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HUMAN RESOURCE MANAGEMENT PRACTICES AND INNOVATION

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HUMAN RESOURCE MANAGEMENT PRACTICES AND INNOVATION

Abstract

We survey, organize, and discuss the literature on the role of organizational practices for explaining innovation outcomes. We discuss how individual practices influence innovation, and how the clustering of specific practices matters for innovation outcomes. Relatedly, we discuss various possible mediators of the HRM/innovation link, such as knowledge sharing, social capital and network effects. We argue that the causal mechanisms underlying the HRM/innovation links are still ill-understood, calling for further research.

INTRODUCTION

Human capital is a key, and by all accounts increasingly important, part of the resource-base of firms. Human resources have been called the "key ingredient to organizational success and failure" (Baron and Kreps, 1999), including success and failure in company innovation performance. It is important to understand why and how human capital encourages innovation, and what deployment of human resource management (HRM) practices inside the firm can produce desired levels of innovation performance.

Individual employees, founders, or executives may *directly* give rise to superior innovation performance (Felin and Hesterly, 2007), as in the cases of "innovative genius" (Glynn, 1996) and "stars" (Lacetera, Cockburn and Henderson, 2004) among. Such human capital is substantially above-normal in innovative capacity, whether this is innate (personified, perhaps, by Bill Gates or Steve Jobs) or acquired through training efforts. University researchers that create entrepreneurial start-ups exemplify the direct link between human capital and innovation performance. Superior innovation performance may also be the result of the "capabilities" stemming from the interactions within a firm's human capital pool (Lepak and Snell, 2002).

The organizational set-up of the firm, notably its human resource management practices, also matter to the contribution of human capital to innovation performance, and it this effect that we mainly address in this chapter. Thus, management deploys training arrangements, makes decisions on reward structures, sets up teams, allocates decision-rights and so on, and these arrangements have implications for the contribution of human capital to innovation.

The influence of these practices may be modelled both in terms of mediator (human capital mediates the influence from HR practices to innovation performance) and moderator (practices

weaken or reinforce the link from human capital to innovation performance) models.[1]

Extant research suggests multiple mechanisms through which such HRM practices influence the relationships between human capital and innovation. Employee communication networks, as partly shaped by organizational structure, may influence innovation (Tsai, 2001). Motivational research demonstrates that the kind of creative behaviours that underlie successful innovation is stimulated by some kind of rewards but reduced by others (Ryan and Deci, 2000). Managerial styles, the use of feedback, the setting of goals, the use of teams and projects, have all been argued to influence creativity and innovative behaviours.

Organizational practices related to the sourcing, deployment, and upgrading of human capital have been identified in various literatures as influencing innovation performance at the level of firms (Henderson and Cockburn, 1994; Galunic and Rjordan, 1998), networks and industries (Kogut, 2000), and regional or national innovation performance (Almeida and Kogut, 1999; Furman et al., 2002). These practices are important constituent components of "innovation" or "dynamic capabilities" (Teece, 2007). A significant part of such practices are those organizational practices that relate to the attraction, selection, training, assessment, and rewarding of employees. They also include organizational practices that may not conventionally be seen as HRM, such as quality circles, extensive delegation of decision rights, management information systems, and formal and informal communication practices in the firm (see Chapter by Phillips).

In this chapter we survey, organize, and discuss the literature on the \role of organizational practices for explaining innovation outcomes. We discuss how individual practices influence innovation, and how the clustering of specific practices matters for innovation outcomes (cf. Ennen and Richter, 2010). Relatedly, we discuss various possible mediators of the HRM/innovation link,

[1] In general, a moderator is a variable that affects the direction and/or strength of the relation between an independent and a dependent variable. A mediator variable is a variable which represents a mechanism through which the focal independent variable is able to (indirectly) influence the dependent variable. See Baron and Kenny (1986) for a detailed exposition.

such as knowledge sharing, social capital and network effects. We argue that the causal mechanisms underlying the HRM/innovation links are still ill-understood, calling for further research.

Organizing the Literature

The literature on the relation between HRM practices and innovation performances is vast and not easily identifiable, as relevant papers are not necessarily published in HRM journals and may primarily focus on other issues. There is a choice to be made regarding whether research on, say, the impact of monetary incentives on creativity should be included. We specifically put an emphasis on what is often called "new" or "modern" HRM practices (also often called "High-Performance Work Practices") (Laursen and Foss, 2003; Teece, 2007; Colombo and Delmastro, 2008) and its relation to innovation performance. We argue that the literature on HRM practices and innovation can be split into five basic sub-literatures (although inevitably there is some overlap). These are shown diagrammatically in Figure 1. Link I represents a stream of literature that considers the relationship between HRM practices and firm-level financial performance, using innovation as a theoretical link between these variables. Link II denotes a stream of literature that considers the direct link between HRM practices and innovation, while Link III considers a subsequent literature that in addition to this direct link considers mediating and moderating factors of the HRM-innovation relationship. Link VI comprises a small body of literature that has looked not only at the HRM-innovation relationship, but also at antecedents to HRM practices that lead to innovative outcomes. We will discuss these literatures, but first we will identify the most important HRM practices considered in the innovation-related literature.

