Innovation and Human Resource Flexibility

Analysis in a Cooperative, Dynamic and High-Tech Context

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Abstract

This paper analyzes the relationship between external human resource flexibility and innovation with the moderator effects of inter-organizational technology cooperation, environmental (market) dynamism, and the use of flexible technology in the production process. We propose a conceptual model grounded on the resource-based view and dynamic capabilities of the firm that develops several research hypotheses. Logic and linear hierarchical regressions test the hypotheses with panel data in the period 2003-2006 collected from a sample of 1,626 Spanish industrial firms.

Introduction

It is often claimed that innovation is one of the main factors underlying a country's international competitiveness, economic growth rate and employment performance [1]. Interest is increasingly focused on understanding the processes and determinants of innovation, adoption and diffusion within and between firms, industries and countries. A firm's capacity to innovate is the ability to adopt or implement new ideas, processes, or products successfully. This capacity enables the firm to respond more successfully to its environment and develop new capacities to achieve a competitive advantage and higher performance.

At the same time, global competition and expanding customer expectations creates the need for faster new product development to stay ahead from competition which require greater combinations of innovation and flexibility. Among the factors influencing innovation, the relationship between human resource flexibility and innovation has received little attention, and the literature reveals disagreements about the nature of this association. For example, while there are models of firm strategy which emphasize the need to build and sustain committed and capable human resources, others argue that looser employment relationships could be beneficial for innovation because they would exert a discipline upon labor which counteracts complacency, and would also enable firms to gain access to external knowledge from contingent employees [2-5]. The failure to comprehensively analyze

moderator effects could be one reason to explain the non-conclusive relationships, and therefore there is a research gap worthy to explore.

The purpose and contribution of this paper is the development of a conceptual model that links human resource flexibility and innovation with three moderator effects to reconcile prior non-conclusive findings: (1) inter-organizational cooperation in technological activities, (2) environmental (market) dynamism, and (3) the use of flexible technology in the production process.

Discussion and hypotheses

Innovative products and processes are the 'outgrowths' of underlying resources and capabilities. Capability theory [6] predicts that the firm's ability to build and reconfigure internal and external competencies to respond to rapid changes in their environment lies at the centre of innovation. Some scholars [7] find that the explanatory power of the dynamic-capability view exceeds that of research-based view in volatile environments. Firms that possess dynamic capabilities can effectively enhance their competitive advantages, despite facing uncertain and turbulent environments.

Flexibility options have the potential to broaden the range of capabilities necessary to innovate. To attain the level of organizational flexibility that customers value (i.e., quick delivery of a variety of innovative, high-quality, low-cost products), firms must manage different types of flexibility. An overview of the literature reveals that the taxonomy of flexibility is very extensive, due to the fact that this concept is widely applied to different areas of the organization. This paper focuses the analysis on flexibility dimensions related to human resources and external relations because labor flexibility constitutes a platform to build other levels of flexibility [8,9] and because external relations are a source of knowledge that contribute to innovation.

Since the seminal contribution of Atkinson [10] about the flexible firm, the literature distinguishes between internal and external human resource flexibility. Internal flexibility involves efforts to increase the firm's ability to adjust to uncertainty by changing the internal labour market or work organization, whereas external flexibility uses changes in the external labour market through layoffs or temporary employees.

From the resource based view of the firm, it might be expected that emphasize secure, long-term and high-commitment-based employment policies, would be more conducive to innovation. On the contrary, flexible employment contracts, such as fixed-term contracts or external work arrangements, could damage innovation. Thus, Michie and Sheehan [11] in a survey of 242 UK manufacturing organizations found that the use of short-term and temporary contracts was negatively correlated with all categories of innovation. Storey et al. [5] also found that employers rarely used flexible working to achieve innovation in a large-scale survey of 2,700 UK companies.

However the increasing complexity of markets makes it difficult for firms to have all of the resources necessary to innovate. External technology sources are sometimes the only option for firms that wish to keep up-to-date. Barney [12] has suggested that firms do not need to own all relevant capabilities to innovate, as long as they have sufficient access to them. While the capability to manage resources in the innovation process may be internal to the organization, the resources to be mobilized may be external – they are complementary assets.

