folds. First, as a constituent of development of products as an extrapolation of novel ideas. Second, a commercial aspect of it as a component to market the products developed. This study further reinforces the thought that there are several elements in the program that markets the new products such as packaging, guarantees, logistics and supply chain, product design among others (Krishnan and Ulrich, 2001). The creativity in the development of programs to market newly designed products significantly increases its penetration. In congruence with (Amabile, 1983) this study studies creativity in two dimensions – one, newness that differentiates the product from those already existing in the marketplace) and two, importance of the program (meaningfulness) that enables greater accessibility of the product to the intended customer base. This novelty and meaningfulness are widely accepted components of creativity in both psychology and marketing (Sethi, Smith, and Park, 2001) (Amabile, 1983) (Im and Workman, 2004).

The study arrives upon four constituents of creativity – newness and meaningfulness of newly designed products and the programs to market them. The new products and the programs to ensure their marketing help in setting them apart from their competitors and influences their customer awareness and penetration in the markets (Im and Workman, 2004).

3. Research Model
Dimensions relating to dynamics of teams are combined with creativity as they have the power the level of creativity and innovation at different levels in an organisation (Krishnan and Ulrich, 2001). Following the similar line of thought dynamics of teams, factors of creativity constitute a part of this model as creativity is impacted by team characteristics and this in turn affects innovation at a strategic level. Both dimensions of teams – external and internal are taken into consideration (Ford, 1996). Incentive systems, risk-taking appetite of the management and organisational structure are also included as a part of this study (Brockman and Morgan, 2003).

Hence, the following points are hypothesised as a part of this study:

H1. High social cohesion in a team has a positive effect on
   i. meaningfulness of new product
   ii. meaningfulness of market program

H2. High superordinate identity in an innovation team has a positive effect on
   i. creativity of new product
   ii. creativity of market program

H3. A market based reward system in a team has a positive effect on
   i. novelty of new product
   ii. novelty of market program

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H4 High structural planning and formalisation among team has 
  i negative effect on novelty and meaningfulness of newly developed product
  ii positive effect on novelty and meaningfulness of newly developed product

H5 Encouragement from management on innovation of products and take risks has a 
  i positive effect on novelty of new product
  ii positive effect on novelty of market program

H6 All four dimensions of creativity have a positive impact on gaining a competitive advantage

![Conceptual model of newly developed product and creativity of marketing program hypothesized relationship](image)

**Figure 1.** Conceptual model of newly developed product and creativity of marketing program hypothesized relationship

**4. Methodology**
Data was collected from employees in the Indian information technology industry. The industry was chosen because of their inclination towards intense innovation initiatives in the areas of development of products, activities that fuel creativity and are subject to frequent changes as a result of which we see rapidly changing industry as well as customer expectations. (Ettlie and Pavlou, 2006). The respondents were connected with the development of new products and managing innovation in one way or another. Nonresponse bias in the data was eliminated by way of a t-test, which confirmed that there was no significant difference between responses received at the first and the last points in the timeline (Montoya-Weiss and Calantone, 1994). Diagnostic tests for multicollinearity was done to do away with issues relating to multicollinearity in the analysis (condition indices for all < 30; variance inflation
factors < 10). It was also found that violations of regression assumptions did not exist (i.e., normality & linearity). Questionnaire for the study was adopted on a five-point Likert scale suggested by (Im, Montoya, and Workman Jr., 2012). There were significant correlations (p < 0.01) between ratings from both managers and customers regarding newly designed products and the programs to market them indicating that managers make relevant assessment of creativity. The tests for validity and reliability was carried out and a Cronbach’s alpha value > 0.7 indicated decent level of internal consistency in the constructs. All measurement instruments suggested good validities – convergent and divergent (Bagozzi,Yi, and Phillips, 1991). All significant and positive factor loadings are indicated in Table 1. Significant chi-square differences leaning towards freely estimated correlations (i.e., unrestricted models) are exhibited by all constructs as compared to models with correlation values fixed at 1 (i.e., restricted models) at a level of 0.5, thus, confirming the discriminant validity of all constructs (Anderson and Gerbing, 1988). A factor analysis illustrated that the data was uni-dimensional. In the model, the dimensions namely: size of the organisation, the rate of change in technology, their potential markets; affect the competitive advantage gained by a particular product. The variables also included internal and external factors for assess the impact of organisational resources on innovation (Krishnan and Ulrich, 2001).

