

ANTECEDENTS OF HRM INTEGRATION MECHANISM USAGE IN MNC SUBSIDIARIES IN CHINA

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Track 4: Management, Organisation and Cultural Issues

Abstract

A neglected issue in the international HRM literature are the mechanisms through which MNC headquarters control and coordinate the HRM activities of foreign subsidiaries, and why they are used. Accordingly, the present study aimed to investigate the antecedents of HRM integration mechanism usage in MNCs and to establish the extent to which these antecedents differ in importance across different mechanism types. The sample on which the study is based comprises 76 European-owned subsidiaries located in China. The results show that to varying extents the number of expatriates in the subsidiary, the background of the subsidiary HR manager, MNC size, the nature of subsidiary operations and MNC home region explain the use of at least one type of HRM integration mechanism.

Keywords MNC, human resource management, control, China

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1. Introduction

Many of the studies that address the issue of control in MNCs adopt the contingency view of organisations insofar as different sets of contextual factors (e.g. country of origin or host institutional environment) and universal contingencies (e.g. firm size, age and industry) will determine the kinds of control mechanisms deployed (Baliga & Jaeger, 1984). The general consensus so far is that whilst universal contingencies can help to explain patterns of control in MNCs to some extent, explanations are more commonly related to country-of-origin effects (e.g. Bartlett & Ghoshal, 1989; Calori et al., 1994; Harzing, 1999; Harzing & Sorge, 2003).

Despite the wealth of research conducted in the area of control in MNCs, our knowledge about the use of control mechanisms in MNCs remains fragmentary and inconclusive (Hennart, 2005; Björkman, 2007). Whilst we have come to learn that MNCs will deploy both formal and informal control mechanisms (Martinez & Jarillo, 1989), in combination and at varying levels of intensity (Engelhoff, 1984; Kim et al., 2003), it remains unclear which factors are most important in explaining the use of different mechanisms as well as the kind of effects they have. Earlier studies on control mechanisms have been argued to be fairly narrow, in terms of the limited number of mechanisms included, the relatively small sample sizes or the number of countries represented (Harzing & Sorge, 2003). Furthermore, such studies have tended not to investigate control at the business function level (cf. Kim et al., 2003). This is especially true for the control of the HR function.

Indeed, a neglected issue in the international HRM literature is the mechanisms through which MNC headquarters control the HRM activities of foreign subsidiaries (Smale, 2007). Those studies that have incorporated HRM control mechanisms into their analysis tend to focus on specific mechanisms such as expatriation (Björkman & Lu, 2001; Hetrick, 2002) or internal benchmarking (Martin & Beaumont, 1998), or on in-depth case-study evidence regarding power relations or political explanations behind their usage (Martin & Beaumont, 1999; Ferner et al., 2004).

In light of the above, the present study aims to investigate the antecedents of HRM integration mechanism usage in MNCs. More specifically, the study seeks, firstly, to identify which factors best explain the use of HRM integration mechanisms in MNC subsidiaries, and secondly, to establish the extent to which these antecedents vary in importance across different types of integration mechanisms. The sample on which the study is based comprises 76 European-owned subsidiaries located in China.

In pursuing the above aims the present paper answers calls for more research into the types of HRM control mechanisms deployed by MNCs and the reasons behind their usage (Gomez & Sanchez, 2005). It achieves this by adopting a systems approach that incorporates multiple mechanisms of control in the same study, which is argued to reflect more accurately how they are used in practice (Kim et al., 2003).

The following section reviews the literature on the mechanisms of HRM integration in MNCs. Based on this literature as well as the general international management literature on control in MNCs, testable hypotheses are developed regarding the antecedents of HRM integration mechanism usage. After presenting the methods and results of the study, the paper concludes with a discussion of the results that includes implications and some suggestions for future research.

2. Mechanisms of HRM integration in MNCs

At this juncture, it is necessary to clarify some definitions in relation to the concepts of control, coordination and integration which are used somewhat interchangeably in the international management literature. Firstly, whereas control has been defined as any process in which a person, group or organisation determines or intentionally affects what another person, group or organisation will do (Baliga & Jaeger, 1984: 26), coordination refers to the means through which the different parts of an organisation are integrated or linked together to accomplish a collective goal (Van de Ven et al., 1976; Martinez & Jarillo, 1989). In line with the approach by Kim et al. (2003), the present study views integration as comprising both of the above tools of control and coordination which are used to achieve consistency of international business activities.