---Insert Figure 1 here---

HRM Practices

The notion of "modern HRM practices" has become an increasingly used way of referring to high levels of delegation of decisions, extensive lateral and vertical communication channels, high

reward systems, often linked to multiple performance indicators, and other practices that either individually or in various bundles are deployed to achieve high levels of organizational performance (Ichniowski et al., 1997; Zenger and Hesterly, 1997; Colombo and Delmastro, 2002; Teece, 2007; Colombo and Delmastro, 2008). In this context, Guthrie (2001: 181) states that: "The common theme in this literature is an emphasis on utilizing a system of management practices giving employees skills, information, motivation, and latitude and resulting in a workforce that is a source of competitive advantage."

Following Foss, Laursen and Pedersen (2011) we posit that the HRM practices considered in the literature involve: a) delegation of responsibility, such as team production; b) knowledge incentives, such as profit sharing, individual incentives and incentives for knowledge sharing; c) internal communication, encouraged for instance by practices related to knowledge sharing or job rotation; d) employee training, both internal and external; and e) recruitment and retention, such as internal promotion policies). It can be noted that the first three classes of practices include the practices that are typically included as "modern" HRM practices in the literature (Teece, 2007), while the latter two classes in a stylized fashion can be considered more traditional HRM practices. Table 1 provides an overview of our taxonomy and describes the results of a number of representative papers from various parts of the literature.

---Insert Table 1 Here ---

The early literature was concerned with various "stand-alone" HRM practices and their effect on organizational performance (e.g. Gerhart and Milkovich, 1990; Terpstra and Rozell, 1993). Most of the empirically-based literature since the mid-1990s has focused on the effects of complementary practices, rather than the effect of individual practices (see the recent overview of the general complementarities literature by Ennen and Richter, 2010). The idea of complementarities in our context implies that the introduction of one HRM practice increases the returns to doing more of

other HRM practices related to innovation output. Note that although the notion of "internal fit" is arguably less precise than the idea of complementarity, this notion is often used in the HRM literature in a similar fashion to that of complementarity (see e.g., Baird and Meshoulam, 1988; Arthur, 1994). Ideas on "systems" or "bundles" of HRM practices (see, Subramony, 2009) operate with a similar logic.

The empirical literature on organizational complementarities suggests two approaches: an interaction and a systems approach (cf. Ennen and Richter, 2010). The interaction approach (e.g., Capelli and Neumark, 2001) examines the effect of a few organizational practices, and in contrast, the systems approach (e.g., Ichniowski et al., 1997; Laursen and Foss, 2003) looks at the relative performance outcomes of entire sets of variables. Given the sheer number of individual practices considered in the literature, the systems approach is dominant, even if it only confers an indirect test of complementarity.

Link I: The Role of Innovation

Link I represents a large literature stream that has considered innovation mainly in an indirect fashion. This large body of literature (including for instance, Huselid, 1995; Ichniowski et al., 1997; Ichniowski and Shaw, 1999; Datta et al., 2005) considers HRM Practices as explanatory factors (typically complementary) in determining dependent variables such as productivity and profitability. In a typical statement Huselid (1995: 638) notes the

> … theoretical literature clearly suggests that the behavior of employees within firms has important implications for organizational performance and that human resource management practices can affect individual employee performance through their influence over employees' skills and motivation through organizational structures that allow employees *to improve how their jobs are performed*.

It should be noted, however, that improving "how … jobs are performed," in this case may refer to incremental process innovations that are not included in the remit of innovation management as described in this book

Research within this literature has typically been published in management journals, but some highly influential studies have been published in economics journals (in particular, Ichniowski et al., 1997). As mentioned above this literature has considered the direct effect of (complementary) HRM practices on economic performance, but also moderated relationships between these variables, for example, by the type of manufacturing strategy pursued by the respondent's firm (Youndt et al., 1996) or its industry affiliation (Datta et al., 2005). The majority of contributions under this heading adopts a cross-sectional approach, and hypothesizes empirical links between a set of complementary HRM practices and economic performance. There is also research based on panel data within this stream. While initial evidence suggested that these organizational practices (Capelli and Neumark, 2001) had little effect on economic performance such as productivity, more recent panel data evidence has tended to confirm the findings from the studies based on cross-sectional evidence in that a set of complementary HRM practices have in general been found to have positive influences on economic performance, including productivity and profitability (Van Reenen and Caroli, 2001; Kato and Morishima, 2002; Janod and Saint-Martin, 2004; Colombo et al., 2007). Given this body of literature is only indirectly concerned with innovation management, we will not go in depth with this literature (see, Colombo et al., 2012 for an in-depth review of this literature).

Link II: The Direct Link between HRM and innovation

Link II refers to literature that has established a direct theoretical and empirical link between HRM practices and innovation outcomes, typically in the form of product or process innovation.

Until the 2000s, the innovation literature was characterized by relatively scant attention being paid to HRM practices and how they influence innovation performance (Laursen and Foss, 2003). The clear exception is some scholars' interest in Japanese organization and how this connects to innovativeness (Aoki and Dore, 1994). Thus, Freeman (1988, p. 335) explicitly notes how in "Japanese management, engineers and workers grew accustomed to thinking of the entire production process as a system and of thinking in an integrated way about product design and process design," and he makes systematic reference to quality management, horizontal information flows, and other features of modern HRM practices. The concern with horizontal information flows in Project SAPPHO in the late 1960s demonstrates a long-standing awareness of the relation between HRM practices and innovation performance (Rothwell et al., 1974).

