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How to Make a Sustainable Manufacturing Process: A High-Commitment HRM System

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Abstract: The primary purpose of this study is to investigate the relationship between high-commitment human resource management (HCHRM) practices and process improvement activities (i.e., manufacturing flexibility) by utilizing the theory of social exchange. We conducted an empirical study to discover the links between social exchange theory and process management from an HRM perspective. For the empirical investigation, we used data from 601 manufacturing enterprises provided by the Ministry of Trade, Industry, and Energy in South Korea. The research is conducted based on employees' capabilities for process management as a mediator in the analysis of the impact of the HCHRM system on manufacturing flexibility (i.e., internally-driven and externally-driven flexibility). The results of the study show that the HCHRM system ultimately explains manufacturing flexibility through enhancement of employees' capabilities.

Keywords: manufacturing flexibility; high-commitment HRM system; social exchange theory

1. Introduction

The fourth industrial revolution, generally referred to as Industry 4.0, is expected to have a significant impact on manufacturing industries, as it creates faster changes in technology and market conditions. Manufacturers are facing a moment of change that this paradigm shift will generate. However, industry 4.0 is not only an obstacle but a formidable opportunity for manufacturers that are capable of keeping up with the new environment, while threatening those preserving the status quo [1]. Thus, appropriate responses to existing or upcoming changes are essential to achieving sustainable, competitive advantages for manufacturers. Since these changes usually accompany an increase in uncertainty due to changing customer needs, taking flexible actions in the face of changes, and ultimately creating sustainable business value, become more crucial in this era [2].

In today's business environment, represented by rapid market change and technological acceleration, researchers and practitioners recognize that manufacturing flexibility is critical for building sustainable manufacturing because the flexibility of manufacturing process enables firms to achieve customization, even in large-scale production, without sacrificing cost efficiency. Since manufacturing flexibility is defined as the ability that enables firms to cope with market uncertainty effectively [3,4], prior research has focused on the technological aspects of manufacturing flexibility, or on the corresponding strategic fit. For instance, Gupta and Somers [5] found that proper business strategy helps increase manufacturing flexibility and achieve better organizational performance. Gerwin [6] also suggested links between manufacturing strategy, manufacturing flexibility, and performance in response to environmental uncertainties. Cousens et al. [7] suggested a framework to enable manufacturers to establish a competitive capability for flexible manufacturing. A recent

study has shown the influence of manufacturing flexibility on business models and firm performances, considering their contextual fit with the market environment [8]. Besides, Chen et al. [9] considered the impact of manufacturing flexibility on the product-process relationship that resulted from technological evolution and cyclical development. Kotha and Swamidass [10] investigated the interaction effect of strategy and advanced manufacturing technology on growth and profitability. In sum, we can find a positive relationship between manufacturing flexibility and sustainable competitive advantage, in terms of increasing efficiency internally and satisfying customers externally. To put it concretely, if a firm has a high level of manufacturing flexibility, the firm can make good performance (i.e., profits or growth) which is known as the source of firm's sustainability. It is important to consider that manufacturing flexibility makes a firm likely to achieve both generic goals (i.e., cost efficiency and customer satisfaction) without compromise. Based on this good performance, the firm with a high level of manufacturing flexibility finds a way of sustainable improvement. Thus, manufacturing flexibility contributes to maturing sustainable manufacturing processes because sustainable manufacturing processes connote an integrative view for economic (i.e., profitability and productivity), social, and environmental stewardship to generate the firm's sustainable competitive advantage [11].

However, the implementation of a new technology or particular strategy should be applied to firms with a reasonable amount of resources (e.g., time, money, or effort), and their success will depend on the human resources that are responsible for performing the task. In other words, it is people who do the real work, even though highly advanced technologies or particular business strategies are involved in the manufacturing system. Therefore, appropriately trained and well-managed employees are a vital factor in fueling an improvement in manufacturing flexibility.

Without a doubt, one of the most critical resources in a business unit is human resources. Our topic begins with the following question, which is old and perhaps somewhat banal. Are human resources consumed or developed? Some researchers in the strategic human resource management (HRM) field which is mainly interested in a firm's financial outcomes have assumed that human resources can be consumed or even exploited like other substitutive resources [12]. In reality, some people also believe that human resources, like other resources, have to be reduced to improve productivity or efficiency in the economic sense. For example, many manufacturers predict that technological advances in the fourth industrial revolution will undermine the importance of human resources because technology will replace most human workers. This shows that human resources are still perceived in a quantitative, not qualitative, way. However, other researchers in strategic HRM that emphasizes the human factor or sustainability of HRM have argued that human resources are not cost rather investment objects to be developed for a firm's sustainability [13,14]. As Ehnert and Harry [15] pointed out, the view that human resources are consumed is too short-term oriented and not enough to see the human resources' distinct features whereas a developmental view is based on a long-term oriented and considering people in organizations as a source of competitive advantage to make the firm sustainable. In the developmental view of human resources, technology will not simply replace human workers rather human takes other roles that only people can conduct in this era. Therefore, in this research, we follow the literature that assumes human resources can be developed and reproduced.

As noted by Bányai et al. [16], the human factor cannot be neglected in manufacturing. Thus, we can presume that the manufacturing flexibility, the measure of operational performance, will vary depending on how firms leverage the human resources. Barney [17] showed that corporate human resources are one of the most important sources of sustained competitive advantage, and Youndt et al. [18] also demonstrated that human resource management (HRM) has a crucial role in developing employees' capabilities to achieve organization-level goals. Accumulated research focusing on HRM configurations fitted with the firm's environment, and their systematic effect on organizational-level outcomes, is defined as strategic HRM [19]. In particular, the high-commitment HRM system (HCHRM), a type of strategic HRM system, refers to a set of HRM policies and procedures that influence employee attitude (i.e., commitment) and motivation toward their work and organization [20]. In the literature, HCHRM is known as practices that contribute to greater

achievements in manufacturing (e.g., higher productivity) [21–23], successful implementation of integrated management in manufacturing [24], and lower scrap rates [19]. However, while there are many studies on the relationship between HRM practices, specific business competitive strategies, and their outcomes [25–27], there are few studies on the relationship between HCHRM and manufacturing flexibility. Moreover, it is hard to find literature investigating the mediating role of employees in the HCHRM—manufacturing flexibility relationship. To fill this gap, we empirically examine the link between two business functions, HRM and manufacturing (i.e., production), while considering HCHRM and manufacturing flexibility. Thus, the main purpose of this study is to investigate the detailed mechanism through which HCHRM systems influence manufacturing flexibility. In addition, we present additional implications for the analysis of this relationship by incorporating the mediating effect of employees' capabilities. We draw the theoretical framework as shown in Figure 1.

