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Review article

Innovation across types of organization: a meta-analysis

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ABSTRACT

A meta-analysis was performed on the relationship between specialization and innovation in organizations. This analysis showed a statistically significant correlation for this relationship. Results suggest that the type of organization is a moderator of the specialization-innovation relationship as such that in manufacturing organization this correlation is stronger than in service organizations. Some implications for future research are presented.

Innovación sobre tipos de organización: una revisión metanalítica

Palabras clave:
Innovación organizacional
Especialización
Innovación técnica
Tipo de organización

RESUMEN

Se desarrolló un metanálisis para analizar la relación entre especialización e innovación en las organizaciones. Este análisis produjo correlaciones estadísticamente significativas de la relación estudiada. Los resultados indican que el tipo de organización es un moderador de la relación entre especialización e innovación, de modo que en organizaciones de manufactura esta relación es más fuerte que en organizaciones de servicios. Se presentan además algunas implicaciones para investigaciones futuras.

According to Damanpour and Gopalakrishnan (2001) firm's competitiveness over time depends on its ability to adopt different types of innovation. Among diverse categories of innovation advanced in the literature, three have achieved the principal attention, each focuses on a couple of types of innovation: administrative and technical, product and process, and radical and incremental (Kimberly & Evanisko, 1981; Nord & Tucker, 1987; Zmud, 1982; Sternberg, Pretz & Kaufman, 2003). The primary goal of much of the previous studies has been to demonstrate the presence of dissimilar dimensions of innovation and distinguish their associated determinants.

Prior studies on organizational innovation exhibit variation in magnitude, statistical significance, and direction of relationships studied between innovation and its correlates

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or determinants (Damanpour, 1987; Fennel, 1984; Sorensen & Stuart, 2000; Frambach & Schillewaert, 2002; Weerawardena, O'Cass & Julian, 2006). Although conceptual and qualitative reviews of the organizational innovation literature have surfaced, in light of recent findings, it would be useful to conduct a quantitative, meta-analytic review of this research stream.

Meta-analysis is particularly useful when empirical findings produce diverging results. At first place, by estimating the mean values and range of effects for relationships, meta-analysis provides empirical generalizations across multiple studies (Hunter & Schmidt, 2004). In this way, it allows scholars to estimate true relationships between variables in study. Besides, meta-analysis can be used to detect moderating effects (Ostroff & Harrison, 1999). This meta-analytic review offers some insights about innovation in different types of organizations.

The purpose of this study is, through a meta-analytic procedure: *(a)* test the hypothesized relationship between innovation and specialization or complexity, and *(b)* explore the moderation effect of the type of organization in the innovation-specialization relationship. The main research questions of this paper are: *(a)* What is the mean correlation between innovation and specialization in the organization?; *(b)* Is the type of organization a moderator of this relationship?, and *(c)* What is the nature of the moderation effect of the type of organization in the innovation-specialization relationship?

Theoretical framework and hypotheses

Organizational innovation

According to Dosi (1988), innovation is a process of problem-solving in which solutions to economically important problems are learned via search. In other words, innovation concerns the process of creating and applying new knowledge. The creation of new knowledge frequently engages a different recombination of existing elements of knowledge (Fleming, 2001), or the reconfiguration of the manners in which knowledge elements are connected (Henderson & Clark, 1990).

The need to improve or change a product, process or service stimulates the organizational innovation. Innovation turns around changes, but is important to notice that not all change is an innovation. According to Yang, Phelps, and Steensma (2010), organizational innovation promotes individuals to think independently and creatively in applying personal knowledge to organizational challenges. Authors have distinguished between studies of the diffusion and adoption of innovations (Kimberly, 1981, p. 85) as well as between studies of innovating and innovativeness (Garcia & Calantone, 2002, p. 111). In some degree an overlap between these concepts may exist, nevertheless this study focused on the adoption of innovations in organizations.

The adoption of innovations is understood to comprise the generation, development, and implementation of new ideas or behaviors. An innovation can be a new product or service, a new production process technology, a new structure or administrative system, or a new plan or program pertaining to organizational members (Zaltman, Duncan & Holbek, 1973). Consequently, innovation is well-defined as the adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization (Damanpour & Gopalakrishnan, 2001). This definition is enough wide to incorporate different types of organizational innovations.