Laursen and Foss (2003) supply a number of theoretical arguments for why HRM practices are favourable to innovative activity. One prominent characteristic of many HRM practices is that they increase decentralization by delegating problem-solving rights to the shop-floor. When implemented appropriately, these rights co-exist alongside access to relevant knowledge, much of which may be inherently tacit and thus requires decentralisation for its efficient use. Increased delegation may better allow for the discovery and utilization of local knowledge within the organization, especially when there are rewards in place that support such discovery (Hayek, 1945; Jensen and Meckling, 1992). The increased use of teams is an important component in the set of modern HRM practices. The use of teams also implies that better use can be made of local knowledge, leading to improvements in processes and perhaps also to minor product improvements (Laursen and Foss, 2003: 248). Teams have additional benefits, since they are often composed of different human resource inputs. This may imply that teams bring together knowledge that hitherto existed separately, potentially resulting in process improvements when teams are on the shop floor or "new combinations" that lead to novel products (Schumpeter, 1912/1934), especially when teams

are in product development departments. Increased knowledge diffusion through job rotation, and increased information dissemination facilitated by IT, may also be expected to provide a positive contribution to innovation performance. Training may be a factor leading to a higher rate of process improvements and may also lead to product innovations.

The adoption of a single such practice may sometimes provide a contribution to innovative performance. The increasingly widespread practice of rewarding shop floor employees for putting forward suggestions for process improvements—such as by giving them a share of the cost savings—is likely to increase incremental innovation activity (Bohnet and Oberholzer-Gee, 2001), regardless of whether or not the firm has employed other organizational practices as well. However, HRM practices should be most conducive to innovation performance when adopted, not singly, but as a system of mutually reinforcing practices. The arguments in favour of this argument are as follows (Laursen and Foss, 2003: 249). The innovation pay-off from giving shop floor employees more problem-solving rights will likely depend on the level of training of such employees. The converse is also likely to hold: employees may invest more in upgrading their skills if they are also given extensive problem-solving rights, especially if they are provided intrinsic or extrinsic motivational encouragements. Rotation and job-related training may have complementary impacts on innovative activity. All these practices are likely to complement various incentive-based remuneration schemes—based on individual, team or firm performance—profit sharing arrangements, and promotion schemes. To the extent that implementing HRM practices is associated with extra effort or with disruption of changing routines, employees will usually demand compensation. From an agency theory perspective one would expect many HRM practices to work well, in both profits and innovation performance, only if accompanied with new, typically more incentive-based, remuneration schemes.

Arguably the first paper to empirically establish the link between a system of HRM practices and innovative activity was Michie and Sheehan (1999). Using a sample of 480 UK firms drawn from the UK's 1990 Workplace Industrial Relations Survey, the authors investigate the relationships between firms' HRM practices and the level of R&D expenditure. The results suggest that what the authors term "low road" HRM practices—strict job-description, short term contracts, etc.—are negatively related to investment in R&D and the adoption of advanced production equipment. In contrast, "High road" work practices (modern HRM practices) are positively correlated with investment in R&D and modern production equipment.

Laursen and Foss (2003) introduce an innovation-output measure in the HRM literature: the degree of novelty in product innovation. Based on the theoretical arguments presented above regarding complementarities and using data from a Danish survey of 1,900 business firms, the authors conjecture that HRM practices should influence innovation performance positively. Laursen and Foss identify two HRM systems that are conducive to innovation. In the first, seven of a total of nine HRM variables matter nearly equally for the ability to innovate: interdisciplinary workgroups, quality circles, systems for collection of employee proposals, planned job rotation, delegation of responsibility, integration of functions, performance related pay, and pay-for-performance. The second system is dominated by firm-internal and firm-external training. While only two individual practices are strongly significant in explaining the degree of novelty of product innovation the two systems are strongly significant in the regressions. The authors interpret these findings as evidence of complementarity.

In a later study in a sample of 240 UK manufacturing firms also using an innovation output measure of product and process innovation as the dependent variable, Michie and Sheehan (2003), find that firms using HRM practices extensively are much more likely to be process and/or product innovators. The so-called "low road" HRM practices (see above) are found to be negatively

associated with process innovation, but appear unrelated to product innovation. On the basis of a dataset on approximately 1,400 Swiss firms for the period 1998-2000, Arvanitis (2005) presents findings that are consistent with Michie and Sheehan's findings: a system of HRM practices has a positive effect on firms probability of introducing process innovation, but not of introducing product innovation. Arvanitis also examines whether there is complementarity between numerical flexibility variables (use of part-time work and temporary work) and HRM practices, and complementarity is found between temporary work and HRM practices in process innovation, but not in product innovation. Jimenez-Jimenez and Sanz-Valle's (2008) study of 173 Spanish firms indicate that product, process and administrative innovation contribute positively to business performance and that a comprehensive set of HRM practices enhances innovation. Beugelsdijk (2008) uses a sample of 988 Dutch firms. His results indicate the importance of task autonomy, training and performance-based pay for generating incremental innovations (share of new-to-the-firm products as a percentage of total sales). For radical innovations (share of new-to-the-industry products as a percentage of total sales), the findings underline the importance of task autonomy and flexible working hours. The use of standby (seasonal/temporary/casual/fixed term) contracts is found to be associated with significantly lower levels of innovativeness. Beugelsdijk also detects significant interaction effects between individual HRM practices, proving further evidence in support of the notion of complementarities between these practices.

Love and Roper (2009) using data on UK and German manufacturing plants examine the issue of potential complementarities which may arise when cross-functional teams are used in different elements of the innovation process. Using the "interactions approach" (Ennen and Richter, 2010), they demonstrate that patterns of complementarity are complex; however, they are more marked in the UK than in Germany. The most uniform complementarities are between product design and development and production engineering, with little synergy evident between the more technical

phases of the innovation process and the development of marketing strategy. The results points to the value of using cross-functional teams for the more technical elements of the innovation process, but also suggests that the development of marketing strategy should remain the domain of specialists.