This line of argument begins to suggest that even quite extensive use of flexible employment contracts may be compatible with the in-house capabilities of innovation in dynamic environments to ensure the presence of knowledge and technological resources that may be beyond existing internal capabilities. Matusik and Hill [3] argue that contingent work,

although so far mainly introduced for cost reasons, can be more positively used for the creation and accumulation of new knowledge. Externals may bring knowledge and industry best practices into a firm, and they may stimulate exploration of new processes and ideas outside the firm's knowledge stock. For instance, Nesheim [13] found in a sample of 26 Norwegian firms that firms in dynamic environments often use external personnel deliberately in core value-creation areas: the use of external arrangements in the core value-creation areas was positively related to innovation strategy.

There are even studies that challenge the assumption that the use of flexible employment (e.g., temporary contracts) will have negative consequences for innovation. For example, Guest et al. [14] report that, overall, contingent workers displayed no differences in levels of motivation, organizational commitment or innovative behavior compared with permanent employees. Indeed, the authors suggest that those on fixed term and temporary contracts, especially when they have chosen this form of employment, sometimes actually report a more positive 'psychological contract' and a potential higher propensity for innovation. Other scholars find positive relationships between flexible employment contracts and innovation but they suggest a different causal relationship because innovation may sometimes influence flexibility.

Then, prior research has established more consensuses about the impact of internal human resource flexibility (e.g., functional flexibility) than on the influence of external human resource flexibility. Whereas some theoretical perspectives and empirical research suggest the need to build and sustain committed human resources with full-time and permanent contracts [10, 11], others argue that looser employment relationships are beneficial to innovation [13]. The failure to analyze moderators could explain the non-conclusive relationships between external human resource flexibility and innovation.

This paper proposes a research model that links external human resource flexibility and innovation with three moderator effects to reconcile prior non-conclusive findings: (1) inter-organizational cooperation in technological activities, (2) environmental (market) dynamism, and (3) the use of flexible technology in the manufacturing process.

(1) Moderator effect of inter-organizational cooperation

The role of inter-organizational cooperation is important because as a firm increases interactions with other members in the supply chain, it may experience changes in its organizational flexibility. External cooperation may modify (increase or decrease) the need to be flexible internally and this could have implications for the firm's innovation performance. Firms that cooperate in new product development within the supply chain can broaden their knowledge base and contribute to diffuse innovative work practices along the supply chain. High-cooperation firms can access a broader knowledge base than low-cooperation firms, and therefore they may be more able to deploy a wider dispersion of knowledge through human resource flexibility that contributes to greater innovation performance.

Firms that combine resources can gain a competitive advantage over firms that are unable to do so, and this is viewed as one of the key benefits of inter-organizational cooperation. For instance, Baptista and Swann [15] found that firms in clusters are more product-innovative. Gupta et al. [16] also found that involvement of suppliers and participation in joint-venture/strategic alliances in the R&D process is greater in high-R&D effective organizations than in low R&D-effective.

Previous experiences of inter-organizational cooperation in the supply chain forge close bonds over time and increase confidence that exchange partners will pursue mutually compatible interests thereby facilitating the exchange of knowledge crucial for innovation performance. Accordingly, cooperation experience may foster supports adaptability, and

deters opportunism that can positively contribute to innovation performance. Besides, inter-organizational cooperation will require the use of inter-organizational systems which other studies have demonstrated that provide flexibility in relationships with connected trading partners, improving responsiveness and other flexibility dimensions relevant to innovation [17].

Thus, inter-organizational cooperation may positively moderate the relationship between external human resource flexibility and innovation, which enables high-cooperation firms to benefit from external flexibility. This moderator effect could reconcile competitive results from the literature about the relationship between external flexibility and innovation. Employing contingent workers in combination with internal employees might be advantageous to upgrade the firm's knowledge stock. Externals from inter-organizational cooperation activities may also bring knowledge of occupational and industry best practices into a firm, and stimulate exploration of new processes and ideas outside the firm's knowledge stock. Then, we propose:

Hypothesis H1. The firm's inter-organizational cooperation moderates positively the relationship between external flexibility and innovation performance.