The implicit assumptions of this body of research, according to Subramanian and Nilakanta (1996, p. 632) are: *(a)* innovation adoptions are organizational responses to external environmental changes; proponents of the contingency theory believe that an organization's external environment is uncontrollable; in order to be successful, an organization must adapt to the changing environmental conditions by altering its organizational characteristics such as its structure or its processes (Lawrence & Lorsch, 1967); *(b)* the adoption of innovations by an organization is a consequence of strategic initiatives proactively pursued by decision makers in the organization; proponents of the strategic choice theory believe that organizations do not merely react to external environmental changes, instead they proactively take strategic actions that change the environment (Child, 1972); much of the research in strategic management is based on this assumption; *(c)* the adoption of innovations is desirable; innovations energize the adopting organizations and enhance their organizational performance (Dos Santos & Pfeffers, 1995), and *(d)* innovative organizations have identifiable organizational characteristics that distinguish them from their non-innovative counterparts (Damanpour, 1987).

The general purpose of the adoption of organizational innovations is to contribute to the performance and effectiveness of the adopting organization. Innovation is a way of transforming an organization, whether as a reaction to changes in its internal or external environment or as a tactical action taken to influence an environment. This meta-analytic revision concentrated on studies of multiple innovations because organizational innovativeness is better represented when multiple innovations are considered, as even the most stable environments change (Hage, 1980), and for this reason organizations adopt innovations constantly over time.

Organizational attributes and innovation

Of all potential aspects that influence organizational innovation, organizational variables have been the most extensively studied, and some authors have pointed to their primary importance as determinant factors of innovation (Damanpour, 1987; Kimberly & Evanisko, 1981).

According to Subramanian and Nilakanta (1996), organizational innovativeness is accelerated (or de-accelerated) and influenced by organizational characteristics such as vertical differentiation, internal communication, external communication, slack of resources, administrative intensity, technical knowledge resources, managerial tenure, managerial attitude toward change, centralization, formalization, professionalism, functional differentiation, and specialization, among others (Kim, 1980; Kimberly & Evanisko, 1981).

Statistically significant associations between the adoption of innovations and organizational characteristics have been

found in previous research, some of them shown negative associations: formalization, centralization, and vertical differentiation, while other organizational determinants positively influence innovation (Kimberly & Evanisko, 1981; Thompson, 1965; Damanpour, 1987; Fleming, 2001; Kotha, Zheng & George, 2011; Dewar & Dutton, 1986).

This study focuses on the effect of specialization on organizational innovation. Specialization represents different specialties found in an organization. Some studies have used other names for this variable, such as complexity and role specialization (Aiken, Bacharach & French, 1980; Yang, Phelps & Steensma, 2010). Consistent with prior literatures, a larger diversity of specialists would make available a bigger knowledge base, and increase the generation of new ideas (Aiken, Bacharach & French, 1980; Kimberly & Evanisko, 1981).

However, this course of research has come under criticism because of extreme variances in the findings of many investigations (Miller & Friesen, 1982). Trying to explain the differences in outcomes, some sub-theories of organizational innovation have been proposed. For example, Daft (1978) suggested that organizational innovations can be generally catalogued as technical and administrative, this is known as the dual core model of innovations (Evan, 1966). As proposed by Evan (1966), this distinction between administrative and technical innovations is crucial because it associates to a more general distinction between social structure and technology. Together, both types of innovation represent changes introduced in a broad series of activities in an organization. Technical innovations concern to products, services, and production process technology; they are related to basic work activities (Damanpour & Evan, 1984). Administrative innovations involve organizational structure and administrative processes, they are indirectly associated to the basic work activities of an organization, and are more directly linked to its management.

In previous research, Damanpour (1987) found that high levels of specialization promote the adoption of technical innovations rather than administrative innovations. Given the debate on the relationship between specialization and organizational innovation, and consistent with this previous research, our hypothesis is as follows:

H1: Specialization positively influence the adoption of technical organizational innovation.

Moderators of the specialization-organizational innovation relationship

Previous meta-analytic revisions of the relationship between organizational factors and the adoption of innovation have recognized the type of innovation, the stage of adoption, and the type of organization as moderators of this relationship (Damanpour, 1991). Damanpur's meta-analytic revision (1991), included 25 studies in order to analyze 12 organizational determinants of the adoption of innovations. I pretend to analyze the type of organization as moderator of the relationship between specialization and the adoption of technical innovation; to do this I have considered papers that were published between 1975 and 2011, and include some of those considered by Damanpour (1991) in his analysis.

Previous researches have found significant differences in the impact of organizational variables on innovation adoption among different types of organizations. For example, Miller and Friesen (1982, p. 9) found that entrepreneurial firms shown significantly higher degrees of organizational differentiation, and heterogeneity than conservative firms, and also they found that the rate of innovation adoptions is superior in entrepreneurial than in conservative firms. For its part, Hull and Hage (1982, p. 567) reported the association between innovativeness and structural variables to varies among traditional, mechanical, organic, and mixed organizations.