While all the above studies report findings based on cross-sectional data, other studies have begun to examine longitudinal variation. This is a difficult task, since research on HRM practices inevitably involves questionnaire-based data that will typically suffer from sample attrition as substantial numbers of firms typically disappear over time. On the other hand, the use of data with a time dimension reduces the concerns one might have regarding endogeneity in cross-sectional studies.

Shipton et al. (2005) provide results based on two waves of a survey in which 27 UK manufacturing firms were present in 1993 and 1995. The dependent variable were measured in 1995 and the independent variables in 1993. Even if the study is small scale and only a limited number of control variables are allowed given the small sample, the authors find that HRM practices, excluding monetary incentives, lead to higher levels of product innovation but not to higher levels of process innovation. Monetary incentives linked to appraisal appear to yield a negative impact on product innovation although again it seems that there is no effect on process innovation. These results are only present when the independent variables are lagged: the HRM and incentive variables are insignificant when included in an instantaneous model, indicating that the negative effect is not of a short-term nature.

Zhou et al. (2011) uses a merged dataset based on four waves of Dutch survey data of 2044 firms collected between 1993-2001, with the dependent variables measured at *t* and independent variables measured at *t-2*. Zhou et al. find that functional flexibility (internal labour mobility), training efforts and highly qualified personnel appear to affect product innovation positively (percentage of sales of

products new to the market). Zoghi et al. (2010) use a balanced panel of 3,203 establishments from the Canadian Workplace and Employment Survey. The questions about HRM practices were posed in 1999, 2001 and 2003. The dependent variable is a dummy variable representing whether the given establishment introduced product innovation in the given year. The independent variables include decentralization, information-sharing, and incentive pay (and interactions between them). To mitigate the problem related to time-invariant firm heterogeneity and simultaneity bias the authors use a fixed effects model and a model including a lagged dependent variable. The authors find a clear positive link between these factors and product innovation. However, the results suggest that these relationships are not causal (for further discussion of this issue, see below). The results show that the correlation between HRM practices and innovation holds for information-sharing, but is much weaker for decentralized decision-making or incentive pay programs.

Link III: Moderated and Mediated Relationships between HRM and Innovation

Link III embodies the literature that has established a mediated or moderated theoretical and empirical link between HRM practices and innovation outcomes.

Laursen (2002) posits that organizational theory suggests that more knowledge-intensive production activities often involve higher degrees of strategic uncertainty for firms and performance ambiguity in relation to individual employees. Therefore he expects that HRM practices perform better within knowledge-intensive industries of the economy, as compared to other industries. Using a sample of 726 Danish firms with more than 50 employees the results confirm other findings that HRM practices are more effective in influencing product innovation performance when applied together, as compared with situations in which individual practices are applied alone. Furthermore, he found, the application of complementary HRM practices is more effective for firms in “high” and “medium” knowledge-intensive industries.

Ritter and Gemünden (2003) examines a model in which "network competence" mediates the relationship between HRM and a composite encompassing process and product innovation. Network competence is defined to be company-specific ability to handle, use, and exploit inter-organizational relationships. Drawing upon a sample of 308 German mechanical and electrical engineering companies, results reveal that network competence impacts on a firm's product and process innovation success. The organizational antecedents that impact on a company's network competence include intra-organizational communication and openness of corporate culture.

Lau et al. (2004) outlines the role of organizational culture in the link between the HRM system and the development of new products and services. The authors propose that a developmental culture is a missing link in-between HRM system and innovation outcomes. It is argued that an HRM system that emphasizes extensive training, performance-based reward, and team development is needed to construct an "organizational culture" that is conducive to product innovation. Based on a survey of 332 firms in Hong Kong, the empirical results are consistent with the idea that organizational culture acts as a mediator between firms' HRM systems and product innovation outcomes.

Jensen et al. (2007) contrasts two modes of innovation. The first, the Science, Technology and Innovation (STI) mode, is based on the production and use of codified scientific and technical knowledge. The second, the Doing, Using and Interacting (DUI) mode is akin to a set of HRM practices (except that incentives are not included in the set of HRM practices). Drawing on the results of the 2001 Danish DISKO Survey encompassing 692 firms, analysis shows that firms combining the two modes are more likely to innovate in new products or services than those relying primarily on one mode or the other. In other words, high levels of codified scientific and technical knowledge increases the benefits of HRM practices.

The study by Beugelsdijk (2008) mentioned above also reports significant interaction effects between HRM practices and firm size, and between HRM practices and R&D intensity, so that the effect of HRM is complementary to other firm-level variables. Based on data from the German Community Innovation Survey, Rammer et al. (2009) find that R&D activities are a main driver of innovation output (number of different types of innovations). However, small and medium sized firms without in-house R&D can yield a similar innovation success when they apply HRM practices to facilitate innovation processes.

Camelo-Ordaz et al. (2008) examine whether the strategic vision of the top management team and the way employees working in teams are rewarded and assessed affect firms' innovation performance. The study is based on a relatively small sample of 97 Spanish companies from high-tech industries. The results indicate that innovation output requires the existence of compensation practices based on the ideas generated and developed by project teams aligned with top management teams' strategic vision. Using a sample of 188 UK firms, Oke et al. (2012) find that the interaction of innovation strategy execution by top-management and a set of innovation-focused HRM practices is positively related to product innovation performance.