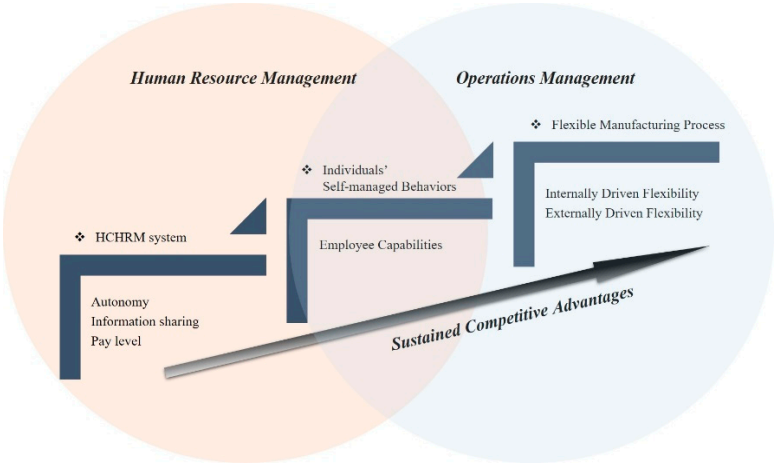


Figure 1. Theoretical framework.

We expect this study to make theoretical and empirical contributions in three ways. First, we advance the strategic HRM literature by focusing on the HCHRM system. The HCHRM system integrates several HR practices (e.g., autonomy, information sharing, pay level, etc.) that enhance manufacturing outcomes and organizational performance, by fostering employees' capabilities resulted in treating employees as investment objects. Thus, it is important for firms to motivate employees to work appropriately, since manufacturing employees may create manufacturing effectiveness. The HCHRM system can enhance employees' efforts and ability, especially by motivating them internally. According to social exchange theory [28], employees respond to employers' favor not because of economic transactions, but due to long-term trust relationships. That is, people in organizations try to work more and harder if the organizations are sufficiently supportive of them, implicitly or explicitly, by instituting practices that satisfy employees' internal needs [29]. Therefore, managing employees becomes an important issue for the firm's sustainable operations. With regard to the previous research, we suggest that the HCHRM system can be an essential component of firm sustainability.

Second, we advance the understanding of the literature on manufacturing flexibility by investigating its relationship with the HCHRM system. Organization-wide practices (e.g., discretionary level, information sharing by the top management team (TMT), HR practice consistency, etc.) directly or indirectly influence manufacturing processes including enhancing manufacturing flexibility. Following D'Souza and Williams' typology [30], we examine the HRM system's effect, not only on manufacturing flexibility during the firm's manufacturing processes (internally-driven flexibility), but also on manufacturing flexibility to satisfy customer needs (externally-driven flexibility). This typology will help us to understand the HCHRM—manufacturing flexibility relationship in terms of competitive strategy (i.e., the generic strategy of the firm); that is, HCHRM makes firms increase the sustainable competitive advantage by making their manufacturing processes flexible in response to

internally or externally generated needs. Thus, we can suggest a novel approach to manufacturing flexibility literature.

Finally, we offer a new mechanism to explain how HCHRM practices impact on manufacturing flexibility. Employees' capabilities take a key role in the mediated relationship between HCHRM and manufacturing flexibility. As mentioned, people take a pivotal role in strategic or policy implementation during the manufacturing process. Employees' capabilities can be regarded as a proximal outcome developed by HCHRM practices, and in the end, they allow the manufacturing system more flexibility. However, empirical research examining this relationship is lacking. We suggest that employees' capabilities are a mediator that helps to understand the positive relationship between HCHRM practices and manufacturing flexibility.

The rest of this article proceeds as follows: The next section presents the theoretical background, reviewing the relevant literature, and articulates our research hypotheses. Section 3 describes the measures, sample, and data. Section 4 presents the statistical results. In Section 5, we conclude the paper by highlighting our contributions and limitations.

2. Theoretical Backgrounds

2.1. HCHRM: A Source of Firm Sustainability

A great deal of research is conducted in the field of strategic HRM, which focuses on how the role of HRM aligns with a firm strategy in continually changing environments [19]. According to Boselie et al. [31], HRM refers to attentively designed combinations of practices for managing employees, coordinated to enhance organizational effectiveness and boost performances. Researchers in the field of strategic HRM have concentrated on the effect of a particular bundle of HRM practices aligned with the firm's goal or its context, not on the effect of each HRM practice. According to Arthur [19], there are two distinct HRM systems: control and commitment. A control HRM system monitors or enforces employees with strict rules and steps they should follow, and rewards employees based on quantitative performance appraisals. In addition, the control HRM system enhances organizational or individual outcomes only when the manager has complete knowledge of the field or perfect monitoring-reward policies [19]. On the other hand, a commitment HRM system (i.e., the HCHRM system) draws on desired employee behaviors and attitudes by reconciling individual goals with organizational goals [19]. Moreover, the HR practices that represent the HCHRM system are combined with organizational-level policies that encourage employees to be intrinsically motivated and committed to their work [20]. Specifically, practices based on the HCHRM system include employment security, selective hiring, incentive compensation, comparatively higher than industry-average pay levels, developmental appraisals, extensive training and development activities, employee participation, pervasive information sharing, discretion and decentralization, and flexible work arrangements [18,24,32,33]. The HCHRM system has been known to lead to improvements in various outcomes such as financial performance [21,23,34,35], productivity [21–23], integrated manufacturing management (advanced manufacturing technology, total quality, just-in-time) [24], scrap rate [19], turnover or retention [21–23], employee commitment [20,36], job satisfaction [36], and employees' AMO (ability, motivation, and opportunity) [23].

According to Ehnert and Harry [15], there is no 'consistent' research in sustainable HRM. Moreover, the research on sustainable HRM is not integrative yet, and there are various related concepts, such as sustainable HRM, green HRM, socially responsible HRM, or ethical HRM [14]. Regardless of how it is called, these concepts share perceptions about sustainable HRM, and researchers in this field have been attempted to clarify what the socially responsible corporate behaviors are. According to the literature, there are two different foci in the socially responsible corporate behaviors: a focus on internal employees and a focus on external stakeholders. Diaz–Carrion et al. [37] argued that the employee focused firm's behaviors (i.e., a firm's activities for increasing employee satisfaction) make a firm get sustained competitive advantages whereas the contextual focused firm's behaviors (i.e., a firm's

activities for following market or institutional pressures) help a firm to adopt sustainable HRM as a response of national pressures. Similarly, Jamali et al. [38] pointed out that internal level corporate social responsibility (CSR) includes organization-wide behaviors related to "employees' skill and education, workplace safety, working conditions, human rights, equity considerations, equal opportunity, health and safety, and labor rights" (p. 446) while external level CSR considers responsibility for social and environmental citizenship. The research on sustainable HRM, ultimately, stresses not only to fulfill social or environmental standards but also to satisfy employees in organizations as an end (e.g., considering employees' well-being), not as a mean [14,39]. In other words, we can understand that HCHRM follows the principle of CSR (e.g., transparency, empowerment, non-discrimination, objectivity, etc.) as sustainable HRM does [37]. Thus, HCHRM system grounded in the high-performance HRM can be a conventional, but more intensive approach, going along with sustainable HRM, to explain how HRM works for long-term sustainability.