5. Analysis and Results
The statistical values derived from the analysis of data is depicted in Table 1. The signs as indicated in the correlation matrix are concurrent with the hypotheses. To test the hypotheses, a structural equation model can be tested using maximum likelihood estimation. The study follows the approach suggested by Anderson and Gerbing (1988). The method suggests the calculation of a confirmatory model measurement before the measurement or calculation of the sub models. The results from this model calculations are depicted in Figure 2. The dimensions of the construct about creativity was evaluated using factor analysis (Anderson and Gerbing, 1988).

Figure 2. Maximum likelihood estimation results standardized coefficients fit statistics: \( \chi^2 \) (degrees of freedom)=2000.66(1033)*# normed fit index=.93; relative fit index=.92; incremental fit index=.96; Tucker-Lewis index=.95; root mean square error of approximation=.07
Table 1. Correlations among major constructs (n = 206)

|        | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | Cronbach’s α | Mean (±SD) |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|--------------|------------|
| 1. Social cohesion | 1    |      |      |      |      |      |      |      |      |      |      |      |      | .90           | 5.14 (1.16) |
| 2. Superordinate identity | .72** | 1    |      |      |      |      |      |      |      |      |      |      |      | .93           | 4.88 (1.13) |
| 3. Market-based reward | .54** | .39** | 1    |      |      |      |      |      |      |      |      |      |      | .79           | 3.35 (1.17) |
| 4. Formalization | .19** | .29** | .47** | 1    |      |      |      |      |      |      |      |      |      | .85           | 3.15 (1.41) |
| 5. Risk taking | .33** | .45** | .29** | .21** | 1    |      |      |      |      |      |      |      |      | .76           | 4.23 (1.24) |
| 6. NP novelty | .15*  | .16*  | .17*  | .16*  | .15* | 1    |      |      |      |      |      |      |      | .89           | 4.74 (1.45) |
| 7. NP meaningfulness | .18** | .30** | .17** | .13   | .16* | .25** | 1    |      |      |      |      |      |      | .90           | 5.06 (1.85) |
| 8. Marketing program novelty | .21** | .29** | .36** | .32** | .32** | .17** | .20** | 1    |      |      |      |      |      | .91           | 3.86 (1.41) |
| 9. Marketing program meaningfulness | .30** | .33** | .39** | .32** | .14** | .53** | .72** | 1    |      |      |      |      |      | .90           | 4.84 (1.07) |
| 10. Product competitive advantage | .14*  | .16*  | .04   | -.01 | .08   | .36** | .30** | .27** | .23** | 1    |      |      |      | .72           | 5.51 (1.15) |
| 11. Firm size | -.08  | -.08  | -.11  | -.11  | -.07  | .09   | -.18** | -.10  | -.17*  | -.01 | 1    |      |      | -             | 4.51 (2.54) |
| 12. Technological turbulence | .19** | .19** | .18*  | .11   | .09   | -.01  | .12   | -.01  | .05   | .02  | .01 |      |      | .68           | 3.53 (1.04) |
| 13. Market potential | .15*  | .16*  | .22** | .04   | .11   | .13   | .19** | .29** | .27** | .10  | -.03 | .24** | 1    | .77           | 3.55 (1.04) |

*p < .05, **p < .01. *Average mean scores for composite scales. All items are measured by 7-point scales, except for firm size. NP: new product; s.d.: standard deviation.

