A review of organizational control and innovation

Balaji Subramanian

Abstract

The purpose of this paper is to review the effect of organizational control on innovation. Specifically, the effect of three types of organizational control – input control, behavior control and output control on the different types of innovation are studied. We find that behavior control has been studied extensively, followed by input control. However output control has not received much attention in research on organizational control and innovation. Of the various structural variables studied under these control types, four variables- professionalization, specialization, centralization and formalization, have been objects of considerable research. Based on the review, we present multiple propositions on the relationship between organizational control and innovation.

Keywords: Innovation, input control, behavior control, output control, organizational control

1. Introduction

The purpose of this paper is to study the effect of organizational control on innovation by reviewing papers in the area. Control is defined as “any process by which managers direct attention, motivate, and encourage organizational members to act in desired ways to meet the firm’s objectives” (Cardinal, 2001 p.22). From our review, we have identified three types of organizational control...
that have been studied in relation to innovation. The three types are: input control, behavior control and output control. Input control is related to the governance of the causal conditions of performance (e.g., professionalization, specialization); behavior control is related to the implementation of procedures and rules, regulating behaviors and activities (e.g., centralization, formalization); output control is related to the regulation of results and outcomes instead of the means by which outputs are achieved (e.g., emphasis on output, goal specificity) (Cardinal, 2001). Of the three types of control, behavior control has been studied extensively followed by input control. Only few papers have studied the effect of output control on organizational innovation, a point that Cardinal (2001) also emphasizes: “output controls have not been studied in either the literature on the management of technological innovation or the literature on innovation adoption” (p.25).

Under each control type, different control forms or sub-type have been identified in literature. Under the input control we have identified five forms - professionalization, specialization, socialization, depth of knowledge and organizational slack that have been studied in relation to organizational innovation. Of these, professionalization and specialization have been the objects of considerable research, while the other forms have only been sparsely studied. Under the behavior control, we have identified nine forms- centralization, formalization, internal communication, functional differentiation, performance evaluation, administrative intensity, routinization, vertical differentiation and stratification. Of these, centralization and formalization have been studied extensively in literature, while only few studies have been done on other forms. Under the output control, we have identified four forms of control - emphasis on output, goal specificity, rewards and recognition and emphasis on professional output. Table 1 lists the categorization of articles based on the forms of control examined.

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Control Sub-type</th>
<th>Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Professionalization</td>
<td>Bao et al. (2012); Cardinal (2001); Chen and Huang (2009); Daft (1978); Damanpour (1987); Damanpour (1991); Dewar and Dutton (1986); Gambardella (1992); Hage and Dewar (1973); Kimberly and Evanisko (1981); Lauren and Foss (2003); Li et al. (2006); Pierce and Delbecq (1977)</td>
</tr>
<tr>
<td>Specialization</td>
<td>Dewar and Dutton (1986); Bantel and Jackson (1989); Cardinal (2001); Damanpour (1987); Kimberly and Evanisko (1981); Damanpour (1991); Ettlie et al. (1984); Hage and Dewar (1973)</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Behavior</th>
<th>Socialization</th>
<th>Persaud (2005); Rijsdijk and Ende (2011); Jansen et al. (2005); Li et al. (2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth of Knowledge</td>
<td>Dewar and Dutton (1986); Ettlie et al. (1984); Damanpour (1991)</td>
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<tr>
<td></td>
<td>Organizational Slack</td>
<td>Damanpour (1987); Nohria and Gulati (1996)</td>
</tr>
<tr>
<td></td>
<td>Centralization</td>
<td>Dewar and Dutton (1986); Bailyn (1985); Cardinal (2001); Ettlie et al. (1984); Hage and Dewar (1973); Jansen et al. (2005); Jansen et al. (2006); Kimberly and Evanisko (1981); Lauren and Foss (2003); Damanpour (1991); Li et al. (2011); Persaud (2005); Pierce and Delbecq (1977)</td>
</tr>
<tr>
<td></td>
<td>Formalization</td>
<td>Bonner (2005); Rijsdijk and Ende (2011); Brion et al. (2010); Cardinal (2001); Hage and Dewar (1973); Jansen et al. (2005); Ettlie et al. (1984); Jansen et al. (2006); Li et al. (2010); Damanpour (1991); Persaud (2005); Pierce and Delbecq (1977)</td>
</tr>
<tr>
<td></td>
<td>Internal Communication</td>
<td>Damanpour (1991); Dougherty (1992); Jansen et al. (2005); Jansen et al. (2006); Lauren and Foss (2003); Persaud (2005)</td>
</tr>
<tr>
<td></td>
<td>Functional differentiation</td>
<td>Damanpour (1987, 1991); Kimberly and Evanisko (1981); Pierce and Delbecq (1977)</td>
</tr>
<tr>
<td></td>
<td>Performance evaluation</td>
<td>Cardinal (2001); Li et al. (2011); Shalley (1995)</td>
</tr>
<tr>
<td></td>
<td>Administrative Intensity</td>
<td>Damanpour (1987, 1991)</td>
</tr>
<tr>
<td></td>
<td>Routinization</td>
<td>Jansen et al. (2005); Ohly et al. (2006)</td>
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<td></td>
<td>Vertical differentiation</td>
<td>Damanpour (1991)</td>
</tr>
<tr>
<td></td>
<td>Stratification</td>
<td>Pierce and Delbecq (1977)</td>
</tr>
<tr>
<td></td>
<td>Emphasis on output</td>
<td>Cardinal (2001); Bonner (2005); Li et al. (2006); Li et al. (2010); Rijsdijk and Ende (2011); Walker et al. (2010)</td>
</tr>
<tr>
<td></td>
<td>Goal Specificity</td>
<td>Cardinal (2001); Rijsdijk and Ende (2011); Shalley (1995); Zanzi (1987)</td>
</tr>
<tr>
<td></td>
<td>Rewards and Recognition</td>
<td>Bonner (2005); Brion et al. (2010); Cardinal (2001); Lauren and Foss (2003); Li et al. (2006)</td>
</tr>
<tr>
<td></td>
<td>Emphasis on professional output</td>
<td>Cardinal (2001)</td>
</tr>
</tbody>
</table>

The remainder of this paper is divided into two sections. In the first section, we briefly explain the different types of innovation as most of the papers reviewed have studied the effects of organizational control on a specific innovation type.