The HCHRM system works based on social exchange theory [28]. Social exchange refers to "favors that create diffuse future obligations, not precisely specified ones, and the nature of the return cannot be bargained about but must be left to the discretion of the one who makes it" [28] (p. 93). It is different from an economic exchange, which is a relatively quick, small, and monetary-based transaction [40]. Moreover, social exchange assumes the norm of reciprocity, meaning "people should help those who have helped them" [41] (p. 171). In other words, people in social exchange relationships consider some exchanges to be based on long-term reciprocal transactions, not on short-term simple mercantile deals, so they behave reciprocally towards others in the social exchange relationship [40,42,43]. Putting this theory into our argument, the HCHRM system builds the social exchange relationship between the organization and its employees, because the system consists of practices that let employees feel autonomous, fairly treated, and well-regarded. Employees who perceive the organization's good faith think that they have received something from the organization and ought to do something favorable for the organization to pay back its kindness. Thus, they are more likely to develop into well-trained, skillful workers, and to make great achievements in their jobs.

There is a growing literature on corporate sustainability that connects issues on the sustainability to economic motivations. These studies commonly explain that a firm's consideration for society and the environment is rooted in the desire for higher economic efficiency, and thus corporate social and/or environmental strategies are perceived as a means to enhance financial outcomes. However, this line of research is challenged and questioned by scholars who consider corporate sustainability performance from a more integrated perspective. Hahn and Figge [44] claimed that the aforementioned approach impairs precise decision making based on a comprehensive assessment, as it results in a priori predominance of just one facet of sustainability. While we adopt this newly emerging view, we consider human resources as one source of corporate sustainability that contributes to enhancing the value of firms in the long run. In other words, we argue that employees' capabilities to perform in their positions fuels corporate sustainability by building and maintaining competitive advantages.

Although it is not an easy task, requiring a long wait and massive effort, having quality human resources is critical for a firm's sustained competitiveness. It is required to have HRM practices that motivate employees internally, to develop long-lasting and trustworthy capabilities. Besides, it is also critical to be consistent in those practices to achieve the desired outcome; that is, implemented practices should fit together to reach organizational goals [45]. Thus, it is worth it to contemplate implementing an HCHRM system in the workplace, because it is a well-aligned practice that emphasizes personal responsibility, independence, and employee empowerment. Given this discussion, we consider a HCHRM system as a set of intrinsic motivation-enhancing practices, coupled with fair assessment and compensation, for cultivating human resources in pursuit of corporate sustainability.

2.2. Manufacturing Flexibility and HCHRM

Demand uncertainty is one of the most significant challenges in manufacturing. The ability of a manufacturing system to respond appropriately to demand variability determines the stability

and profitability of a business unit [2]. Such an ability is defined as manufacturing flexibility in the literature; that is, manufacturing flexibility enables firms to cope effectively with uncertainties coming from changes in customer requests and varying market conditions [3,4]. Thus, there is a consensus that honing flexibility is a sterling, strategic weapon for modern manufacturing, in that it contributes to the stability and profitability of a business unit, especially given a complex, competitive, and fast-changing market. In other words, manufacturing flexibility is closely associated with the firm's sustainability because a firm that has a flexible manufacturing process can earn more profits pursuing both cost-efficiency and customer satisfaction without compromise. Based on this economic sustainability, firms can expand their contributions to other stakeholders.

From early research in the eighties, a considerable literature has accumulated on the multi-dimensionality of manufacturing flexibility. While Sethi and Sethi [45] identified 11 dimensions of flexibility, Gerwin [6] suggested taxonomy of seven dimensions. These are the ability to: produce a variety of products with fast set-ups (mix flexibility), change the products currently being offered into new ones in a short time (changeover flexibility), rapidly implement minor design changes (modification flexibility), change production volume at an aggregate level (volume flexibility), alter the sequence of jobs (rerouting flexibility), adapt to unexpected variations in input materials (material flexibility), and the ability to incorporate the other six flexibilities (flexibility responsiveness). Contrary to early studies that provide sophisticated classifications, D'Souza and Williams [30] proffered four dimensions of manufacturing flexibility that fall into two generalized dimensions: externally and internally driven. Externally driven dimensions include volume and mix flexibilities that are closely related to the ability to adjust the outputs of a process (e.g., quality or product mix). Internally driven dimensions, including process and materials handling flexibilities, are associated with the ability to accommodate a manufacturing process even during unpredictable events such as machine breakdowns. Similarly, Zhang et al. [46] classified the various dimensions of manufacturing flexibility into flexible competence and capability. Zhang et al. [46] also empirically found that flexible competence antecedes flexible capability, where flexible competence consists of the flexibilities that accommodate the flow of jobs in the manufacturing process, and flexible capability includes the volume and mix flexibilities that heavily associate with customer satisfaction. Given this line of research, we consider these two dimensions of flexibility (externally and internally driven) as the measures of performance in manufacturing.

To establish either internally or externally flexible practices in manufacturing processes, managing employees is a critical success factor. The people in firms have been strongly emphasized as a source of the firms' sustained competitive advantage [17]. Since a pivotal role in HRM is to develop the relationship between employees' capabilities and the performance of the firm [18], internal or external manufacturing flexibility is achieved by well-managed employees suited to the manufacturing processes of the firm.

Therefore, we expect that the HCHRM system will positively impact a firm's process management, in particular with regard to manufacturing flexibility. As mentioned above, internally driven flexibility requires improved process management practices, such as eliminating bottlenecks, rapid changes in resource allocation, and quick adjustments of operations [2]. These practices are attributed to employees' quick judgments and responses derived from discretionary work decisions, explicit or implicit work knowledge, intrinsic motivation, and experience levels. In addition, autonomous decision making and work-related knowledge also contribute to a firm's externally driven flexibility, which requires rapid responses to satisfy customer needs. Consequently, the HCHRM system helps firms increase their manufacturing flexibility level since the HCHRM system encourages employees to perform autonomous decision-making, intensive training, incentive compensation related to performance, and sharing core information.

However, there is one thing we should ponder. Although the HCHRM system finally makes manufacturing flexible, the implementation of HRM practices in the workplace must entail a medium, namely people. As pointed out in Section 2.1, the HCHRM system develops capable employees. Thus,

employees' capabilities, fostered by the HRM system, become a link between the HCHRM system and internally or externally driven manufacturing flexibility.