(2) Moderator effect of environmental dynamism

Environmental dynamism describes the rate and unpredictability of change in a firm's external environment. Dynamic environments are characterized by changes in technologies, and variations in customer preferences and product demand. In lowly dynamic environments, firms might efficiently fit their human resources with the demands of the competitive environment, by developing a human capital pool with a narrow range of skills. However, when the firm's operating environment is highly dynamic, previously developed capabilities may not be able to keep up with the frequent changes in technological conditions. The misfit between a firm's existing capabilities and the firm's operational environment may be mitigated if the firm can explore new areas and build new capabilities. Firms engaging in continuous exploration of knowledge are likely to have technical groups with varied perspectives and are then better able to reframe problems and overcome competitive traps when the environment demands organizational change [18].

Firms in highly dynamic environments may also need more access to relevant external knowledge than firms in more stable environments. These externals may bring knowledge of occupational and industry best practices into the firm [13]. External knowledge may leverage the internal stock of knowledge to develop innovations in order to overcome greater environmental uncertainty. At the same time, firms in highly dynamic environments may need to enhance the in-house dispersion of knowledge and the deployment of employees´ skills through core innovation activities.

Firms in highly dynamic environments may need more adjustments than firms in low-dynamic environments. If environmental dynamism raises the rotation of temporary employees, then the negative influence of short-term hires and temporary help agencies would be enhanced in terms of lower organizational commitment which in turn would negatively affect innovativeness. Then, we propose that external flexibility and innovation is more positively related in highly dynamic markets than in low-dynamic markets.

Hypothesis H2. The firm's environmental dynamism moderates positively the relationship between external flexibility and innovation performance.

(3) Moderator effect of level of flexible technology in the manufacturing process

We also propose a positive moderator effect in the flexibility-innovation relationship of the level of flexible technology in the production process. Flexible production environments need more deployment and access to knowledge than traditional production environments in order to accommodate changes in the business environment and the increasingly demanding needs of well-informed customers. Flexible production technologies also require the use of flexible employment to accommodate changes in production and market demand enabled by increasing levels of flexibility in production technology. The development and implementation of flexible production technologies may need as well the access to external experts and consultants on the technological activities required to carry out such projects.

Hypothesis H3. The firm's level of flexible technology in the production process moderates positively the relationship between external flexibility and innovation performance.

Procedures for collecting data

In order to test these hypotheses, we conducted an empirical study on Spanish industrial firms. We use the Survey of Business Strategies (SBS) questionnaire which contains a set of statements that permit the study of human resources and innovation for a great number of Spanish industrial firms. The SBS is an annual survey conducted by the SEPI Foundation[1] in collaboration with the Spanish Ministry of Industry with the objective of knowing the evolution of the characteristics and strategies of Spanish industrial firms. This survey contains information about markets, customers, products, employment, technological activities and economic-financial data of the firms. The reference population comprises industrial firms operating in Spain and with more than 10 employees, with representativeness being one of its characteristics. We develop a database with panel data from 1,626 industrial firms in the period 2003-2006.

The research hypotheses were tested through hierarchical regression analysis: we entered the control variables in the first step, the 'main effects' in the second step, and then the three interaction terms (cross products) in the next three consecutive steps. To reduce the potential negative effect of multicollinearity after introducing interaction terms of moderator variables, we used Lance's [19] residual centering technique to control this problem.

The dependent variable in the study is innovation performance at the firm level. We use three variables to run two logistic regressions and one linear regression: product innovation (dummy), process innovation (dummy), and number of patents granted. The independent variables are three measures of external flexibility: the percentage of temporary employees in the workforce, the use of R&D external employees from technology centers/contracting firms (dummy), and the outsourcing of R&D activities (dummy).

The three moderator variables are: inter-organizational cooperation in technological activities with customers, competitors, suppliers and R&D centers (categorical variable from 0 to 4), market dynamism (index of change in the marketplace), and flexible production technology (use of flexible production technologies – categorical variable from 0 to 6 that tales into account the number of flexible technologies implemented in the production process: robots, flexible manufacturing systems,…).