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In the second section, we discuss the effect of three types of organizational control on innovation and present the propositions.

**Process of literature review**

The selection of papers for the review started with the article Cardinal (2001) as the base. Cardinal (2001) is one of the seminal and highly cited\(^1\) paper that studied the relationship between organizational control and innovation and has played a prominent role in shaping the field over the past decade. We did a keyword search on all the articles that cited Cardinal (2001).

*Google Scholar* was used for the keyword search. Following keywords were used: organization control and innovation, organizational structure and innovation, organizational factors and innovation, HRM practices and innovation. To identify articles published before Cardinal (2001), we followed a snowball sampling process, in which we identified relevant articles from the references of the already selected articles. Through this process, a total of 56 articles were collected. Then we read the abstract of these papers and checked their relevance with the topic of our study. In this process, we have to omit few papers as they were not directly related to our topic. For instance, Adler and Chen (2011) discusses about the relationship between management control and creativity. We didn’t include this paper in our review as we were interested in studying the relationship between management control and innovation and not creativity. Finally we selected 30 articles to be included in our review. A summary of these 30 articles is given in Appendix 1.

**Types of Innovation**

Most of the studies reviewed have studied the effects of organizational control on a specific type of innovation. So in this section, we briefly explain the different types of innovation identified in the literature. Three types of innovation have received the most attention in the literature, each representing a pair of innovation types: technical and administrative, process and product, and incremental and radical (Damanpour, 1991). In addition to these three types, few recent papers (Brion et al., 2010; Jansen et al., 2006) talk about organizational ambidexterity (exploratory and exploitative innovation). Few other papers (e.g., Jansen et al., 2005) take a knowledge based view on innovation and talk about absorptive capacity. These different types are explained briefly below.

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\(^1\) As per Google Scholar database, Cardinal (2001) has received 782 citations as on Jan 5, 2018.
Administrative and technical innovation

Technical innovations are concerned with basic activities of work and can be related to services, products or technological processes. Administrative innovations pertain to administrative processes and structure of the organization. They are more related to management than the basic work activities of an organization (Damanpour, 1987, 1991; Kimberly and Evanisko, 1981).

In addition to administrative and technical innovation, Damanpour (1987) has studied the effect of organization control on another type of innovation called “ancillary innovations”. Ancillary innovations are those that happen at the intersection of the organization and its environment and are not fully controlled by the organization’s management. Examples include community service programs of a library, after-school supplementary education programs and consumer involvement programs for generation of ideas.

Product and process innovation

Innovations such as introducing new services or products by an organization to meet user or market needs are called product innovations. Innovations such as introducing new elements in the service of the organization or the production process such as material inputs, equipments, tasks and work flow mechanisms are called process innovations (Damanpour, 1991).

Radical and incremental innovation

Radical and incremental innovations are classified based on the amount of change caused by an innovation. Radical innovations create vital changes in the organizational activities that are clearly different from existing routines and practices. Incremental innovations create only minor changes in the organizational practices (Dewar and Dutton, 1986; Ettlie et al., 1984).

Exploratory and exploitative

Innovations that are radical and are created to meet the requirements of new markets or users are called exploratory innovations (Jansen et al., 2006; Brionet et al., 2010). They offer new distribution channels, designs or create new markets. Exploratory innovations depart from existing knowledge or require new knowledge.

Innovations that are incremental and are created to meet the requirements of
existing markets or users (Jansen et al., 2006; Brion et al., 2010) are called exploitative innovations. They expand existing services or products instead of innovating new ones, strengthen existing skills, and increase competence of existing distribution channels (Jansen et al., 2006). Exploitative innovations reinforce available structures, practices and skills and build on existing knowledge.

**Absorptive capacity**

Absorptive capacity is defined as a “set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability” (Zahra and George, 2002, p.186). These four capabilities represent four dimensions of absorptive capacity. The dimensions knowledge acquisition and assimilation are called “potential absorptive capacity” and they represent efforts spent to identify, acquire and assimilate new knowledge from sources external to the organization. The dimensions knowledge transformation and exploitation are called “realized absorptive capacity” and they represent efforts spent in gaining new insights by combining existing knowledge and newly acquired knowledge and incorporating them into actions.

**Organizational Control and Innovation**

In this section, we review the effect of three types of control (input, behavior and output) on innovation. As noted earlier, while input and behavior controls have been studied extensively, output control has been studied only by few papers. Of the 30 papers reviewed, 20 papers have studied one or more forms of input control, 21 papers have studied behavior control and only 10 papers have studied the output control.