2.3. Employees' Capabilities

Human capital is pivotal in a high-commitment organization, composing a source of businesses' competitive advantage [47–49]. It is more and more apparent that value creation depends on employee competence, especially in new firms that have invested in advanced manufacturing processes and technologies [18,50]. Accordingly, employees' capabilities can be defined as their abilities to solve problems, make decisions, and handle overall processes in manufacturing management. Considering the HCHRM system, the commitment perspective has focused on people's intrinsic motivations, endogenous commitments, or enhanced satisfaction. It implies that the HCHRM system treats employees not as instruments, but as goals. Therefore, the term "capability," which refers to "the ability of human beings to lead lives they have reason to value and to enhance the substantive choices they have" [51] (p. 1959), is more appropriate to comprehend the HCHRM system. As Sen [51] has clarified, capability includes the meaning, not only of economic production (which the "human capital" view usually highlights) but also of social development. This argumentation can be applied to sustainability; that is, employees' capabilities enhance a firm's economic sustainability based on increasing the firm's efficiency. Moreover, developing employees' capabilities can be regarded as one activity of increasing a firm's social sustainability. Thus, developing employees' capabilities directly or indirectly contributes to the firm's sustainability. In line with this perspective, high-commitment firms utilize HR practices that develop and support employees who are self-managing or self-regulating [22]. In other words, as we have discussed, the HCHRM system develops employees in terms of self-management (e.g., autonomous decision making, self-regulated work scheduling, or discretionary participation) because the system promotes individuals' self-managed behaviors, based on practices like secure employment, selectivity, competitive compensation, developmental appraisal, structured training, participatory activities, bilateral information sharing, autonomy, and flexible work arrangements [18,24,32,33]. Finally, the HCHRM system fosters the employee capabilities required in organizations. This leads to our first hypothesis.

Hypothesis 1 (H1). *The HCHRM system is positively related to employees' capabilities.*

The employee capabilities cultivated by the HCHRM system are likely to be remarkable in the field of process management, especially manufacturing flexibility. Manufacturing flexibility, by definition, requires autonomous decision-making, abundant skills and work knowledge, and executive ability, even though the types of manufacturing flexibility are distinct (internally versus externally driven). These requirements are more likely to be satisfied when the firm implements a higher level of commitment-centered HR practices that advance the employees' capabilities. Not surprisingly, reinforcing employees' capabilities increases the level of both internally driven and externally driven manufacturing flexibility in the firm. Therefore, we develop the following hypotheses:

Hypothesis 2a (H2a). *Employee capabilities are positively related to the level of internally driven manufacturing flexibility in the firm.*

Hypothesis 2b (H2b). *Employee capabilities are positively related to the level of externally driven manufacturing flexibility in the firm.*

With Hypotheses 1 and 2, we propose that employee capability improvement is the mechanism through which the HCHRM system enhances the firm's level of manufacturing flexibility. That is, if a firm implements HCHRM practices, the employees of the firm improve in terms of their abilities, motivations, and opportunities. In turn, they perform better work with their enhanced capabilities. Virtuous cycles between the firm and the employees, so-called reciprocity, are more likely to be planted

in a firm utilizing the HCHRM system [40,42,43]. This mechanism reflects the central argument of social exchange theory. From a social exchange perspective, when people think that their company is furnishing them with a system of interconnected and well-designed HR practices, they are more likely to be committed to the organization and more willing to perform, not only in-role behaviors but also extra-role ones, well [52]. Through this mechanism, individuals' abilities for work enhance reciprocal relationships [53].

In conclusion, well-developed employees contribute to organizational performance, especially organizations facing abrupt changes in internal or external circumstances. This means that reinforcing employees' capabilities with an HCHRM system is more likely to lead to improvements in a firm's level of manufacturing flexibility. Therefore, instituting HCHRM practices is not a costly practice, but rather a long-term investment for the firm. Based on social exchange theory, we predict the following:

Hypothesis 3a (H3a). *Employee capabilities partially mediate the relationship between HCHRM and internally driven manufacturing flexibility.*

Hypothesis 3b (H3b). *Employee capabilities partially mediate the relationship between HCHRM and externally driven manufacturing flexibility.*

To sum up, this paper proposes to investigate a research model (see Figure 2) in which HCHRM systems and employees' capabilities are identified as critical antecedents for managing processes in the production line more flexibly.

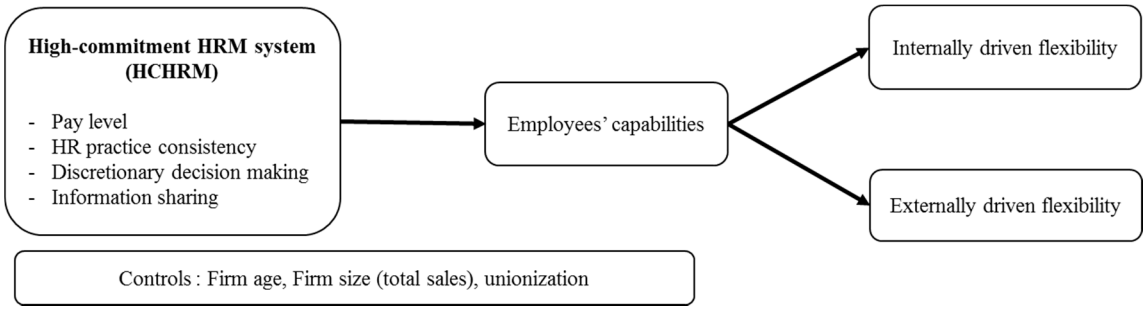


Figure 2. Research model of this study.

3. Methods

3.1. Measurements

3.1.1. Dependent Variables: Manufacturing Flexibility

We followed the manufacturing flexibility taxonomy of D'Souza and Williams [30]: internally driven flexibility and externally driven flexibility. Internally driven flexibility is operationalized by process flexibility, focusing on efficiency improvement during manufacturing processes, such as the effort that firms use to try to save preparation time or the duration of fixed product plans, to employ a small lot system, or to coordinate work processes flexibly. Externally driven flexibility is specified by product flexibility, concentrating on firms' competences in modifying their product lines when the environment (e.g., customers' needs, industrial forces, economic boom, and bust, etc.) changes.

We measured the two distinct concepts of internally driven flexibility and externally driven flexibility, employing several items that were developed and validated in previous studies. Specifically, we asked four questions to measure internally driven flexibility. Modifying items from D'Souza and Williams [30], they were: "our firm tries to reduce lot sizes," "our firm tries to shorten the preparing time for molds or tools," "our firm tries to shorten the fixed cycle time of production planning," and "continuing production is possible, based on coordinating the work processes when production

facilities are broken." Externally driven flexibility can be captured by four different items, such as "our firm can produce a variety of products," "our firm smoothly deals with the customers' modification of orders," "our firm rapidly responds the radical change of production," and "our firm can properly react to the product changes." These items are derived from Avittathur and Swamidass [54], with contextual modifications.

Each manager in the manufacturing department evaluated their firm's manufacturing flexibility level compared to the industry average using a seven-point Likert scale (1: relatively very low, ~4: average, ~7: relatively very high).