Existent literature has reported considerable differences in the technologies and its related dimensions of structure in manufacturing and service organizations (Yang, Phelps & Steensma, 2010; Kotha, Zheng & George, 2011). The characteristics of activities of manufacturing and service organizations are different (Brax, 2005), unlike the situation in manufacturing organizations, in service organizations the output is intangible and its consumption immediate, and the producer is close to the customer or client, producer and customer must interact for delivery of the service to be complete (Mills & Margulies, 1980).

In a service context, technical core employees are the service providers, and must deal with client variety and unpredictability, whereas in a manufacturing context, buffering roles reduce uncertainty and disruptions of the technical core. These differences would unequally affect both the determinants of innovation and the strength of their influence in each context (Damanpour, 1991). Empirical findings supporting the hypothesis that service companies can show different innovation patterns compared to manufacturing firms; for instance, in the service industry there are usually more departments and project teams engaged in the innovation process than in the manufacturing sector. Innovation in service industry is not the result of a scientific research process (Dosi, 1988) and, therefore, has to be handled differently. It can be summarized that internal science and technology-based R&D play only a minor role in services compared to manufacturing; the service firms have to focus on other forms of knowledge generation (Hipp & Grupp, 2005). Other study showed that the number of patents in the service organizations is considerably less than in the manufacturing organizations (Blind et al., 2003). Based on the previous discussion, I hypothesized the following:

H2: The relationship between specialization and technical innovation adoption is stronger in manufacturing organizations than in services organizations.

The proposed theoretical model is presented in figure 1.

Method

Database development and inclusion criteria

To develop the database, I considered journals that typically publish studies of organizational factors and innovation, and focus on general management issues. I acquired pub-

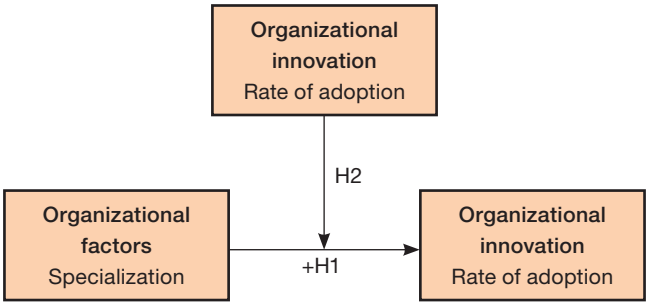

Figure 1 – Proposed theoretical model. Source: Own elaboration.

lished empirical studies of organizational innovation adoption through a variety of sources. First, I searched the ABI/INFORM, EBSCO, JSTOR, and ScienceDirect databases for studies on organizational innovation published between 1975 and 2011, using multiple keywords to identify relevant articles. Second, I manually searched abstracts from the set of journals. Finally, I examined the references from the articles identified in these previous steps to locate additional studies that the other searches were unable to capture. Studies were included in the meta-analysis if they met the following criteria:

1. I included in the meta-analysis only studies that reported the *r*-family of effects, such as correlation coefficients (Rosenthal, 1991). Several studies could not be included because their results only included multivariate models.
2. The ultimate dependent variable used was the rate of adoptions or organizational innovativeness.
3. I included only the articles that measured the organizational innovation at the organizational level of analysis so that results from research with incomparable goals were not aggregated (Hunter & Schmidt, 2004).
4. The score of innovation was based on at least two innovations.

To address the problem of conceptual replication, I ascertained that studies were independent and had no overlapping samples. If multiple studies were based on the same dataset with the same variables, I included only the effect size of one study. If datasets were the same but variables differed, I maintained the effect sizes separately. Total cumulative sample size across all studies amounted to 1693 firms. Each of the studies used in this meta-analysis was read and coded by the author for interdependence, sample size, reliabilities of independent and dependent variables, level of analysis, and effect sizes. Sample sizes were directly taken from the method and results sections of the articles included. Classification of the study variables was based on the descriptions of the measures. For most of the variables of interest, I followed widely accepted definitions described in past research. The variables used in this study were the following:

Organizational innovation: measured by the rate of the adoption of innovations, as a dependent variable.

Table 1 – Results for test hypothesis 1

Total *N*	M_r	SD_r	M_ρ	SE_ρ	95%CI for M_r
1693	.386	.012	.387	.035	.32-.46

Specialization: measured by the number of different occupational types or job titles in an organization, as independent variable.

Type of organization: categorical variable used for analyze the moderation effect. This variable could take the following values: service, manufacturing.