From the review, we also observe that earlier papers before 1990s, have focused mainly on the antecedent conditions of innovation. They predominantly studied the effect of structural variables such as specialization, centralization and formalization on innovation (e.g., Hage and Dewar, 1973; Kimberly and Evanisko, 1981; Damanpour, 1987). Also most of the studies were based on a sample from USA. But over the last decade or so, we see many studies were done using samples from European and Asian countries such as China (e.g., Bao et al., 2012; Li et al., 2006) and Taiwan (e.g., Chen and Huang, 2009). Topics such as ambidexterity (e.g., Jansen et al., 2006; Brion et al., 2010), innovation in SMEs (Li et al., 2011), HRM practices and innovation (Lauren and Foss, 2003; Li et al., 2006) have received more attention in the recent literature. Also recent studies are
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taking a knowledge based view, and studying constructs such as absorptive capacity and knowledge management in relation to innovation (e.g., Jansen et al., 2005; Li et al., 2010).

**Input Control and Innovation**

As noted earlier, five forms of input control have been studied in relation to organizational innovation. They are professionalization, specialization, socialization, depth of knowledge and organizational slack.

<table>
<thead>
<tr>
<th>Innovation type studied</th>
<th>Author and Year</th>
<th>Findings and Viewpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect of professionalization on innovation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical and Administrative</td>
<td>Daft (1978); Damanpour (1987); Li et al. (2006)</td>
<td>Daft (1978) proposes the technical and administrative innovations as adual-core model of innovation in organizations. Professionalization has a stronger effect on technical innovation than administrative innovation.</td>
</tr>
<tr>
<td></td>
<td>Kimberly and Evanisko (1981)</td>
<td>Professionalization is not a significant predictor of both technical innovation and administrative innovation.</td>
</tr>
<tr>
<td></td>
<td>Chen and Huang (2009)</td>
<td>Strategic human resource practices such as professionalization have a positive effect on knowledge management capacity which, in turn, affects innovation performance positively.</td>
</tr>
<tr>
<td>Increment and Radical</td>
<td>Dewar and Dutton (1986)</td>
<td>Professionalization is not significantly related to both incremental and radical innovation</td>
</tr>
<tr>
<td></td>
<td>Cardinal (2001)</td>
<td>Professionalization positively related to the incremental and radical innovation</td>
</tr>
<tr>
<td>Product/Service</td>
<td>Bao et al. (2012)</td>
<td>Professionalization enhances radical innovation</td>
</tr>
<tr>
<td></td>
<td>Hage and Dewar (1973); Gambardella (1992); Lauren and Foss (2003)</td>
<td>Professionalization is significant in predicting product innovation</td>
</tr>
<tr>
<td>NA</td>
<td>Damanpour (1991)</td>
<td>Type of innovation does not moderate the professionalization-innovation relation. But in general professionalization is positively related to innovation.</td>
</tr>
<tr>
<td>Stage of innovation - Initiation, adoption, implementation</td>
<td>Pierce and Delbecq (1977)</td>
<td>Professionalism is positively related with all three stages of organizational innovation</td>
</tr>
<tr>
<td></td>
<td>Damanpour (1991)</td>
<td>Stage of adoption does not moderate the professionalism-innovation relation.</td>
</tr>
</tbody>
</table>
Professionalization

This reflects an organization’s professional knowledge gained by its members through experience and education. It is measured in terms of the percentage or number of employees with particular educational backgrounds or by the degree of professional training received by employees (Damanpour, 1991). Introduction of diverse kinds of professionals or “technical generalists” who maintain contact...
with their field through reading, attendance at meetings, etc., should positively relate to diversity of ideas and then to innovation (Hage and Dewar, 1973).

Except for two studies (Kimberly and Evanisko, 1981; Dewar and Dutton, 1986), all other studies have identified a positive effect of professionalization on innovation. Also the strength of the effect seems to vary based on the type of innovation - technical or administrative. Three studies (Daft, 1978; Damanpour, 1987; Li et al., 2006) have found that professionalization has a stronger effect on technical innovation than administrative innovation, which is contrary to Damanpour (1991) who found that type of innovation does not moderate the professionalization-innovation relation. Regarding the relation between professionalization and stage of innovation, two studies (Pierce and Delbecq, 1977; Damanpour, 1991) have found that professionalism is positively related with all three stages (initiation, adoption and implementation) of organizational innovation.

**Proposition 1a:** Professionalization positively affects organizational innovation

**Proposition 1b:** The type of innovation, administrative or technical, moderates the effect of professionalization on organizational innovation

**Proposition 1c:** Professionalization positively affects all three stages, initiation, adoption and implementation of organizational innovation

**Specialization**

Specialization represents different specialties in an organization. Other names such as “complexity” is also used to represent this variable (Hage and Aiken, 1967). It is measured by the number of occupational types or job titles present in an organization (Damanpour, 1991). More the diversity of specialists, the greater is the organizational knowledge base and hence specialization is generally hypothesized to be positively related with innovation (Damanpour, 1987).

From our review, we could find that, specialization positively affects innovation. Except for one study (Dewar and Dutton, 1986), all other studies support the positive effect. Also like professionalization, specialization has a stronger effect on technical innovation than administrative innovation (Kimberly and Evanisko, 1981; Damanpour, 1987, 1991; Bantel and Jackson, 1989). Regarding the stage of innovation, specialization is stronger in implementation stage than initiation stage (Damanpour, 1991).

**Proposition 2a:** Specialization positively affects organizational innovation
Proposition 2b: The type of innovation, administrative or technical, moderates the effect of specialization on organizational innovation

Proposition 2c: The positive effect of specialization is stronger in implementation stage than initiation stage

Other forms of input control

The other three less studied forms of input control are socialization, depth of knowledge and organizational slack.