3.1.2. Independent Variable: HCHRM System

According to Whitener [20], the HCHRM system can be defined as configurations of HR practices that enhance organizational effectiveness by making employees highly involved in their work. Following prior studies, we chose four sub-dimensions of HCHRM: pay level compared to industry average, HR practice consistency, employees' work autonomy level, and information sharing by the TMT. An HR manager in each firm appraised its pay levels and HR practice consistency, while a manufacturing manager evaluated the autonomy level of the manufacturing workers and the level of information sharing from the TMT. Specifically, the item for pay level was "the pay level for the production workers of our company is competitive relative to its market competitors (1: relatively very low, ~7: relatively very high)," adapted from Chiang et al. [55]. For HR practice consistency the items were "how does the skillfulness/training and development/multi-functional/participation level of the production workers in your company influence their performance appraisal, promotion, or compensation? (1: no influence at all, ~7: very highly influenced)," four items developed for this study. For autonomous decision making, the items were "this organization provides manufacturing workers with a role and responsibilities for their process," "this organization allows manufacturing workers to make their own decisions," and "manufacturing workers solve normal problems of their own accord (1: relatively very low, ~7: relatively very high)," three items from Kwon et al. [42] with contextual modifications. The items for TMT information sharing were "my company provides employees with timely business information," "my company communicates the company's key decisions to the employees without delay," and "my company shares the firm's strategies and goals with employees, and the employees understand them well (1: strongly disagree, ~7: strongly agree)," three items modified from Wu [56].

3.1.3. Mediating Variable: Employees' Capabilities

We used the level of employee capabilities as a proximal outcome of the HCHRM system. Improvements in the manufacturing flexibility level are derived from the company's HRM system by enhancing the production workers' abilities. An HR manager from each company evaluated the capability level of their manufacturing workers, based on four criteria: knowledge or skill level, work proficiency, work-related problem-solving ability, and overall ability. A Likert seven-point scale was used, in a way similar to the flexibility measures (1: relatively very low, ~4: average, ~7: relatively very high).

3.1.4. Control Variables

- Firm age

Firm age is a determinant of firm growth and the possibility of firm dissolution [57]. Young firms are more likely to face risks resulting from deficiencies in resources and capabilities than are older firms [58]. A lack of resources and capabilities can lead to a firm's early failure, known as the "liability of newness," which refers to the drastically increased mortality rate in the early years of a firm [58]. This phenomenon implies that firm age matters to firm performance, not only financially, but also on the manufacturing side. That is, firms are likely to have different levels of process management,

depending on the age of the firms. Thus, we considered each firm's age in our analysis, to control for this effect. However, since the age ranges given for firm age vary widely in the data, we took the natural log of the firm age in the regression function. If the firm's age was less than one year, we entered it as zero.

- Firm size

Firm size plays a role in firm resource deficiencies that is similar to firm age [57]. A larger firm with good financial performance (i.e., high sales or profit), is more likely to have abundant resources and capabilities from inside and outside the company [59]. Employing abundant resources and capabilities represents the firm's ability to invest in products or process improvements. It is a reasonable assumption that large firms can afford the expense of instituting novel technologies, implementing new HR practices, or fostering a desirable organizational culture [60]. As Dang et al. [61] pointed out, choosing a proper firm size measure as a control variable is important because each firm size measure reflects different aspects of the firm size. In the literature, various proxies represent firm size such as total assets, market capitalization, total sales, or a total number of employees [61]. Among these proxies, total sales is a proper measure of this study since total sales reflects product market competition [61] and manufacturing flexibility can be influenced by product market characteristics. Manufacturing flexibility, by definition, is sensitive to the internal (e.g., process defects in the company) or external changes (e.g., customer preferences transition). Total sales can represent to overcome these internal or external changes as the firm in the turbulent circumstances survives recording the higher level of total sales. Thus, we used the log form of total sales in 2012 as a firm size measure [59–61].

- Union representation

Unions can affect employees' competencies and attitudes, as well as firms' decision-making processes and their organizational culture. This is because employees in unionized settings are more likely to remain at the same workplace, to have secure employment, and to accumulate explicit or implicit work knowledge [22,32]. Therefore, we controlled for the union effect (if the firm had a union, then we coded it as one).

3.2. Data Collection and Sample

We used the manufacturing productivity survey (MPS) data collected by the Korean Productivity Center in 2012, entrusted by the Ministry of Trade, Industry, and Energy in South Korea. The sample was composed of 2218 firms in the first stage, based on the KIS-LINE database, which provides Korean enterprises' financial and credibility information, of the NICE Information Service. 601 enterprises (27%) responded to the survey. The original MPS survey questionnaire was divided into seven categories: financial management, human resources management, planning management, sales planning, production management, purchasing management, and research and development. Divisional managers responded to the questionnaire. Responses from different departments were helpful for reducing the risks of falling into a single source variance. For this study, the responses of HR management and production teams were used for statistical analysis. Table 1 gives the sample breakdown. In terms of firm age, firms established for 10 to 15 years were the plurality at 24.13%, and 15- to 20-year-old firms were next at 18.30%. By total sales in 2012, 39.43% of the firms recorded sales between KRW 10 billion to KRW 30 billion, and firms with KRW 30 billion to KRW 50 billion in sales were the next largest group (15.81%). The majority of firms (83%) had no union.

Table 1. Profile of companies.

Characteristics	Item	Number	Percentage of the Sample (%)
Firm age (years)	0~5	56	9.32
	5~10	90	14.98
	10~15	145	24.13
	15~20	110	18.30
	20~25	62	10.32
	25~30	54	8.98
	30 or longer	84	13.97
Sales in 2012 ($)	0~5 billion	33	5.49
	5 billion~10 billion	66	10.98
	10 billion~30 billion	237	39.43
	30 billion~50 billion	95	15.81
	50 billion~100 billion	81	13.48
	100 billion~300 billion	58	9.65
	300 billion or more	31	5.16
Unionization	Yes (1)	102	17.00
	No (0)	499	83.00