Lopez-Cabrales et al. (2009) examine how two sets of modern HRM practices ("collaborative HRM practices" and "knowledge-based HRM practices") and employees' knowledge influence the level of innovative activities as they pertain to product innovation. Using a sample of 86 Spanish manufacturing firms, the results indicate that HRM practices are not directly associated with innovation unless they take into account employees' knowledge. Specifically, the analyses suggest a mediating role for firm-specific uniqueness of knowledge between collaborative HRM practices and innovative activity. The findings suggest that the so-called knowledge-based HRM practices and innovation output appear not to be linked.

Chen and Huang (2009) examine the role of knowledge management capacity (knowledge acquisition, knowledge sharing and knowledge use) in the relationship between HRM practices and innovation performance (measured as both technical and administrative innovation). The authors use regression analysis to test the hypotheses in a sample of 146 Taiwanese firms. The empirical findings indicate that HRM practices are positively related to knowledge management capacity which, in turn, has a positive effect on innovation performance. In other words, the results suggest that knowledge management capacity plays a mediating role between HRM practices and innovation performance.

Foss et al. (2011) argue that firms that attempt to leverage user and customer knowledge in the context of innovation must design an internal organization appropriate to support it and that this can be achieved in particular, through the use of HRM practices, notably those involving intensive vertical and lateral communication, rewarding employees for sharing and acquiring knowledge, and high levels of delegation of decision rights. Using a dataset drawn from a survey of 169 Danish firms among a sample of the largest firms in Denmark, the authors find that the link from customer knowledge to innovation is aided substantially by HRM practices (see also, Petroni et al., 2012, for a discussion of the needed changes in R&D organization and personnel management as a consequence of the implementation of the open innovation model).

An important feature of the model proposed by Foss et al. (2011) pertains to the fact that so-called "knowledge incentives" are part of the organizational variables (positively) mediating the relationship between customer interaction and innovation performance. Somewhat in contrast to this Fu (2012)—based on a sample of 384 SMEs in the British manufacturing and business services sectors covering the period 1998–2001—finds that while both openness and incentives are positively associated with product innovation efficiency, a substitution effect is found between openness and incentives. Long-term incentives appear to enhance efficiency to a greater extent than

short-term incentives, and the substitution effect of openness is stronger in the case of long-term incentives. As measures of long-term incentive schemes Fu uses the proportion of managers and employees participating in a stock option scheme in the total labour force (alternatively, a dummy variable for firms that have introduced a stock option scheme). Short-term incentive schemes are measured using a dummy variable for firms that have introduced performance-related pay. However, Foss et al. (2011) used incentives related to upgrading own skills and to knowledge sharing "knowledge incentives". One explanation for these seemingly conflicting results might thus be that internal knowledge sharing is of central importance when it comes to utilizing external knowledge (cf. Cohen and Levinthal, 1990). For this reason it may be advisable to incentivize this type of behaviour when managers want to benefit from external knowledge. On the other hand, incentive schemes that value individuals' personal innovative performance will increase the innovative effort from these individuals, but might discourage the application of external knowledge.

Moving the focus from firm-level to the individual level, Binyamin and Carmeli (2010) examine a mediation model that suggests that the relationship between structuring of HRM processes and employee creativity is explained by the intervening variables of perceived uncertainty, stress, and the psychological ability to carry out work-tasks (dubbed "psychological availability"). Empirically, the study is based on 213 individuals working in knowledge-intensive firms. The results suggest that structuring of HRM processes is negatively associated with perceived uncertainty and stress. Moreover, these perceptions produce a sense of psychological availability, which in turn enhances employee creativity. Arguably, all other things being equal, increased creativity should lead to more innovation at the firm-level.

All in all, this more recent part of the literature documents that the relationship between HRM practices and innovation outcomes (in particular related to product innovation) is not only a direct

one. The relationship is often found to be conditional on contingent factors and to be fully or partially mediated by other factors related to knowledge-creation.

Link IV: Antecedents to HRM Practices

Link IV represents the literature that has established a theoretical and empirical link between HRM practices and their antecedents related to innovation outcomes. The existing literature typically treats HRM variables as being strictly exogenous in explaining innovation outcomes. Accordingly, only a few studies have dealt with this issue. Jackson et al. (1989) examine the driver of the adoption of "personnel practices" that correspond well to HRM practices. Jackson et al. show that these practices are a function of the principal industry sector, the pursuit of innovation as a competitive strategy, the type of manufacturing technology, and of organizational structure.

In a study utilizing data on 1,884 Danish firms examining complementarities between HRM practices, Laursen and Mahnke (2001) confirm that industry-affiliation is a key determinant of the adoption of HRM practices. Moreover, they find that innovator strategy, linkages to suppliers and customers, and linkages to knowledge institutions are important determinants of the adoption of (complementary) HRM practices. Laursen and Mahnke (2001) do not, however, consider innovation outcomes. The paper by Foss et al. (2011) discussed above suggests that an open innovation strategy is an important antecedent to the adoption of a set of complementary HRM practices, and that the combination of interacting with customers and HRM practices is a necessary condition for strong innovation performance. Using a sample of 294 Flemish firms De Winne and Sels (2010) demonstrate that the human capital and the use of a range of external experts are determinants of the adoption of a broad range of HRM practices and that such a broad range of practices in turn are determinants of innovation output (a composite mixture of items relating to administrative, process and product innovation).