Recent case study evidence suggests that in recent years MNCs have been increasingly shifting their attention towards the integration and cohesion side of the integration-responsiveness tension (Ghoshal & Gratton, 2002). Taylor (2006) argues that the two mutually reinforcing trends of the need to leverage organisational learning across borders and the need to integrate 'sustainability' into a firm's global strategy are likely to further the global integration of the international HR function in MNCs. From an evolutionary perspective on the international HR function, the required organisational levels of coordination now necessary to execute global strategies have provoked the emergence of a strategic global HRM agenda (Kiessling & Harvey, 2005). Some of the defining features of this global HRM agenda are argued to be the continued management of strategic international HRM activities, but through the application of global rule-sets or values that carry universal meaning across cultures (Sparrow et al.,

2004), and the facilitation of organisational learning, knowledge and talent flows throughout the MNC (Roberts et al., 1998; Sparrow, 2006; Taylor, 2006). It is logical then that the tools used by the international HR function to achieve greater global integration have become subject to increasing interest.

Most of the empirical work carried out on the mechanisms of global HRM integration adopts qualitative case study designs, often involving only one or two MNCs from predominantly US or UK origin. The mechanisms of HRM integration (especially expatriates) in some of these studies takes a somewhat secondary role in analyses of HRM integration-responsiveness (Monks, 1996; Hetrick, 2002; Gamble, 2003), however other case studies explore more explicitly a range of HRM integration mechanisms used, highlighting variation both between and within MNCs in how HRM is integrated in foreign subsidiaries (Edwards, Ferner & Sisson, 1996; Tempel, 2001).

Quantitative studies on HRM in MNCs rarely include variables related to integration mechanisms in trying to explain the degree of global integration versus local responsiveness. The few studies that have included integration mechanisms, however, have shown that parent-affiliate communication (Rosenzweig & Nohria, 1994) and expatriation (Björkman & Lu, 2001) are positively related to greater HRM integration as measured by the resemblance of foreign subsidiary HRM practices to the corporate parent.

Among the most comprehensive studies into HRM integration mechanism usage is Wolf's (1997) study on the use of HRM coordination processes in 82 foreign subsidiaries of US and European MNCs. The findings of the study supported the notion of the heterarchical MNC, namely that HRM coordination mechanisms are used heterogeneously from subsidiary to subsidiary within MNCs. In conclusion, Wolf urges

caution about attributing such patterns to the nationality of MNCs since MNCs of the same national origin also differed in their use of coordination mechanisms. A further comprehensive study was conducted by Gomez and Sanchez (2005). Their main finding was that each type of HRM control mechanism ('formal' or 'informal') has a different set of internal (i.e. subsidiary characteristics) and external (i.e. host institutional environment) antecedents. In addition, a global strategy was related to the greater use of both formal and informal HRM control mechanisms, and the extent of subsidiary embeddedness in their local environment was linked to the greater use of informal mechanisms.

In sum, relatively little research attention has been paid specifically to the issue of how HRM is integrated in MNC subsidiaries and even less research on the possible reasons behind the use of HRM integration mechanisms. Thus, drawing on the above literature and the general international management literature on the use of coordination and control in MNCs, the next section develops a set of hypotheses to be tested regarding the antecedents of parent HRM integration mechanism usage.

4. Hypotheses

An assumption is made in this study that HRM integration mechanisms are capable of being driven by different antecedents, that is to say that integration mechanisms are not mutually exclusive but can meaningfully co-exist. This approach is in line with those of other similar studies (Ferner, 2000; Kim et al., 2003; Gomez & Sanchez, 2005) and more accurately reflects the realities of how MNCs use integration mechanisms in achieving greater consistency amongst multiple, heterogeneous subsidiaries.

Based on the seminal work of Lawrence and Lorsch (1967) the contingency view on organisational control attributes explanations for control mechanism usage to either contextual or universal factors. In terms of contextual factors, studies on MNC control have applied various concepts including ‘uncertainty’ (Baliga & Jaeger, 1984), ‘complexity’ (Ghoshal & Nohria, 1989) and ‘volatility’ (O’Donnell, 2000) in attempts to capture how the external pressures subsidiaries face affect the use of control mechanisms. Whilst there is some agreement that more complex host environments are associated with less centralisation, there is less agreement, for example, about whether such environments lead to the greater or lesser use of formalisation and other mechanisms of control.