Socialization: This represents the mechanisms employed by an organization to in still organizational norms, shared values, and beliefs into the employees (Li et al., 2010). The mechanisms include activities such as trainings, team activities, meetings and other indoctrination programs. Socialization creates a shared understanding among the employees and minimizes the misunderstandings over the meanings and interpretations of an organization's knowledge (Li et al., 2010). From our review, we can infer that, socialization positively affects innovation and is related to knowledge constructs such as absorptive capacity and knowledge codification and exploitation.

Depth of Knowledge: This represents the technical potential and resources of an organization. It is measured by the presence of a technical personnel (Dewar and Dutton, 1986) or technical group (Ettlie et al., 1984). From our review, we find that depth of knowledge is positively related to both incremental and radical innovation. But it the effect is stronger on radical innovation than on incremental innovation (Dewar and Dutton, 1986).

Organizational Slack: It represents the difference between the current resource pool of an organization and minimum resource level required to sustain operations. Examples of slack resources are excess employees, capacity and inputs (Nohria and Gulati, 1996). The presence of slack in an organization implies that the organization can absorb failure, buy expensive innovations, and can explore new ideas and hence slack can positively affect innovation (Damanpour, 1987). For instance, it was found that organizational slack strongly affects technical innovation (Damanpour, 1987). However Nohria and Gulati (1996) have found that slack has an inverted U-shaped relationship with innovation. Hence we need more studies to conclusively propose the relationship between innovation and organizational slack.

Proposition 3: Socialization positively affects organizational innovation
Proposition 4a: Depth of knowledge positively affects organizational innovation

Proposition 4b: The effect of depth of knowledge is stronger on radical innovation than on incremental innovation

Behavior Control and Innovation

Of the three types of control, behavior control has been the object of considerable research (Cardinal, 2001). In our review, we have identified nine forms of behavior control that have been studied in relation to organizational innovation. They are centralization, formalization, internal communication, functional differentiation, performance evaluation, administrative intensity, routinization, vertical differentiation and stratification. Of these, centralization and formalization have been studied extensively in literature, while the other forms have been only sparsely studied.

<table>
<thead>
<tr>
<th>Innovation type studied</th>
<th>Author and Year</th>
<th>Findings and Viewpoints</th>
</tr>
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<tbody>
<tr>
<td><strong>Effect of centralization on innovation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical and Administrative</td>
<td>Kimberly and Evanisko (1981)</td>
<td>Centralization is negatively related to technological innovation and not significantly related to administrative innovation</td>
</tr>
<tr>
<td>Increment and Radical</td>
<td>Dewar and Dutton (1986)</td>
<td>Centralization is not significantly related to both incremental and radical innovation</td>
</tr>
<tr>
<td></td>
<td>Cardinal (2001)</td>
<td>Centralization is positively related to both incremental and radical innovation</td>
</tr>
<tr>
<td></td>
<td>Ettlie et al. (1984)</td>
<td>Centralization is negatively related to both incremental and radical innovation</td>
</tr>
<tr>
<td>Product/Service</td>
<td>Hage and Dewar (1973); Lauren and Foss (2003); Persaud (2005)</td>
<td>Centralization is negatively related to the firm’s ability to innovate</td>
</tr>
<tr>
<td>Exploratory, Exploitative</td>
<td>Jansen et al. (2006)</td>
<td>Centralization has a negative relationship with exploratory innovation; but not significantly affects exploitative innovation</td>
</tr>
<tr>
<td>NA</td>
<td>Damanpour (1991)</td>
<td>Centralization is negatively related to innovation; Type of innovation does not moderate the centralization-innovation relation.</td>
</tr>
<tr>
<td>NA</td>
<td>Damanpour (1991)</td>
<td>Centralization is negatively related to innovation; Type of innovation does not moderate the centralization-innovation relation.</td>
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</tr>
<tr>
<td>NA</td>
<td>Bailyn (1985)</td>
<td>At the start of the career of R&amp;D professionals, strategic autonomy should be lower than operational autonomy; operational autonomy should rapidly increase initially and it should be followed by increase in strategic autonomy.</td>
</tr>
<tr>
<td>Stage of innovation</td>
<td>Pierce and Delbecq (1977)</td>
<td>Centralization will be negatively related with initiation and implementation, stronger with initiation than implementation and may be positively related to adoption.</td>
</tr>
<tr>
<td></td>
<td>Damanpour (1991)</td>
<td>No difference in relationship based on stage of innovation.</td>
</tr>
<tr>
<td>Knowledge Management</td>
<td>Jansen et al. (2005)</td>
<td>Decentralization positively affects acquisition but not assimilation dimension of potential absorptive capacity; not significantly associated with both dimensions of realized absorptive capacity.</td>
</tr>
<tr>
<td></td>
<td>Li et al. (2011)</td>
<td>Decentralization positively moderates the relationship between endogenous innovation and knowledge exploitation.</td>
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**Effect of formalization on innovation**