RESEARCH GAPS

The above summary of research involving (modern) HRM practices and innovations reveals considerable activity not only HRM and innovation research, but also strategic management and organizational studies. However, several research gaps exist, calling for additional research efforts. In this section we briefly discuss some of these gaps.

More Time-series Evidence

As noted above, time series evidence on HRM-practices and innovation outcomes is scarce. Zoghi (2010) found that controls for unobserved heterogeneity significantly weakened their results, and moreover, lagged variables did not provide clear evidence that organizational changes predate innovation. While these findings are extremely interesting and based on sound econometric method, we still need more investigations taking a longitudinal perspective, not least because the fixed effects estimator and the lagged dependent variable estimator tend to produce rather conservative estimates (see also, Zoghi et al., 2010: 632-633).

Clustering of Practices

In spite of the prominence in HRM/innovation streams of research of thinking on the clustering of practices (cf. Ennen and Richter, 2010), there is still little theorizing that predicts exactly which HRM practices bundle and why, and little empirical work that examines this issue. Empirical work may be somewhat ahead of theory in this area. A good illustration is Laursen and Foss (2003) who find two clusters of HRM practices that are conducive to innovation, but essentially do not theorize why there are differences between them. Empirical work has tended to lump together HRM practices, claiming systems effects. Often empirical research confirms that such systems effects indeed exist, but it may well be that some practices are much more important for the system of practices than others, in other words, that relations of complementarity are stronger between some practices. Clarifying this issue is of obvious practical significance, but extant research has so far had little to say about it.

Specific Practices

Laursen and Foss (2003) found that while systems of HRM practices mattered greatly to innovation performance, the contribution of individual practices was negligible. However, some of the practices they considered were measured rather crudely; for example, rewards are represented with a simple variable representing the share of employees involved in any form of pay-for performance (though not piece rates), and their measure for job design only incorporates delegation which is at best an imperfect measure of freedom in the job. Until much more detailed research is conducted, drawing to a much larger extent on the richness of the HRM literature, it is not warranted to conclude that systems of HRM practices matter much more to innovation performance than individual practices.

It should also be noted that single practices may, on conceptual grounds, vary widely with respect to their impact on innovation performance. We have already alluded to potential controversy concerning what kind of incentives are most likely to drive innovation performance. In addition to the temporal dimension of incentives and the tasks that are incentivized, there is also an issue relating to the levels at which incentives are provided. Are group incentives, for example, more effective than individual incentives on innovation performance? To the extent that groups are capable of mobilizing synergistic advantages with respect to creative problem-solving (Paulus, 2000), group-level incentives may make more sense than individual-level incentives.

Moreover, an increasingly prominent argument in motivational psychology asserts that extrinsic motivators, such as monetary incentives, may actually be counterproductive because they tend to drive out the kind of autonomous motivation that is essential for successful problem-solving, learning and creativity (Deci and Ryan, 1985), essential micro-level dimensions of innovative performance. This line of research does not deny that rewards matter, but rather tend to focus on

softer, less controlling rewards (than contingent performance rewards). The inclusion of such rewards in future research seems highly promising.

Finer Grained and Richer Causal Stories

While highly attractive because of its emphasis on complementarities between practices, the systems approach that is so influential in research on the HRM/innovation performance link risks obscuring much of the fine-grained causal texture that links HRM practices and innovation. Thus, individual practices may have an impact that is additional to and goes beyond the systems effect.

Consider, for example, job design, one of the most frequently researched practices in the HRM literature. Jobs contain characteristics, such as feedback, the size of the task portfolio, the characteristics of individual task, the ability to carry out a job from the beginning to the end, repetitiveness, and so on, that stimulate different kinds of motivation (Foss et al., 2009). Jobs that imply a greater degree of employee control, autonomy, and non-controlling feedback, for example, are likely to stimulate the autonomous motivation that drives creativity and learning, and, ultimately, innovation performance. Similar arguments may be developed on the basis of other modern HRM practices. Research on teams, for example, has clarified that team problem-solving effectiveness is highly dependent on the clarity to team members of the task structure within the team (Kozlowski and Bell, 2003; Ilgen et al., 2005).

There is considerable room for expanding the understanding of how exactly individual HRM practices contribute to innovation performances by unpacking them and understanding the contextual variables (i.e., moderators) that influence this contribution. A possible outcome of better understanding on this domain is an improved understanding of systems of HRM practices, because one practice may be a relevant contextual variable influencing the effectiveness of another practice.

What Kind of Innovation?

A final issue concerns the dependent variable in figure 1, that is, performance in terms of product or process innovation. A pertinent question thus is whether there are (modern) HRM practices that are inherently more supportive of one kind of innovation than another. It would seem natural to expect quality circles, for example, to be more conducive to process than to product innovation. Similarly, it could be hypothesized that internal training was also more conducive to process innovation, whereas external training could contribute more to product innovation performance because external training gives employees access to larger networks with more diverse knowledge. Other HRM practices may similarly be hypothesized to have a differential impact on innovation performance.

A further way of advancing research is to dehomogenize the basic process and product innovation categories. Thus, the process innovation category includes not only innovations in the basic production process itself, but also innovations in the administrative structure of the firm (Birkinshaw et al., 2008)—including innovations in HRM. While management innovations may mainly be introduced by the higher echelons of the firm, there are HRM practices, notably reward systems, that may positively influence such innovation. Thus, because management innovations are likely to be implemented across the board in the various departments of a firm, and thus affect the financial performance of the entire company, upper echelons are arguably incentivized to implement such innovations by reward instruments that link pay to overall company performance.