Upon analysis of the outcomes of testing the hypotheses, it is found that meaningfulness is positively impacted by social cohesion without affecting dimensions on newness. Fully supporting H1. Superordinate identity inflates meaningfulness of newly designed product and the novelty of its market program but has no impact on other dimensions. Thus, partially supporting H2. Coming to H3, market based reward system was directly linked to novelty dimensions of the newly designed product and the program to market them. Hence, H3 was not supported. In case of H4, putting structure in place is detrimental of the novelty of newly designed product and had no impact on other dimensions; partially supporting H4. In H5, the risk taking appetite of the management has a positive impact on novelty of market program and no effect on others; H5 is also partially supported. In case of H6, meaningfulness and novelty of newly designed product have a reinforcing effect on the competitive edge gained whereas market program dimensions remain unaffected. H6 is also fully supported. The control variables are also evaluated which indicate that firm size has an adverse impact on meaningfulness dimensions. Hence, it is observed that the bigger organisation produce products that have high novelty. It is also understood that potential of the market enhances all the dimensions undertaken thus; hinting technological developments enhance both novelty and meaningfulness. The relationship pathways depicted in the structural model were put to test using Baron and Kenny’s (1986) mediating test and was found to be appropriate.

6. Discussion
The study explores the effect of team dynamics – Both internal and external on creativity involved in design of new products and market programs, the competitive edge it adds to the outcomes of innovation at a strategic level. At an instance where a majority of the studies already carried out place creativity in an individual’s capacity, our study illustrates empirically that creativity, though lacks tangibility, contributes significantly at giving a competitive edge (Hargadon and Sutton, 1997). This competitive edge is gained by nurturing the creative ideas in newly designed products and market programs (Ettrillie and Pavlou, 2006). The study further indicates that various factors encapsulated in newly designed products and their market programs can be enhanced by taking care of the dynamics of the team. Results tabulated in Table – 1 delve deeper into the framework and the relationships encompassing the various factors that constitute a part of the model. The competitive edge gained by the product also explains the impact of creativity on organisational productivity ultimately, contributing to its success (Andrews and Smith, 1996). However, it can also be argued that absence or lack thereof in terms of creativity or simply put imitation may lead an organisation too an alternate path of performance (Nelson and Winter, 1982).
Competitive edge gained also correlates with novelty and meaningfulness in newly designed products. Thus, by virtue of extrapolation, novelty of products and its impact on success can be analysed. This study also makes a contribution towards the dynamics of teams and dimensions of newly designed products. As a result, enhancing novel ideas for product design comes with its own risks and must be counteracted with measures at the organisational level. Also, team cohesion is an important contributor to design of products that end up being successful and thus, it is an important concept for all managers to understand. Having said that, social cohesion doesn’t not contribute to the meaningfulness dimensions of products and markets. It is also suggested that managers are advised to manage the effects of team dynamics on creativity as this ultimately affect organisational performance. This can be done through identification of problem areas and facilitating solutions by removing barriers and encouraging communication and avoiding conflict (Brockman and Morgan, 2003). It is also suggested that teams with high superordinate identity level, design products that have a high value attached to them (Van de Ven, 1986). At this juncture, establishing ownership and accountability towards the outcomes of the team is a pertinent task at the organisational level.

7. Limitations
The findings of this study has a few shortfalls. Firstly, the sample set of the information technology sector limits the applicability. The higher importance of creativity in the program for product marketing over the creativity in the novelty of the product could be result of the overall high performing information technology industry. Thus, to expand the applicability of this study and concept, further research across other sectors is recommended. Further exploration towards the application of the findings of this study in the long term is also recommended to assess the impact of memory failure as far as products are the programs to market them are concerned. Furthermore, the scope of this study is limited to the analysis of dynamics at the team level; greater inferences may be drawn if similar analysis is done at the organisation level. The study can also be further expanded with other contributing variables of the products and programs; this study only focuses on creativity and innovation.

8. Conclusions
This study throws light on the pre-existing limitation by addressing the effect of creativity on dynamics of the team and further relating to resultants of innovation of strategy. This study illustrates the pertinence of dynamics of the team in forecasting creativity. It further goes on to indicate that dynamics of the team- both inside and outside of these teams impact creativity and must be taken care of to leverage the potential innovation in teams from a strategic viewpoint. It is also understood that the competitive edge gained by an organisation is greatly dependent on its capability to encourage, develop and manage ideas in terms of their creativity before ultimately launching them as products in the market. This creativity when leveraged well has considerable impact on dynamics of teams – both external and internal. Hence, an effective management of these teams would have a profound impact on the outcomes and innovation from a strategic standpoint.

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