The regression analysis controls for: firm size (logarithm of number of employees), R&D effort (percentage of employees in the workforce), export-intensity (percentage of sales

[1] The SEPI Foundation is responsible for the survey design and control through the Economic Research programme.

exported), the percentage of foreign capital, identity between firm ownership and control (dummy), firm age (number of years), and industry

Results

Table 1 shows the results from the three regressions. The first model is a logit regression for product innovation. Several control variables explain if the firm has developed a product innovation. Firm size, R&D effort, and firm ownership-control identity are positively related to product innovation. The industry is also significant. Regarding the independent variables, the percentage of temporary employment is negatively related to product innovation (β= -1.559; $p<0.01$), whereas the use of R&D external employment (β= 1.515; $p<0.01$) and R&D outsourcing (β= 0.784; $p<0.01$) are positively related to product innovation.

There are three moderator effects analyzed in the logit regression of product innovation. The first moderator is inter-organizational technology cooperation that is positively related to product innovation (β= 0.798; $p<0.01$) which indicates that technological cooperation moderates partially the relationship of the independent variables. Thus, inter-organizational technology cooperation moderates negatively the relationship between R&D external employment and product innovation (β= -0.335; $p<0.01$), as well as between R&D outsourcing and product innovation (β= -0.156; $p<0.01$).

The second moderator of product innovation is market dynamism that is marginally related to product innovation (β= 0.055; $p<0.1$). There is only one significant for R&D outsourcing and product innovation (β= -0.002; $p<0.05$) that indicates a negative moderator effect. The other two dimensions of external flexibility are not moderated by market dynamism.

The third and last moderator in the logit model of product innovation is the use of flexible production technology that is positively related to product innovation (β= 0.124; $p<0.05$) which indicates that flexible technology moderates partially the relationship of the

Table 1. Regression analysis of innovation performance in the period 2003-2006

	Logit regression		Linear regression
	Product Innovation	Process Innovation	Number of patents
Control variables			
Firm size	0.069* (3.858)	0.122** (15.090)	0.103** (5.612)
R&D effort (R&D employees/total employees)	2.834** (16.565)	-0.582 (0.739)	0.129** (9.577)
Exports/Sales	0.002 (2.496)	-0.001 (0.960)	-0.023+ (1.708)
% Foreign capital	-0.002 (2.413)	0.000 (0.126)	-0.074** (5.322)
Firm ownership-control identity	0.212* (6.192)	0.343** (21.245)	-0.022 (1.605)
Firm age	0.002 (1.150)	-0.002 (1.929)	-0.006 (0.455)
Industry	-0.022** (9.577)	-0.024** (15.141)	-0.006 (0.457)
% Temporary employment (TE)	-1.559** (7.252)	-0.878+ (3.624)	0.020 (0.770)
R&D external employment (RDEE)	1.515** (13.284)	1.145** (7.644)	-0.335** (8.283)
R&D outsourcing (RDO)	0.784** (99.977)	0.452** (36.791)	-0.122** (3.445)

Inter-organizational technology cooperation (TC)	0.798** (67.336)	0.590** (41.165)	-0.129** (3.016)
TE x TC	0.169 (0.596)	-0.179 (0.784)	-0.050** (2.686)
RDEE x TC	-0.335** (8.851)	-0.065 (0.333)	0.032 (1.262)
RDO x TC	-0.156** (27.631)	-0.093** (10.642)	0.142** (2.994)
Market dynamism (MD)	0.055+ (3.692)	0.010** (16.239)	-0.037 (1.520)
TE x MD	0.011 (2.129)	0.018** (8.662)	-0.004 (0.158)
RDEE x MD	0.006 (1.520)	0.002 (0.182)	0.225** (7.258)
RDO x MD	-0.002* (3.974)	-0.002** (7.578)	0.073* (2.120)
Flexible technology (FT)	0.124* (5.689)	0.212** (24.113)	-0.049+ (1.743)
TE x FT	0.349* (5.503)	0.235+ (3.611)	-0.041+ (1.909)
RDEE x FT	-0.116 (2.220)	-0.127 (2.692)	0.300** (10.563)
RDO x FT	-0.039* (5.255)	-0.011 (0.476)	0.135** (3.684)
Model statistics	R^2 Nagelkerke=0.307 R^2 Cox&Snell=0.198 Chi-square = 1433.96 p = 0.000 n = 1,626 firms	R^2 Nagelkerke=0.224 R^2 Cox&Snell=0.155 Chi-square = 1093.62 p = 0.000 n = 1,626 firms	Adjusted R^2 =0.111 F = 37.95 p = 0.000 n = 1,626 firms