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<tbody>
<tr>
<td></td>
<td>Ettlie et al. (1984)</td>
<td>Formalization negatively affects radical innovation and positively affects incremental innovation.</td>
</tr>
<tr>
<td>Product/Service</td>
<td>Hage and Dewar (1973); Bonner (2005); Rijsdijk and Ende (2011); Persaud (2005)</td>
<td>Formalization is not significantly related to innovation. Innovative capabilities are negatively affected by formalization.</td>
</tr>
<tr>
<td>Exploratory and Exploitative</td>
<td>Jansen et al. (2006)</td>
<td>Formalization positively affects exploitative innovation; not significantly affects exploratory innovation.</td>
</tr>
<tr>
<td></td>
<td>Brion et al. (2010)</td>
<td>Ambidexterity has a positive relationship with innovation.</td>
</tr>
<tr>
<td>NA</td>
<td>Damanpour (1991)</td>
<td>There is no significant relationship between innovation and formalization.</td>
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<table>
<thead>
<tr>
<th>Stage of innovation</th>
<th>Knowledge Management</th>
<th>Effect of internal communication on innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pierce and Delbecq (1977)</td>
<td>Jansen et al. (2005)</td>
<td>There is a negative relationship between formalization and initiation, but adoption and implementation have allow positive relationship with formalization</td>
</tr>
<tr>
<td>Jansen et al. (2005)</td>
<td>Li et al. (2010)</td>
<td>Formalization is not significantly associated with potential absorptive capacity; but significantly associated with realized absorptive capacity</td>
</tr>
<tr>
<td>Li et al. (2010)</td>
<td></td>
<td>Formalization positively moderates the relationship between endogenous innovation and knowledge exploitation</td>
</tr>
</tbody>
</table>

**Effect of internal communication on innovation**

| NA | Damanpour (1991); Dougherty (1992); Lauren and Foss (2003); Persaud (2005) | Internal communication is positively related to the firm's ability to innovate |
| NA | Jansen et al. (2006) | Positively affects both exploitative and exploratory innovation |
| NA | Jansen et al. (2005) | Cross-functional interface positively affects both acquisition and assimilation dimensions of potential absorptive capacity; but positively affects only the transformation dimension of realized absorptive capacity |

**Effect of functional differentiation on innovation**

| NA | Kimberly and Evanisko (1981) | Functional differentiation is positively related to technological innovation but not related to administrative innovation. |
| NA | Damanpour (1991) | Functional differentiation is positively related to innovation. |
| NA | Pierce and Delbecq (1977) | Functional differentiation will be positively and strongly related with the initiation stage than for adoption and implementation. |
| NA | Damanpour (1987) | Functional differentiation did not show any differential effect between the three innovations - Technical, Administrative and Ancillary |

**Effect of performance evaluation on innovation**

| NA | Shalley (1995) | Expectation of evaluation has no effect on creativity. |
| NA | Cardinal (2001) | Frequency of performance appraisals has a positive relationship with radical |
Centralization represents the degree of concentration of decision-making in an organization (Damanpour, 1991). It is measured by its inverse, decentralization, the degree of employee participation in decision-making (Damanpour, 1991). Centralization is normally thought to hinder innovation as concentration of decision making power leads to attempts to preserve status quo and prevents imaginative solutions to problems and input from diverse sources (Hage and Dewar, 1973).

Almost all the studies in our review have found a negative relationship between centralization and innovation. Regarding the stage of innovation, Pierce and Delbecq (1977) proposed that centralization will be negatively related with initiation and implementation stage and positively related to adoption stage. But Damanpour (1991) in his empirical analysis did not find significant difference in relationship based on stage of innovation. Bailyn (1985) talks about two types of autonomy – operational autonomy and strategic autonomy. He argues

<table>
<thead>
<tr>
<th>Effect of administrative intensity on innovation</th>
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<tr>
<td>NA</td>
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<tr>
<td>Damanpour (1987)</td>
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<tr>
<th>Effect of routinization on innovation</th>
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<tbody>
<tr>
<td>NA</td>
</tr>
<tr>
<td>Jansen et al. (2005)</td>
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<td>Ohly et al. (2006)</td>
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<tr>
<th>Effect of vertical differentiation on innovation</th>
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<tr>
<td>NA</td>
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<tr>
<td>Damanpour (1991)</td>
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<tr>
<th>Effect of stratification on innovation</th>
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<tbody>
<tr>
<td>NA</td>
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<tr>
<td>Pierce and Delbecq (1977)</td>
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</table>
that, at the start of the career of R&D professionals, strategic autonomy should be lower than operational autonomy; initially there should be large increase in operational autonomy which should be followed by rise in strategic autonomy. Taking a knowledge based view, Jansen et al. (2005) find that centralization is negatively associated only with the acquisition dimension of absorptive capacity and not significantly related with other three dimensions and Li et al. (2011) find that decentralization positively moderates the relationship between innovation and knowledge exploitation.

**Proposition 5:** Centralization negatively affects organizational innovation

**Formalization**

Formalization represents the importance given to following procedures and rules in an organization. It is measured by the degree of freedom available to employees to pursue their activities in contrast to the availability of manuals and job descriptions that accurately define the activities (Damanpour, 1991). It is generally argued that rigid rule observation inhibits diffusion and communication of ideas, suppresses creativity, and consequently is negatively associated within novation (Hage and Dewar, 1973).

Contrary to general opinion, we find that most of the studies in our review have found positive relation between formalization and innovation. According to Ohly et al. (2006), “routinization” might explain why formalization might have positive relation with innovation. They argue that when formalization results in routinization of tasks and activities, it might free cognitive resources of employees to ponder about other aspects of work and hence formalization can be beneficial for innovation. Regarding the stage of innovation, Pierce and Delbecq (1977) propose that formalization will negatively affect initiations, but will positively affect adoption and implementation. Taking a knowledge based view, Jansen et al. (2005) find that formalization is significantly associated with realized absorptive capacity and Li et al. (2010) find that formalization positively moderates the relationship between knowledge exploitation and innovation.