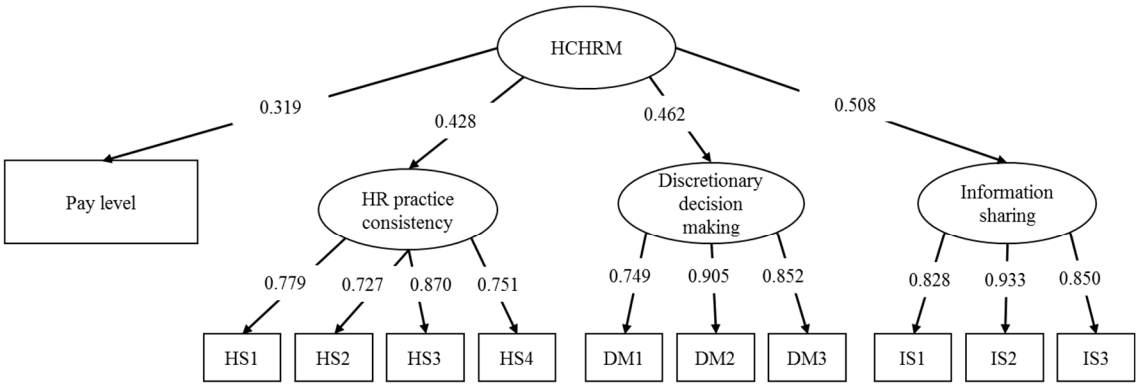
3.3. Reliability and Validity

Before testing our hypothesized model, we assessed three types of validity: content validity, convergent validity, and discriminant validity. Content validity is established by confirming consistency between the measurement items and the extant literature. Threats regarding content validity are minimized by using established questionnaires from the literature. We assessed convergent validity by examining composite reliability (CR) and average variance extracted (AVE) from the measures [62]. Although many studies have used 0.5 as the reliability threshold for their measures, 0.7 is the recommended value for a reliable construct. As shown in Table 2, our CR values range from 0.864 to 0.925. For the AVE by item, a score of 0.5 indicates acceptability [62]. Table 2 also shows that the AVEs for our measures range from 0.615 to 0.760, which are above the acceptable value. All of our Cronbach's α values, a traditional reliability indicator, are also acceptable (above 0.70) since the reliability coefficients indicated that all scales have an acceptable level of internal consistency. In addition, Table 2 exhibits the measurement loadings of our research model, resulted from confirmatory factor analysis (CFA). The standardized loadings (λ) in Table 2 can be interpreted in a way similar to exploratory factor analysis. The squared multiple correlations (SMCs) in Table 2 are the commonalities of the variables. All signs show that it is proper to use these measurements (factor loadings are over 0.6 and SMCs are over 0.5 [63]), and model fit indicators such as the χ^2 test, comparative fit index (CFI), Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA) present good fits for the research model. Second-order factor analysis was used to verify whether the data structure was proper for the construct, as we assumed (see Figure 3). In this sample, an excellent fit was obtained (CFI = 0.981, TLI = 0.975, RMSEA = 0.051), and each of the items loads strongly on the appropriate factor. In addition, we tested a measurement model analysis with HCHRM as a second-order construct. The results in Figure 4 suggest that our measurement model shows a good fit to the data (CFI = 0.960, TLI = 0.955, and RMSEA = 0.052).

Table 2. Confirmatory factor analysis (CFA).

Construct		Measurements	Factor Loadings (λ)	SMC	CR	AVE	Cronbach's α
HC HRM	Pay level	payment	-	-	-	-	-
	HR practice consistency	HS1_skill	0.781	0.610	0.864	0.615	0.862
		HS2_training	0.730	0.533			
		HS3_multifunction	0.866	0.750			
		HS4_participatory	0.752	0.565			
	Discretionary decision making	DM1	0.764	0.584	0.876	0.703	0.872
		DM2	0.894	0.799			
		DM3	0.852	0.725			
	Information sharing	IS1	0.831	0.691	0.904	0.760	0.902
		IS2	0.926	0.857			
		IS3	0.855	0.732			
Employees' capabilities		PMC1	0.801	0.641	0.925	0.757	0.924
		PMC2	0.822	0.675			
		PMC3	0.891	0.794			
		PMC4	0.957	0.916			
Internally-driven flexibility		IDF1	0.730	0.532	0.891	0.674	0.886
		IDF2	0.871	0.758			
		IDF3	0.911	0.830			
		IDF4	0.759	0.576			
Externally-driven flexibility		EDF1	0.763	0.582	0.915	0.730	0.913
		EDF2	0.872	0.760			
		EDF3	0.877	0.768			
		EDF4	0.899	0.807			

Six factor CFA: χ^2 (df = 210) = 446.783, $p < 0.01$, CFI = 0.974, TLI = 0.969, RMSEA = 0.043 (90% CI 0.038–0.049). Four factor CFA (with second-ordered high-commitment human resource management (HCHRM), excluding control variables): χ^2 (df = 221) = 580.611, $p < 0.01$, CFI = 0.960, TLI = 0.955, RMSEA = 0.052 (90% CI 0.047–0.057). NOTE: CFA = confirmatory factor analysis, CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = the root mean square error of approximation.



[Goodness-of-fit Statistics] n = 601, χ^2 (df=41) = 104.107, p < 0.01, CFI = 0.981, TLI = 0.975, RMSEA = 0.051 (90% CI 0.039–0.063);
* NOTE: CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = the root mean square error of approximation.

Figure 3. Second-order confirmatory factor analysis (CFA) of high commitment human resource management (HRM) system.

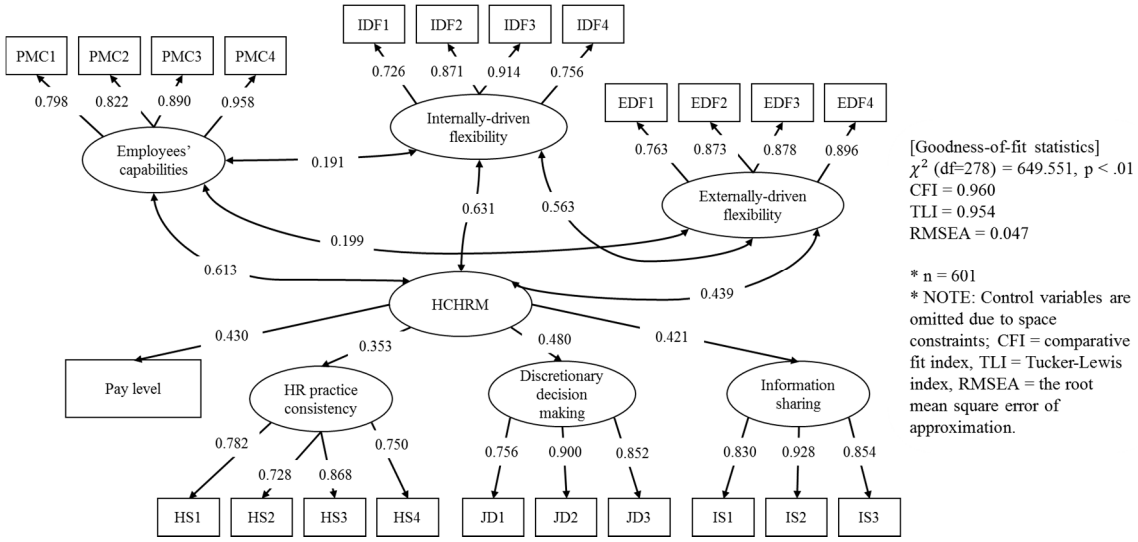
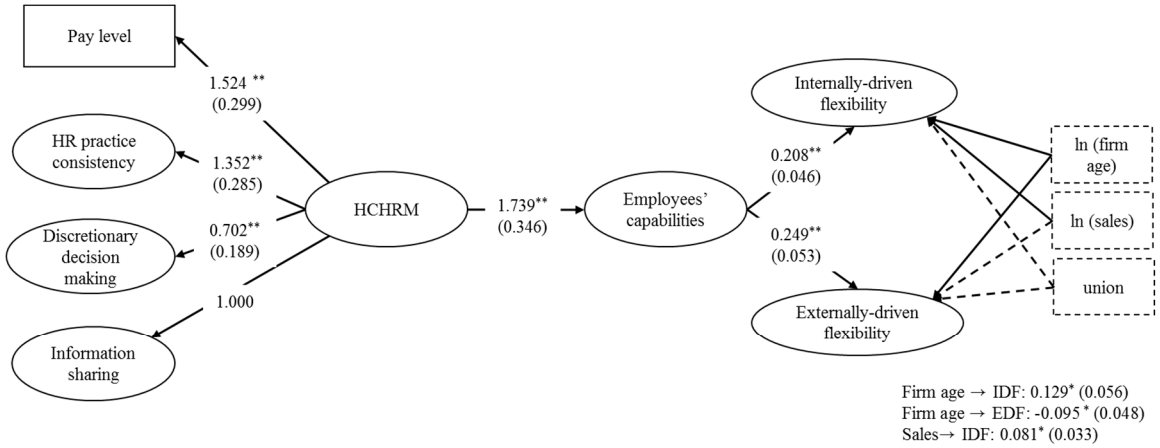


Figure 4. The measurement model.