Notes: +p<0.1 *p<0.05 **p<0.01
Logit regressions – Wald values between parentheses; Linear regression – t-values between parentheses

independent variables. Temporary employment is positively moderated by flexible production technology (β= 0.349; p<0.05), whereas R&D outsourcing is negatively moderated (β= -0.039; p<0.05).

The second logit model of table 1 explains process innovation. Firm size and firm ownership-control identity are positively related to process innovation. The industry is also significant. Regarding the independent variables, the percentage of temporary employment is marginally related to process innovation (β= -0.878; p<0.1), whereas the use of R&D external employment (β= 1.145; p<0.01) and R&D outsourcing (β= 0.452; p<0.01) are positively related to process innovation.

The first moderator in the logit model of process innovation -inter-organizational technology cooperation- is positively related to process innovation (β= 0.590; p<0.01) which indicates that technological cooperation moderates partially the relationship of the independent variables. There is only one significant and negative moderator effect for R&D outsourcing and process innovation (β= -0.093; p<0.01).

The second moderator of process innovation is market dynamism that is positively related to process innovation (β= 0.010; p<0.01) which indicates that market dynamism moderates partially the relationship of the independent variables. There are two significant moderator effects: a positive moderator for temporary employment (β= 0.018; p<0.01) and a negative moderator for R&D outsourcing (β= -0.002; p<0.01).

The third moderator in the logit model of process innovation is the use of flexible production technology that is positively related to process innovation (β= 0.212; p<0.01) which indicates that flexible technology moderates partially the relationship of the

independent variables. There is only a marginal moderator effect on the relationship between temporary employment and process innovation (β= 0.235; $p<0.1$). The other two dimensions of external flexibility are not moderated by flexible production technology.

The last regression in table 1 is a linear regression of patenting (number of patents) as a proxy of innovation performance. Firm size and R&D effort are control variables positively related to patenting whereas the percentage of foreign capital is negatively related. Regarding the independent variables, the use of R&D external employment (β= -0.335; $p<0.01$) and R&D outsourcing (β= -0.122; $p<0.01$) are negatively related to patenting.

The first moderator -inter-organizational technology cooperation- is negatively related to patenting (β= -0.129; $p<0.01$) which indicates that technological cooperation moderates partially the relationship of the independent variables. Thus, inter-organizational technology cooperation moderates negatively the relationship between temporary employment and patenting (β= -0.050; $p<0.01$), and moderates positively the relationship between R&D outsourcing and patenting (β= 0.142; $p<0.01$).

The second moderator of patenting is market dynamism that is not significantly related which indicates that market dynamism fully moderates the relationship of the independent variables. There are significant and positive moderator effects for R&D external employment (β= 0.225; $p<0.01$) and R&D outsourcing (β= 0.073; $p<0.05$).

The third and last moderator in the linear model of patenting is the use of flexible production technology that is negatively marginally related to patenting (β= -0.049; $p<0.1$). There is a marginally negative moderator effect on the relationship between temporary employment and patenting (β= -0.041; $p<0.1$). The other two dimensions of external flexibility are positively moderated by flexible production technology: R&D external employment (β= 0.300; $p<0.01$) and R&D outsourcing (β= 0.135; $p<0.01$).

Conclusion and managerial implications

This empirical research to a sample of 1,626 Spanish industrial firms finds that the percentage of temporary employment in the workforce is negatively related to product and process innovation at the firm level, whereas R&D outsourcing and the use of R&D external consultants and experts are positively related to both product and process innovation. However, the number of patents obtained from these innovation activities is negatively related to R&D outsourcing and R&D external experts.