**Proposition 6:** Formalization positively affects organizational innovation

**Other forms of behavior control**

The other less studied forms of behavior control are internal communication, functional differentiation, performance evaluation, administrative intensity, routinization, vertical differentiation and stratification.
**Internal Communication:** Internal communication reflects the level of communication within an organization among its various units. It is measured in number of ways, such as the frequency of meetings, number of contacts among employees within and across levels, and the level of participation by different units in decision-making (Damanpour, 1991). Terms such as cross-functional interface (Jansen et al., 2005), interdisciplinary work groups (Lauren and Foss, 2003), connectedness (Jansen et al., 2006) have been used to denote internal communication. Internal communication is generally hypothesized to have a positive relation with innovation as it leads to exchange of ideas within an organization (Damanpour, 1991). This is consistent with our review finding, as all the studies reported a positive association between internal communication and innovation.

**Functional Differentiation:** This reflects the degree of differentiation in an organization in terms of functional units (Damanpour, 1991). Functional differentiation is generally hypothesized to be positively associated with organizational innovation as it results in the creation of a coalition of professionals within units who could introduce innovations (Damanpour 1987, 1991; Kimberly and Evanisko, 1981). From our review, we also infer a positive relation between functional differentiation and innovation. While Kimberly and Evanisko (1981) found a differential effect between technological and administrative innovation, Damanpour (1987) did not find any such differential effect between innovation types.

**Performance Evaluation:** While performance evaluation is an important behavior control, its impact on innovation has received less attention (Cardinal, 2001). Cardinal (2001) found that frequency of performance appraisals is not related to incremental innovation, but positively affects radical innovation. Similarly, Shalley (1995) found that expectation of evaluation has no effect on creativity. Li et al. (2011) found that performance evaluation based on long-term measures positively moderates the relationship between innovation and knowledge exploitation. So, from these limited studies we can infer that performance evaluation is positively related to innovation. But more studies are required to concretely establish the link.

**Administrative Intensity:** Administrative intensity represents administrative overhead. It is measured in terms of proportion of managers compared to all employees in an organization. Since adoption of innovations depends on leadership support and managerial coordination, a higher administrative intensity will positively affect innovation (Damanpour, 1987; 1991). In our review, both the studies (Damanpour, 1987, 1991) have found a positive relation between administrative intensity and innovation.
Routinization: Routinization refers to automaticity in behavior (Ohly et al., 2006). Organizations follow routinization to develop tasks that does not require much attention (Jansen et al., 2005). There are two different views on the relationship between innovation and routinization. On the one hand, routinization might positively affect innovation as it frees cognitive resources of employees, on the other hand routinization might be an antithesis to creativity (Ohly et al., 2006). Ohly et al. (2006) found a positive association between innovation and routinization. But more studies are required to concretely establish the link between routinization and innovation.

Vertical differentiation: Vertical differentiation refers to the level of hierarchy in an organization usually measured by the number of levels below top most level. More hierarchical levels in an organization might impede communication and flow of ideas across levels and hence negatively affect innovation (Damanpour, 1991). There are not many studies looking at this relationship. More studies are required to strongly establish the link between vertical differentiation and innovation.

Stratification: Stratification is indicated by the degree of status congruence and ease of intra-organizational mobility (Pierce and Delbecq, 1977). Stratification is generally hypothesized to be negatively related to innovation as status-striving behavior is incompatible with creative thinking and leads to personal insecurity (Pierce and Delbecq, 1977). More studies are required to establish the link between stratification and innovation.

Proposition 7: Internal communication positively affects organizational innovation

Proposition 8: Functional differentiation positively affects organizational innovation

Proposition 9: Administrative intensity positively affects organizational innovation

Output Control and Innovation

As noted earlier, very few papers have studied the effects of output control on innovation. From our review, we identified four forms of output control – emphasis on output, emphasis on professional output, goal specificity and rewards and recognition.
Emphasis on output: Emphasis on output means organization sets standards of performance and assesses outputs against them. Achievable and clear goals provide required information and motivation to act towards preferred ends (Bonner 2005; Cardinal, 2001). Some examples of output measures are profits, customer satisfaction, revenue, market share and product or service quality. In our review, most of the studies have found positive association between emphasis on output and innovation.

Goal specificity: This refers to providing clear definition of the product goals. A clear goal specificity might reduce errors as it decreases uncertainty (Rijsdijk and

Table 4: Effect of output controls on innovation

<table>
<thead>
<tr>
<th>Innovation type studied</th>
<th>Author and Year</th>
<th>Findings and Viewpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Effect of emphasis on output on innovation</strong></td>
</tr>
<tr>
<td>NA</td>
<td>Cardinal (2001); Bonner (2005); Rijsdijk and Ende (2011)</td>
<td>An emphasis on output is positively related to innovation</td>
</tr>
<tr>
<td>Li et al. (2006)</td>
<td>Technological innovation has a negative relationship with emphasis on output</td>
<td></td>
</tr>
<tr>
<td>Walker et al. (2010)</td>
<td>Emphasis on output mediates the relationship between innovation and organizational performance</td>
<td></td>
</tr>
<tr>
<td>Li et al. (2010)</td>
<td>Emphasis on output moderates the relationship between endogenous innovation and knowledge exploitation in an inverse U-shaped relationship</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Effect of goal specificity on innovation</strong></td>
</tr>
<tr>
<td>NA</td>
<td>Cardinal (2001); Rijsdijk and Ende (2011)</td>
<td>Goal specificity is positively related to innovation</td>
</tr>
<tr>
<td>Zanzi (1987)</td>
<td>Goals tend to be less defined in the organic organization and better defined in the mechanistic one</td>
<td></td>
</tr>
<tr>
<td>Shalley (1995)</td>
<td>High levels of creativity occur when individuals have a creativity goal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Effect of rewards and recognition on innovation</strong></td>
</tr>
<tr>
<td>NA</td>
<td>Cardinal (2001); Lauren and Foss (2003); Bonner (2005); Brion et al. (2010)</td>
<td>Rewards and recognition are positively related to innovation</td>
</tr>
<tr>
<td>Li et al. (2006)</td>
<td>Material incentive has a negative relationship and non-material incentive has a positive relationship to technological innovation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Effect of emphasis on professional output on innovation</strong></td>
</tr>
<tr>
<td>NA</td>
<td>Cardinal (2001)</td>
<td>Emphasis on professional output has a positive relationship with incremental innovation, but no significant relationship exists with radical innovation</td>
</tr>
</tbody>
</table>
A review of organizational control and innovation

Ende, 2011). In our review, a positive association is found between goal specificity and innovation.