Finally, we verified the discriminant validity of our instruments by looking at the square root of the AVE, as recommended by Fornell and Larcker [62]. Figure 4 shows the correlation coefficients of the latent variables examined in this study, which confirms the discriminant validity. The square root of the AVE (calculated in Table 2) for each construct is greater than the levels of correlations involved with each construct. The results of the inter-construct correlations also indicate that each construct shares more parts of variances with its measures than with other measures. Therefore, we concluded that this data was appropriate for testing our research model.

4. Results

We used the structural equation modeling of Amos 21.0 to test the hypotheses. Figure 5 shows the results of our structural equation modeling after controlling for the effects of firm age, total sales, and unionization. The hypothesized model showed a good fit with the data (χ^2 (df = 284) = 883.706, $p < 0.01$, CFI = 0.936, TLI = 0.927, RMSEA = 0.059, 90% CI [0.055–0.064]). As shown Figure 5, the level of the HCHRM system is positively associated with the employees' capabilities (b = 1.739, s.e. = 0.346, $p < 0.01$, standardized B = 0.710), supporting Hypothesis 1. The level of employees' capabilities is likely to increase the level of internally driven manufacturing flexibility in the firm (b = 0.208, s.e. = 0.046, $p < 0.01$, standardized B = 0.200), consistent with Hypothesis 2a. In addition, the relationship between employees' capabilities and externally driven manufacturing flexibility in the firm is positive, supporting Hypothesis 2b (b = 0.249, s.e. = 0.053, $p < 0.01$, standardized B = 0.207).



[Goodness-of-fit statistics]
χ^2 (df=284) = 883.706, p < 0.01, CFI = 0.936, TLI = 0.927, RMSEA = 0.059

* n=601, * p < 0.05 ** p < 0.01
* NOTE: Indicators of each latent factor are omitted for clarity; Standard errors are in parentheses; Solid lines mean the relationship is statistically significant whereas dashed lines indicate the non-significant relation; CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = the root mean square error of approximation.

Figure 5. Results of the structural equation modeling.

Hypothesis 3a and 3b predicted that employees' capabilities mediate the relationship between the level of HCHRM and manufacturing flexibility in the firm (H3a: internally driven flexibility, H3b: externally driven flexibility). To test these mediation effects, we used bootstrap procedures to construct 95% bias-corrected confidence intervals based on 5000 random samples with replacement from the full sample [64]. In support of Hypothesis 3a, we found that employees' capabilities mediated the relationship between the HCHRM system and internally driven manufacturing flexibility (b = 0.362, Bootstrapped s.e. = 0.150, 95% CI [0.167–0.746]). The other mediated relationship was also statistically significant (b = 0.434, Bootstrapped s.e. = 0.178, 95% CI [0.206–0.882]), as we expected in Hypothesis 3b. Hence, we conclude that the HCHRM system helps to increase the manufacturing flexibility level by enhancing employees' capabilities.

5. Discussion

The primary purpose of this study is to investigate the relationship between HRM practices and manufacturing flexibility in Korean enterprises. We find that the HCHRM system, which refers to a configuration of HR practices that enhance employee commitment and motivation [19,20], has a strong positive relationship with employees' capabilities for process management. In addition, employees' capabilities mediate the relationship between the HCHRM system and manufacturing flexibility (both internally and externally driven). These findings suggest that the pervasive execution of HCHRM in a company improves its manufacturing flexibility level by fostering the employees' capabilities in manufacturing parts. In line with social exchange theory, HCHRM encourages reciprocal relations between a firm and its employees. That is, HCHRM promotes individual autonomy, skill or knowledge development, and active participation; benefits that employees then pay back to the firm by performing desired behaviors for work-related performance. For example, workers who have opportunities to make discretionary decisions in their jobs are likely to be more capable (with better problem-solving or decision-making abilities). In turn, employees who are well trained and capable achieve good performances at their work. That is, good workers developed through executing HCHRM practices repay their companies with the desired behaviors on their performances. Our research investigates this reciprocal mechanism, not only in theoretical elaborations but also through an empirical test, by concentrating on the manufacturing process. In addition, our findings show that manufacturing flexibility is achieved by developing employees' capabilities by instituting an HCHRM

system. Managing manufacturing processes flexibly to meet changes in customers' needs promptly is an important skill for surviving under rapidly changing circumstances. From our results, employees' capabilities are the requisite antecedent of manufacturing flexibility, because not just internally driven flexibility, but also externally driven flexibility, needs quick decisions and handling competences, depending on the changing needs. In addition, HCHRM plays a role in improving internally driven and externally driven manufacturing flexibility as well.

The results of this study contribute to the strategic HRM literature by finding the link between the HCHRM system and departmental outcomes (e.g., manufacturing flexibility). Considering that flexibility is an emerging issue in HRM disciplines (employment flexibility, workplace flexibility), investigating the relationship between HCHRM and manufacturing flexibility is newly explained and empirically tested in our study. This is important because manufacturing flexibility improves manufacturing firm's sustained competitive advantages that the strategic HRM researchers are also interested in. The reason why we choose HCHRM, and not sustainable HRM practices, is because we think the HCHRM system has the explicitly or implicitly overlapped region between the existing strategic HRM studies (as mainstream as Ehnert and Harry [15] mentioned) and the newly arising sustainable HRM research. To be specific, the HCHRM system and the sustainable HRM has a similar assumption to employees, which is employees in organizations are important in themselves because they are not a means to achieve goals but an end to have values, despite different research foundations. With this assumption, we are inevitable to focus on the role of employee capabilities that allow HCHRM to ultimately influence manufacturing flexibility that can be crucial for a firm's long-term sustainability. Unlike the existing literature on strategic HRM (e.g., see Beltrán-Martín et al. [65]), we believe that our work can make a distinctive contribution to HRM research, in that we try to articulate the impact of HCHRM on the operational outcomes (i.e., manufacturing flexibility) on the basis of the internal level CSR view (i.e., employee focus) developed in sustainability research. In sum, our findings have a theoretical and empirical contribution to the strategic HRM literature and sustainability literature, finding the related point—employees' capabilities—between two different research backgrounds.