These results indicate that we have to differentiate between the influence of external flexibility on the decision to innovate (dummy variables of product and process innovation), and on the intensity of innovation measured by a variable like the number of patents. Thus, firms with greater percentages of temporary employment have less probability to obtain product and process innovation. On the contrary, the access to external knowledge through R&D individual experts or outsourcing activities may positively contribute to a successful product or process innovation. However, the analysis of patenting indicates that external workplace flexibility is not beneficial to a higher intensity of innovation: firms with fewer patents have more access to R&D outsourcing and R&D external experts than firms that generate more patents as innovation output.

Therefore, we can deduct relevant managerial implications when we take into account moderator effects like those studied here that contribute to analyze the different impact of external workplace flexibility on innovation performance. First, the influence of inter-organizational technological cooperation compensates the influence, either positive or negative, of external workplace flexibility on the three studied measures of innovation output. Thus, there is a less positive effect of R&D external experts and R&D outsourcing on innovation in highly cooperative firms than in less cooperative firms. Inter-organizational

cooperation in technological activities can be interpreted as a substitute for contractual access to external technological knowledge through R&D outsourcing and consultants. At the same time, the negative impact on patenting of R&D consultants and outsourcing is less important in highly cooperative firms than in low-cooperative firms which supports hypothesis H1. Inter-organizational cooperation may leverage the use of external work arrangements and R&D outsourcing to facilitate the creation and dissemination of knowledge that contributes to patenting. To benefit from external relations, cooperative rather than adversarial relations in external transactions should be sought when the level of core-related change is high. As the cooperative relationship develops, the persons brought in may be given more vital tasks closer to the core of the firm. In combination with employees and internal competence, the firm's innovative capabilities may be strengthened. Thus, high-cooperation firms that use more external flexibility practices could develop more innovations faster and cheaper.

The second moderator effect of market dynamism positively moderates the relationship between R&D consultants/outsourcing and patenting which supports hypothesis H2. Firms in highly dynamic environments may benefit more from this external flexibility than firms in low-dynamic environments. Environmental dynamism may enhance the need to access relevant external knowledge, as well as the internal dispersion and deployment of knowledge through employees´ skills and abilities. This external flexibility may contribute to the firm's patenting by enhancing the stock of knowledge and its flow through core employees towards innovation. However, the positive contribution of R&D outsourcing to a successful product or process innovation is less important in highly dynamic environments than in low-dynamic environments. This result indicates that low-dynamic environments are less uncertain to develop innovations with the support of external sources of technology, whereas firms in highly dynamic environments may be less reluctant to outsource R&D activities.

Finally, the third moderator effect is the level of flexible technology in the firm's production process. Flexible production technology moderates positively the relationship between temporary employment and product and process innovation which supports hypothesis H3. There is less probability to innovate in firms with larger percentages of temporary employment than in firms with lower temporary employment. However, when there is a greater use of flexible technologies in the production process, firms may benefit more from temporary employment than in more rigid production environments.

However, flexible production technology negatively moderates the relationship between outsourcing R&D activities and product and process innovation. This means that firms with less flexible production systems can benefit more from R&D outsourcing than firms with highly flexible production processes. This external workplace flexibility may help compensate the less dynamic internal environment that contributes to the deployment of knowledge through flexible processes. On the contrary, flexible production technology positively moderates the relationship between R&D consultants/outsourcing and patenting. Firms in highly flexible production environments may patent more intensively when outsource technological activities and have access to the best industrial practices through external experts. Flexible production technologies may enhance the need to access relevant external knowledge, as well as the internal dispersion and deployment of knowledge through employees´ skills and abilities. This external flexibility may contribute to the firm's patenting by enhancing the stock of knowledge and its flow through core employees towards innovation.