In turn, product innovation may be decomposed into innovations of physical products and innovations of services. Service innovation raises distinct HRM challenges. Thus, while the increasing emphasis on user innovation has pointed to the importance of users and customers in the innovation process in general, the importance of heavy customer and user involvement may be particularly important for service innovations, and it may therefore be particularly to empower employees to cooperate with customers and users in the case of these innovations.

CONCLUSIONS

The literature on the links between HRM and innovation that we have surveyed in this chapter has expanded considerably over the last one and a half decades. This may partly reflect that both HRM and innovation have been expanding fields in this period. It arguably also reflects trends in the business world that prompt the emerging integration of HRM and innovation research. As firms increasingly adopt open innovation models and engage with external knowledge sources (see chapter by Dahlander and Alexi), they find that they need to bring new groups of employees into the innovation process. This calls for dedicated training, new performance indicators, new rewards, new ways of communicating with and between employees and so on, in short, it calls for an active HRM effort. Relatedly, firms may open up the innovation process internally, namely by increasingly sourcing ideas and knowledge from organizational members (Dodgson et al., 2006). Such initiatives are also likely to call for new HRM initiatives.

The link between internal organization and innovation performance has been a frequent theme in innovation research since Schumpeter (1942) and Burns and Stalker (1961). Much of the discussion has involved traditional structural variables, typically drawn from structural contingency theory. The emerging research stream in the intersection of HRM and innovation research represents a new, more fine-grained approach to the understanding of the organizational antecedents of innovation performance. However, as we have shown in this chapter, this is a rather recent undertaking and one that represents several research gaps.