**Rewards and recognition:** In our review, all the studies found a positive association between rewards and recognition and innovation (Cardinal, 2001; Lauren and Foss, 2003; Bonner, 2005; Brion et al., 2010). Li et al. (2006) found a differential effect between material and non-material incentive. They found that material incentive has a negative relationship and non-material incentive has a positive relationship to technological innovation.

**Emphasis on professional output:** Only one study (Cardinal, 2001) in our review has studied this variable. Cardinal (2001) found that emphasis on professional output, which is presenting papers and publishing in journals, has a positive relationship with incremental innovation, but no significant relationship exists with radical innovation (Cardinal, 2001). More studies are required to concretely establish the relationship between emphasis on professional output and innovation.

**Proposition 10:** Emphasis on output positively affects organizational innovation

**Proposition 11:** Goal specificity positively affects organizational innovation

**Proposition 12:** Rewards and recognition positively affects organizational innovation

**Conclusion**

In this paper, we reviewed the effect of three types of organizational control on innovation. While the results were contradictory in few studies, we can broadly see that input controls professionalization, specialization, socialization and depth of knowledge positively affect innovation. The effect of professionalization and specialization is stronger on technical innovation. Behavior controls centralization negatively affects innovation while others such as formalization, internal communication, functional differentiation and administrative intensity has a positive relation with innovation. The output controls emphasis on output, goal specificity and rewards and recognition positively affect innovation. We cannot conclusively assess the relationship between innovation and other forms of control such as emphasis on professional output, stratification, vertical differentiation, routinization, performance evaluation and organizational slack. More studies are required to assess the relationship. Many studies (e.g., Bao et al., 2012; Jansen et al., 2006) have highlighted the importance of industry specific moderators such as environmental dynamism and environmental competitiveness that might influence the control-innovation relation. In our review, we observed that the sample used in the studies varied greatly from schools, library, and hospitals to high-tech companies, financial services, and MNCs. So future work can compare studies from a specific industry to yield more insights.
### Appendix 1
#### Summary of reviewed articles