The implications for the sustainability literature are not limited to the HCHRM viewpoint. As we mentioned, manufacturing flexibility is another key to make manufacturing processes sustainable. Since the meaning of sustainable manufacturing processes is related to the possibility of simultaneously achieving organizational goals (i.e., cost efficiency and customer satisfaction) without compromise, manufacturing flexibility is an appropriate concept to discuss the firm's sustainability. We suggest the mechanism of the HCHRM—manufacturing flexibility relationship based on the competitive strategy (i.e., generic strategy of the firm). In other words, HCHRM makes firms increase the sustainable competitive advantage by making their manufacturing processes *flexible* in response to internally or externally generated needs. After all, based on the results, we can conclude that for increasing firm's sustainability, implementing HCHRM is helpful because it develops the employees' capabilities and finally enhances manufacturing flexibility, which can be a direct source of firm's sustainability.

In addition, our study helps theoretically explain reciprocities in the workplace based on social exchange theory. Although the effects of implementing HR practices can be interpreted through various points of view, social exchange theory is suitable to interpret our findings. Employing this theory, we can comprehensively explain the phenomenon of how HRM practices (i.e., HCHRM) create manufacturing flexibility in organizations through employees' capabilities. This is a sound rationale to explain our findings in the field of HRM and manufacturing flexibility.

Finally, our findings have practical implications for organizational leaders or HR professionals. Implementation of HCHRM such as providing opportunities to make decisions autonomously to employees, sharing managerial information, and designing highly consistent HR practices in an organization is vital to nurture employees' capabilities and improve the firm's manufacturing flexibility. Therefore, organizations that want to make the firm sustainable need to be actively considering introducing the HCHRM practices in their organization.

Although it looks expensive in the beginning because the definite effect of the HCHRM implementation will appear when the HCHRM is applied as a system (i.e., a bundle of the related HR practices), the HCHRM system helps the firm manage manufacturing employees by internally motivating and training them, and thus ultimately increases the firm's sustained profitability. Furthermore, organizational leaders or HR professionals need to focus on the development of employees' capabilities. Employees' capability enhancement itself is critical for the firm's sustainability because it is not only a means to increase manufacturing flexibility that is another base of firm's sustained competitive advantage but also an end to make employees satisfy or feel developed. Thus, further efforts to develop and reproduce employees' capabilities are needed in practice because our findings demonstrate it works.

Several limitations should be carefully considered when interpreting our results. First, performance evaluation practices were not included in our study. Some researchers have suggested three dimensions of HR systems, such as skill-enhancing, motivation-enhancing, and opportunity-enhancing [23], or people flow, appraisals and rewards, and employment relations [66]. Motivation-enhancing [23] or appraisals and rewards [66] practices are associated with performance appraisals and incentive programs. Since we follow the control and commitment approach [19], we focused less on performance evaluation and compensation practices in our analysis. Three-dimensional approaches need to be considered in future research. In line with considering three-dimensional approaches, future researchers are invited to discuss sustainable HRM system as an extension of our study. We believe our work regarding the internal level CSR can be a starting point to expand the discussion on the relationship between sustainable HRM and Strategic HRM in the workplace. Although the empirical test of the effect of firm's HRM system is not easy work, in future research, it will be necessary to show what specific HR practices consist of a sustainable HRM system and how to observe and test the effect of a sustainable HRM system on various organizational outcomes considering firm's sustainability.

Second, we collected our data from seven department managers, which this way might benefit to lower common method variance. However, it is less likely to reflect the actual perceptions of manufacturing employees. Future research needs the employees' evaluations of HRM practices, their attitudinal variables, and their cognitive or affective states. This may improve our understandings of the issue with more realistic interpretation. In addition, when the data is collected from each employee, multilevel modeling will be applied to test the relationships.

Third, a potential endogeneity problem should be considered. The endogeneity problem happens "when the explanatory variables and the error term are correlated in a regression model" [67] (p. 149). According to Li [67], there are several remedies of the endogeneity problem in the cross-sectional annual data regressions: control variables, lagged independent variable, firm or industry fixed effects, instrumental variable, lagged dependent variable, or GMM/dynamic model. There is a generic limitation from a simple cross-sectional data, which is employed in this study. Although we input three control variables (e.g., firm age, firm size, and union) that simultaneously influence the explanatory and explained variables, assume and clearly test the second-order factor structure [68], and elaborate the theoretical rationale of how HCHRM (practices) impacts employees' capabilities (ability) and manufacturing flexibility (behaviors) to remedy our data's shortcoming (i.e., a simple cross-sectional data), it remains to worry about the endogeneity problem. In future research, a longitudinal study would be useful to understand the relationship between the HCHRM system and employees' performances. If we can collect a panel data of our model, the causality of HCHRM and manufacturing flexibility will become more apparent, being able to use lagged independent variables or lagged dependent variables. Or quasi-experiment or experimental study will be helpful for improving our understanding in this field. For example, if we know a firm will institute a new HCHRM practice, then we can measure the perceptions, abilities, or behaviors from employees before and after introducing the new practice. Based on a social exchange view, social exchange relationships are based on long-term relationships; that is, they are built on reciprocal experiences of trust. Thus, future research should include investigating perceptional or behavioral changes over time in order to test a dynamic model.

Lowering the endogeneity concerns is very critical to conduct social science research, future research should consider these aspects and encourage not only to make a new methodological process (i.e., data collection, statistical tests) but also to make new logical argumentations based on developed theories.

Finally, we should consider the issue of generalizability. We tested our model with 601 manufacturing firms in South Korea. The reason why we chose this context is that we expect the effect of implementing the HCHRM system might vary in Korea manufacturing firms. South Korea is known to have strengths and dynamics in the manufacturing industry with well-trained employees and highly developed technology. However, in Korea, a lot of manufacturing firms are small or medium-sized and this implies majority of manufacturing firms in Korea are less likely to actively implement HCHRM so that the implementation level of HCHRM, or the considering level of employees by HR policies, varies from firms to firms, so we think the Korea manufacturing context is suitable to observe the effect of HCHRM system on manufacturing sustainability (i.e., manufacturing flexibility). Although we expect that our findings can be applied to other industries and other countries, our focus has fundamental cautions to interpret the results. Our study may not be able to draw a consistent conclusion from other countries (e.g., different cultures or different levels of economic development) and neither does different industries. For example, in some industries in which managing people is critical for the firm's survival, our findings may be working with a strong effect, whereas in other industry in which the firms consider employees as costs, our results are useless to give implications. Therefore, future research should examine other industries (e.g., service or high-tech) to cross-validate our model in different settings.

Despite the limitations of this study, our findings extend the work in the HCHRM literature by examining the relationship between HCHRM practices and manufacturing flexibility via employees' capabilities. On that basis, further research should be able to extend our understanding of the mediation mechanism or find boundary conditions that strongly influence that mechanism. In this way, we can expand our understanding of strategic HRM practices and their outcomes.

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