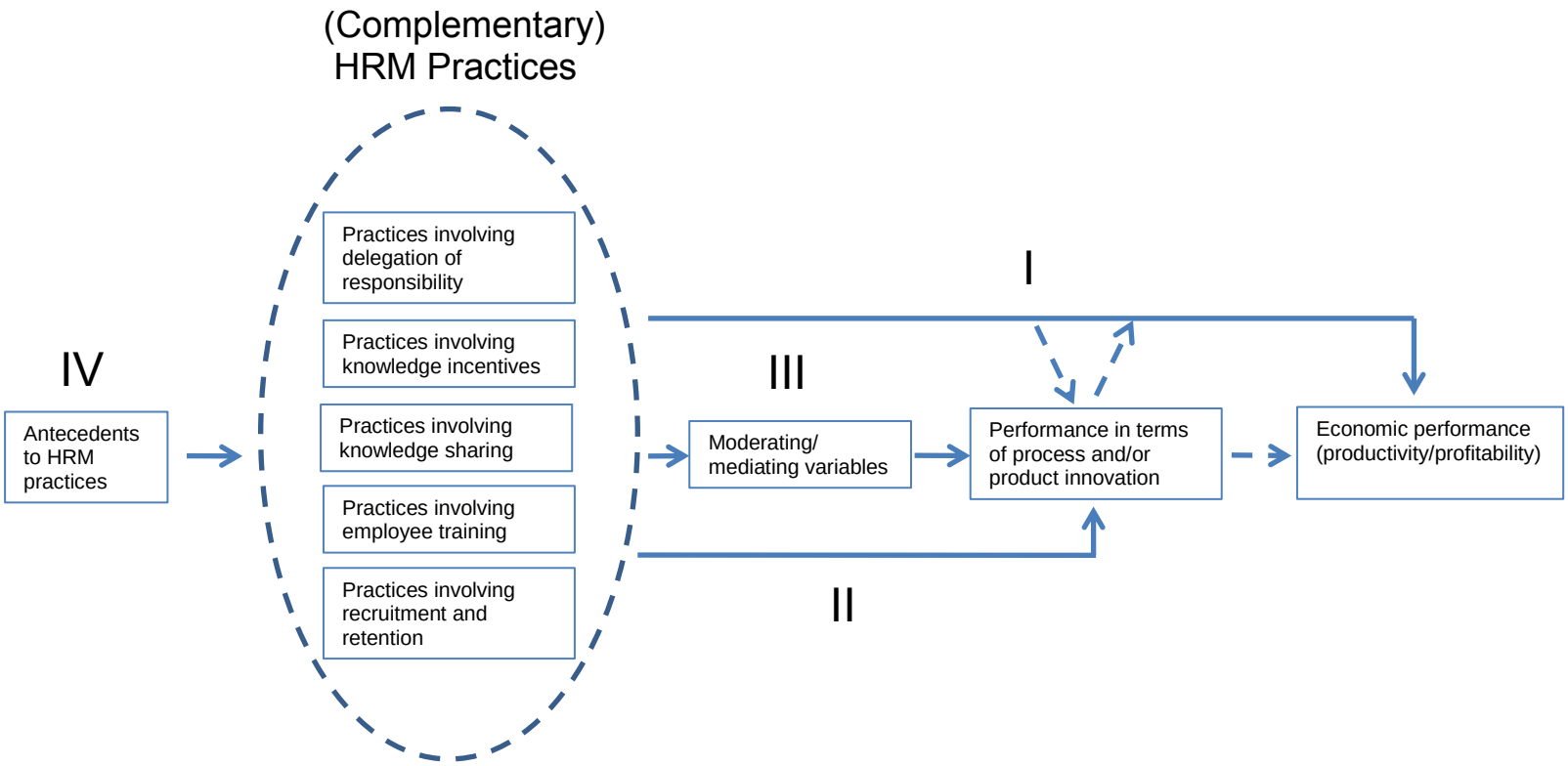

FIGURE 1: THE LINKS BETWEEN HUMAN RESOURCE MANAGEMENT PRACTICES AND INNOVATION

TABLE 1: *Variables in the New HRM Practices Literature*

Authors	Unit of analysis	Dependent variable	Delegation	Internal Communication	Incentives	Employee training	Recruitment and retention	Other HMRP variables
Huselid (1995)	968 publicly listed firms (manufacturing and private services)	Labor productivity, Tobin's *q*	Labor-management teams, Quality circles	Formal information sharing program, Complaint resolution system	Incentive plans/profit sharing, formal appraisals, merit-based promotion	Hours of training	Formal job analysis, Internal promotion, Employment test prior to recruitment	Attitude survey
Ichniowski et al. (1997)	36 steel finishing lines within 17 firms	Percent uptime	Teamwork (3 items)	Communication (2 items), Job rotation	Line incentives	Skills training (2 items)	High screening recruitment	Employment security
Ichniowski and Shaw (1999)	41 steel finishing lines within 19 firms	Percent uptime, Percent prime yield	Teamwork (3 items)	Labor-management communication (2 items), Job flexibility (2 items)	Incentive pay (2 items)	Training (2 items)	Recruiting (2 items)	Employment security
Mendelson and Pillai (1999)	102 business units from 81 different firms (electronics hardware)	Return on Sales Return on value added, Sales growth	Decentralization (3 items)	Information practices (8 items)	Incentives (3 items)			Focus (3 items), Inter-organizational network (5 items)
Michie and Sheehan (1999)	480 firms (manufacturing and private services)	R&D expenditure, Introduction of advance technological machinery	Teamwork	Flexible job assignment, Communication (4 items)	Profit sharing, Share ownership, Individual pay/Line incentives			Employment flexibility
Mendelson (2000)	60 business units (electronics hardware)	Return on Sales Return on value added, Sales growth	Decision architecture (6 items, including 3 delegation items)	Knowledge transparency (6 items)	Decision architecture (6 items, including 3 items measuring incentives)			Activity focus (6 items), (External) Information awareness (8 items), Information Age Network (6 items)
Guthrie (2001)	164 firms (manufacturing and private services)	Employee retention rate, Labor productivity	Teams, Employee participatory programs	Information sharing	Skill-based pay, Group-based pay, Performance-based promotion, Employee stock ownership	Training efforts (3 types)	Internal promotion	
Capelli and Neumark (2001)	Plants in manufacturing and private services (panel, no. of obs. 433/666)	Labor productivity, Labor costs, Sales less labor costs	Self-managed teams, TQM	Scheduled meetings, Job rotation	Pay for skills and knowledge, Profit sharing			Use of computers, Use of benchmarking vis-à-vis other organizations
Colombo and Delmastro (2002)	438 manufacturing plants (panel data)	Change in the number of managerial layers	Teamwork, number of hierarchical layers	Job rotation	Individual line incentives	Firm pays for training		Type of strategic decision maker

Laursen and Foss (2003)	1900 firms (manufacturing and private services)	Product innovation	Delegation of respon-sibility, Interdisciplinary work groups, Quality circles	Integration of functions, Job rotation, Systems for collection of employee proposals	Pay-for-performance	Firm-internal and firm-external training		
Hamilton et al. (2003)	Workers within a single firm (panel data)	Productivity	Team vs. no-team production		Team vs. individual piece rates			
Datta et al. (2005)	132 manufacturing firms	Labor productivity	Self-directed teams	Programs designed to elicit participation and employee input, Complaint resolution system, Provide information to mana-gement	Compensation based on group performance, Pay is based on a skill or knowledge-based system, Formal performance feedback	Intensive/ extensive training	Tests administered prior to hiring, Internal promotions, Intensive/extensive recruiting	
Collins and Smith (2006)	513 high-technology companies	Revenue from new products, Sales growth		Knowledge Exchange and Combination (8 items)	Incentive Policies (3 items)		Selection Policies (4 items)	
Colombo et al. (2007)	109 single plant firms (panel data)	Profitability	Decentralization, Number of plant's hierarchical levels, TQM	Formal team practices, Job rotation	Profit sharing, Individual incentives			
Beugelsdijk (2008)	988 firms (manufacturing and private services)	Incremental, Radical innovation		Job autonomy, Task rotation	Performance-based pay	Training policies, Internal training, External training, Procedures for education of employees	Procedures for recruitment	Procedures for quality maintenance
Chen and Huang (2009)	146 firms (manufacturing and private services)	Administrative innovation (4 items), Technical innovation (3 items)	Participation (3 items)		Appraisal (3 items), compensation (3 items)	Training (6 items)	Staffing (3 items)	
Lopez-Cabrales et al. (2009)	86 firms (manufacturing)	Innovative Activity, Profits	Delegation (two items)	Cross-functional teams, job-rotation	Performance appraisal (4 items) compensation (3 items)	Training activities (two items)	Selection process (4 items), promotion from within	Job-security, socialization program, Tutoring
Zoghi et al. (2010)	3203 firms (panel data) (manufacturing and private services)	Product innovation	Decentralization	Info-sharing	Individual incentive pay, Group Incentive pay, Profit sharing plan			
Foss et al. (2011)	132 firms (manufacturing and private services)	Innovation performance (2 items)	Delegation of Responsibility (two items)	Internal communication (2 items)	Knowledge Incentives (two items)			

Note: Adapted and extended from Foss, Laursen and Pedersen (2011).

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