In addition to correlation coefficients, information on the moderator was coded for each study; studies were not forced into moderator categories. The moderator used was type of organization, and its categories: service or manufacturing. Table 1 also presents the moderator coded for each study.

Data analysis procedure

Raju, Burke, Normand and Langlois' (1991) meta-analytic procedure (RBNL) was used to conduct tests of the hypotheses. This procedure uses sample statistics including available information on sample-based artifacts (e.g., dependent variable reliabilities) to estimate individually corrected effects with standard errors for the individually corrected effects. Subsequently, this meta-analytic procedure computes sample-size weighted estimates of the mean and variance of corrected effects. In contrast, most other meta-analytic procedures rely on distributions of hypothetical artifact values (as discussed in more detail in Raju, Pappas & Williams, 1989) for estimating the mean and variance of corrected effects. Noteworthy, the RBNL meta-analytic procedure permits the construction of a confidence interval around the estimated mean corrected effect.

For using the RBNL meta-analytic procedure, all study effect sizes were first converted to Pearson correlations because this procedure is easily applied to correlational data corrected for unreliability. Consequently, all results are reported in terms of correlations. Also, these meta-analyses only involved corrections for sampling error and, where available, criterion unreliability. The average criterion reliability from available studies was substituted for missing criterion reliability values.

Results

Table 1 shows the meta-analytic results for the correlation between technical innovation (dependent variable) and the independent variable (specialization or complexity). Table 2 presents meta-analytic results for the influence of the type of organization as moderator of the relationship between technical innovation and specialization. I used a 95% confidence interval (95%CI) to determine the significance of the specialization-innovation relationship, considering as statistically significant correlation if the interval does not include zero.

Table 2 – Results for test moderation effect of type of organization

Total *N*	Type of organization	M_r	SD_r	M_ρ	SE_ρ	95%CI for Mr
1078	Services	.338	.006	.318	.035	.25-.39
615	Manufacturing	.469	.010	.484	.045	.40-.57

Hypothesis 1: Specialization-innovation relationship

For this hypothesis, it was expected a positive and significant correlation between specialization (as organizational factor) and the rate of adoption of technical innovations. There was support for this hypothesis, which means that 95%CI for the mean correlation of all studies did not includes zero. For this relationship, through this meta-analytic procedure it was obtained a positive and significant mean correlation (which indicates that organizations with more different specialties, i.e. with higher levels of specialization, are more successful in introducing and adopting technical innovations than organizations with lower levels of specialization.

Hypothesis 2: Moderation effect of the type of organization

This hypothesis predicted that in manufacturing organizations the correlation between specialization and technical innovation will be higher than in services organizations. There was support for this hypothesis, which means that 95%CI for the mean correlation of divided samples did not include zero, and did not overlap each other. For test the moderation effect, I divided the studies according the type of organization, which results in two sub-samples each composed by five studies. I computed the mean correlation and the 95%CI for each sub-sample and I obtained the following: *(a)* the mean correlation of the specialization-technical innovation relationship in manufacturing organizations was .484 and the random standard error of the mean of rho was .045, and *(b)* the mean correlation of the specialization-technical innovation relationship in services organizations was .318 and the random standard error of the mean of rho was .035, which indicates that in manufacturing organizations the level of specialization is a more important organizational factor that promotes technical innovation when comparing with services organizations.

Conclusions

This meta-analysis gathered and summarized the outputs of empirical research on the relationship between specialization and innovation in order to provide information for theory development and future research on organizational innovation. Results indicate that theory accumulation and theory building in the field of organizational innovation is possible and that more elaborate research toward developing reliable theories should be conducted.

Studies of single innovations and their adoption process are essential to understanding the generation, development, and implementation of innovations in organizations. Multiple innovation studies are also needed because identification of the characteristics that facilitate innovation adoption are necessary in the design and management of innovative organizations.

In evaluating the moderation effect of the type of organization, I found that this variable distinctively separate the specialization-innovation relationship. Type of organization should be a primary contingency variable. Organizational types can be identified by industry, sector, structure, strategy, etc. Distinguishing types is crucial, as the variance in environmental opportunities and threats for organizations of different types can influence their degree of innovativeness.

Limitations and implications for future research

The number of studies included in the meta-analysis is low, which could diminish the power of the results even when they are representative studies in the literature and have been cited by many authors.

I only considered two types of organization: manufacturing and services, but other typologies exist. Results could be significantly different also for other types of organizations, which open a window for a future research.

The present study revealed that the adoption of innovation is not equal in manufacturing and services organizations, it could be necessary to develop specific innovation theory that takes into consideration the differences between manufacturing and services organizations.

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