The results reported and commented so far indicate that it is important to differentiate even further the implications of moderator effects on the impact of external human resource flexibility dimensions on firm performance. Our research suggests that future studies should separately formulate hypotheses for each dimension of external flexibility. It should also be

necessary to differentiate among several dimensions of innovation performance, at least for dimensions focused on the decision to innovate and for dimensions that measure quantitative outputs of innovation.

Future studies could also extend the group of moderator effects that may influence the relationship between external human resource flexibility and firm performance. For instance, the level of product innovativeness may also be relevant. When an innovation is less familiar, a project team may require more face-to-face communication as opposed to that involved in more familiar tasks and smaller changes which would reinforce the positive impact of functional flexibility on innovation performance but it would reinforce the negative impact of external flexibility as well. Another extension could be to enlarge the moderator dimension of inter-organizational cooperation activities to include network measures like the intensity or formalization of the firm's relations with the other organizations in the supply chain.

References

[1] Stokey, N. (1995), "R&D and economic growth", *Review of Economic Studies*, Vol. 62 No. 3, pp. 469–489.

[2] Barney, J. (1995), "Looking inside for competitive advantage", *Academy of Management Executive*, Vol. 9 No. 4, pp. 49-61.

[3] Matusik, S. and Hill, C. (1998), "The utilization of contingent work, knowledge creation, and competitive advantage", *Academy of Management Review*, Vol. 23 No. 4, pp. 680-697.

[4] Newton, K. (1998), "The high performance workplace: HR-based management innovations in Canada", *International Journal of Technology Management*, Vol. 16 No. 1-3, pp. 177-192.

[5] Storey, J., Quintas, P., Taylor, P. and Fowle, W. (2002), "Flexible employment contracts and their implications for product and process innovation", *International Journal of Human Resource Management*, Vol. 13 No. 1, pp. 1-18.

[6] Teece, D., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, pp. 509-533.

[7] Wu, L. (2010), "Applicability of the resource-based and dynamic-capability views under environmental volatility", *Journal of Business Research*, Vol. 63, pp. 27-31.

[8] Karuppan, C. (2004), "Strategies to foster labor flexibility", *International Journal of Productivity and Performance Management*, Vol. 53 No. 6, pp. 532-547.

[9] Upton, D. (1995), "What really makes factories flexible?", *Harvard Business Review*, Vol. 73 No. 4, pp. 74-84.

[10] Atkinson, J. (1984), "*The Flexible Firm and the Shape of Jobs to Come*", Labour market issues No. 5, Ruskin College Oxford, Oxford.

[11] Michie, J. and Sheehan, M. (2003), "Labour market deregulation, flexibility and innovation", *Cambridge Journal of Economics*, Vol. 27 No. 1, pp. 123-143.

[12] Barney, J. (1999), "How a firm´s capabilities affect boundary decisions", *Sloan Management Review*, Vol. 40 No. 3, pp. 137-145.

[13] Nesheim, T. (2003), "Using external work arrangement in core value-creation areas", *European Management Journal*, Vol. 21 No. 4, pp. 528-537.

[14] Guest, D., Mackenzie Davey K. and Patch, A. (1999), "Flexible employment contracts, innovation and learning", Paper presented to the International Congress on Competence for Europe, Berlin, 21-23 April.

[15] Baptista, R. and Swann, P. (1998), "Do firms in clusters innovate more?", *Research Policy*, Vol. 22 No. 5, pp. 525-540.

[16] Gupta, A., Wilemon, D. and Atuahene-Gima, K. (2000), “Excelling in R&D”, *Research-Technology Management*, Vol. 43 No. 3, pp. 52-58.
[17] Golden, W. and Powell, P. (2004), “Inter-organisational information systems as enablers of organizational flexibility”, *Technology Analysis & Strategic Management*, Vol. 16 No. 3, pp. 299-325.
[18] Wang, H. and Li, J. (2008), “Untangling the effects of overexploration and overexploitation on organizational performance: The moderating role of environmental dynamism”, *Journal of Management*, Vol. 34, pp. 925-951.
[19] Lance, C. (1988), “Residual centering, exploratory and confirmatory moderator analysis, and decomposition of effects in path models containing interactions”, *Applied Psychological Measurement*, Vol. 12, pp. 163-175.

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