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Sample</th>
<th>Control Type</th>
<th>Control Subtype</th>
<th>Innovation Type</th>
<th>Relationship studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Hage and Dewar</td>
<td>1973</td>
<td>Social welfare and health organizations</td>
<td>Input, Behavior</td>
<td>Specialization, Professionalization, Centralization, Formalization</td>
<td>Product</td>
<td>Studied the relationship between elite values and controls such as professionalization, formalization and centralization</td>
</tr>
<tr>
<td>2  Pierce &amp; Delbecq</td>
<td>1977</td>
<td>Theoretical paper</td>
<td>Input, Behavior</td>
<td>Professionalization, Centralization, Formalization, Functional differentiation, Stratification</td>
<td>Stages of innovation - Initiation, adoption, implementation</td>
<td>A review of initiation, adoption and implementation stages of innovation</td>
</tr>
<tr>
<td>3  Daft</td>
<td>1978</td>
<td>High schools</td>
<td>Input</td>
<td>Professionalization</td>
<td>Technical and Administrative</td>
<td>The role played by technical employees and administrators in innovation adoption</td>
</tr>
<tr>
<td>4  Kimberyan and Evanisko</td>
<td>1981</td>
<td>Hospitals</td>
<td>Input, Behavior</td>
<td>Specialization, Professionalization (external integration), Centralization, Functional differentiation</td>
<td>Administrative and Technical</td>
<td>Effect of contextual, organizational and individual variables on administrative and technical innovation</td>
</tr>
<tr>
<td>5  Ettlieet al.</td>
<td>1984</td>
<td>Food processing industry</td>
<td>Input, Behavior</td>
<td>Specialization, Depth of knowledge (Concentration of technical specialists), Centralization, Formalization</td>
<td>Increment and Radical</td>
<td>Relationship of strategy-structure causal sequence with incremental and radical innovation</td>
</tr>
<tr>
<td>6  Bailyn</td>
<td>1985</td>
<td>Theoretical paper</td>
<td>Behavior</td>
<td>Centralization</td>
<td>-</td>
<td>Analyzes the strategic autonomy and operational autonomy for R&amp;D professionals</td>
</tr>
<tr>
<td>7  Dewar and Dutton</td>
<td>1986</td>
<td>Footwear industry</td>
<td>Input, Behavior</td>
<td>Specialization, Professionalization, Depth of knowledge (number of technical specialists), Centralization</td>
<td>Increment and Radical</td>
<td>Factors that predict the adoption of incremental and radical innovation</td>
</tr>
<tr>
<td>8</td>
<td>Damanpour</td>
<td>1987</td>
<td>Public libraries</td>
<td>Input, Behavior</td>
<td>Specialization, Professionalism, Organizational slack, Administrative intensity, Functional differentiation</td>
<td>Technical, Administrative and Ancillary</td>
</tr>
<tr>
<td>9</td>
<td>Zanzi</td>
<td>1987</td>
<td>Public accounting firm</td>
<td>Output</td>
<td>Goal specificity</td>
<td>Organic and Mechanistic</td>
</tr>
<tr>
<td>10</td>
<td>Bantel and Jackson</td>
<td>1989</td>
<td>Banks</td>
<td>Input</td>
<td>Team diversity (Specialization)</td>
<td>Technical and Administrative</td>
</tr>
<tr>
<td>11</td>
<td>Damanpour</td>
<td>1991</td>
<td>Meta-analysis</td>
<td>Input, Behavior</td>
<td>Specialization, Professionalization (external communication) and Depth of knowledge (technical knowledge resources), Centralization, formalization, Functional differentiation, Vertical differentiation, Internal communication, Administrative intensity</td>
<td>Increment and Radical, Product and process, Technical and Administrative</td>
</tr>
<tr>
<td>12</td>
<td>Dougherty</td>
<td>1992</td>
<td>Computer, communicatio and chemical industry</td>
<td>Behavior</td>
<td>Internal communication</td>
<td>Product</td>
</tr>
<tr>
<td>13</td>
<td>Gambardella</td>
<td>1992</td>
<td>Pharmaceutica l firms</td>
<td>Input</td>
<td>Professionalization</td>
<td>Product</td>
</tr>
<tr>
<td>14</td>
<td>Shalley</td>
<td>1995</td>
<td>UG students (Experimental methodology)</td>
<td>Behavior, Output</td>
<td>Performance evaluation, Goal specificity</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Nohria and Gulati</td>
<td>1996</td>
<td>264 functional departments of two MNCs</td>
<td>Input</td>
<td>Organizational slack</td>
<td>-</td>
</tr>
<tr>
<td>Increment and Radical Innovation</td>
<td>Centralization, Specialization, Professionalization, Frequency of performance appraisals, Formalization, Rewards &amp; recognition, An emphasis on output,Goal specificity</td>
<td>Product Service</td>
<td>Innovative and exploratory</td>
<td>The effect of centralization, formalization and internal communication (cross-functional) on exploratory and exploitative innovation</td>
<td></td>
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<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Input, Behavior, Output</td>
<td>Pharmacuetica I firms (1990 Danish business firms)</td>
<td>2001</td>
<td>16</td>
<td>2003 Lauren and Foss</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17. Projects from several industries</td>
<td>2005</td>
<td>17</td>
<td>2005 Bonner</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19. 79 R&amp;D units of MNCs</td>
<td>2005</td>
<td>19</td>
<td>2005 Persaud</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20. Organizational units of a large financial services firm</td>
<td>2006</td>
<td>20</td>
<td>2006 Jansen et al.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Authors</td>
<td>Year</td>
<td>Firm Size</td>
<td>Input, Behavior, Output</td>
<td>Human Capital Management</td>
<td>Business Environment</td>
</tr>
<tr>
<td>-----</td>
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</tr>
<tr>
<td>22</td>
<td>Li et al.</td>
<td>2006</td>
<td>194 high-tech firms in China</td>
<td>Input, Output</td>
<td>Professionalization (Employee training), Rewards &amp; Recognition (Material and Non-material), Emphasis on output</td>
<td>Technical</td>
</tr>
<tr>
<td>23</td>
<td>Ohly et al.</td>
<td>2006</td>
<td>A German high tech firm</td>
<td>Behavior</td>
<td>Routinization</td>
<td>-</td>
</tr>
<tr>
<td>24</td>
<td>Chen and Huang</td>
<td>2009</td>
<td>146 Taiwanese firms</td>
<td>Input</td>
<td>Strategic Human resource practices (professionalization and training)</td>
<td>Technical and Administrative</td>
</tr>
<tr>
<td>25</td>
<td>Brionet et al.</td>
<td>2010</td>
<td>108 large manufacturing and service firms (&gt; 250 employees) in France</td>
<td>Behavior, Output</td>
<td>Formalization, Rewards &amp; Recognition (Performance oriented management)</td>
<td>Ambidexterity (Exploratory, Exploitative)</td>
</tr>
<tr>
<td>26</td>
<td>Li et al.</td>
<td>2010</td>
<td>607 Chinese firms</td>
<td>Input, Behavior, Output</td>
<td>Socialization, Formalization, Emphasis on output</td>
<td>Endogenous innovation</td>
</tr>
<tr>
<td>27</td>
<td>Walker et al.</td>
<td>2010</td>
<td>English local governments or authorities</td>
<td>Output</td>
<td>Performance management (Emphasis on output)</td>
<td>Process innovation (Information technology and administrative)</td>
</tr>
<tr>
<td>28</td>
<td>Li et al.</td>
<td>2011</td>
<td>213 SMEs in China</td>
<td>Behavior</td>
<td>Strategic control (Performance evaluation based on long term measures, more autonomy)</td>
<td>Endogenous innovation</td>
</tr>
<tr>
<td>29</td>
<td>Rijnsdijk and Ende</td>
<td>2011</td>
<td>148 NPD projects of organizations in Netherlands</td>
<td>Input, Behavior, Output</td>
<td>Socialization, Formalization, Goal specificity, Emphasis on output</td>
<td>-</td>
</tr>
<tr>
<td>30</td>
<td>Bao et al.</td>
<td>2012</td>
<td>High-tech firms in China</td>
<td>Input</td>
<td>Professionalization (external learning)</td>
<td>Radical</td>
</tr>
</tbody>
</table>
References