Due to the inconclusive and fragmentary nature of past findings on control in MNCs (Hennart, 2005; Björkman, 2007) and in order to reduce the complexity of the model to be tested, the present study narrows its focus on universal contingency explanations. Accordingly, the study investigates MNC subsidiaries all located in the same host context (i.e. China) and includes a control for the home region of the MNC. The specific universal contingencies, or antecedents, included in the study are subsidiary size, subsidiary age, the number of expatriates, the background of the subsidiary HR manager, the size of the MNC and the degree of interdependence between the subsidiary and the MNC.

4.1. Subsidiary size

Subsidiary size has been included as a variable in several studies on control in MNCs. According to the work of Child (1973, 1974), as firm size increases centralised control becomes more difficult to exert and is thus replaced with a more decentralised

control strategy accompanied by more rules and procedures (i.e. formalisation/bureaucratic control mechanisms). Subsidiary size has also been shown to be positively related to output control (Engelhoff, 1984), the use of expatriates, socialisation and networks (Harzing, 1999) and indirect personal control (Harzing & Sorge, 2003).

In the international HRM literature, Gooderham et al. (1999) argue from an institutional perspective that large foreign subsidiaries will adopt more socially responsible and legitimate (i.e. localised) HRM practices due to their greater visibility. This, in turn, is likely to present limitations to the use of more centralised and formal types of HRM control. Myloni et al.'s (2004) findings amongst MNC subsidiaries in Greece provide some support for this relationship showing that HRM practices are generally more difficult to transfer to large subsidiaries.

On the other hand, Wolf (1997) provides evidence of how technocratic (i.e. centralisation or standardisation) mechanisms are more prevalent in the coordination of HRM in larger foreign subsidiaries. The explanation provided is that larger units have the administrative potential to interact with headquarters through technocratic means. In agreement with this, Gomez and Sanchez (2005) reveal how subsidiary size is positively associated with the use of formal control mechanisms. In general, therefore, whilst the emphasis on different types of HRM integration mechanisms used might shift as subsidiaries become larger, larger subsidiaries will be subject to more extensive HRM integration efforts than smaller subsidiaries. This leads us to make the following hypothesis:

Hypothesis 1: *The use of parent HRM integration mechanisms will be positively related to the size of the foreign subsidiary.*

4.2. Subsidiary age

Most commonly studied in connection with the use of expatriates, MNCs have been shown to control younger subsidiaries more closely at the beginning but then reduce expatriate presence over time (Harzing, 1999; Harzing & Sorge, 2003). In the international management literature subsidiaries are also described as being subject to a life-cycle insofar as MNCs establish the competitive position of a foreign subsidiary first before then building integration mechanisms across it (Ghoshal & Bartlett, 1996). This life-cycle view is observable in at least the Chinese host context where MNCs who have conducted business operations in China for several years are described to have already entered the ‘strategic investor’ phase where the tighter integration of China operations, including HRM, has become the focus of attention (Braun & Warner, 2002). This pattern of integration over time is argued by Schuler et al. (1993) to be the result of a learning process about how to operate in foreign markets that comes with prolonged international experience, which in turn leads to a greater professionalism of international HR operations. Wolf (1997) describes headquarters’ interactions with older foreign subsidiaries as being characterised by a more intensive use of technocratic HRM integration mechanisms.

However, subsidiaries are also likely to become more locally embedded in their host contexts over time. Indeed, the study by Rosenzweig and Nohria (1994) revealed that due to higher levels of embeddedness older subsidiaries employed more localised HRM practices. Similarly, Myloni et al. (2004) found evidence of less HRM practice

transfers, and thus parent HRM integration, in older subsidiaries compared to middle-aged and young subsidiaries. They attributed this pattern to stronger, more change-resistant organisational cultures in older subsidiaries and the particular characteristics of the host institutional environment at the time of entry. Farley et al. (2004) produce much the same finding regarding subsidiary age and more professional, locally legitimate HRM practices, but go on to state that MNCs have learned how to do this without sacrificing corporate control or operation efficiency.

In line with the life-cycle and learning views, together with empirical evidence that shows MNCs with long established regional presences as being the most advanced in developing integrated, transnational HRM systems (Braun et al., 2003), we argue that the use of parent HRM integration mechanisms will be more extensive in older subsidiaries. The hypothesis proposed is thus:

Hypothesis 2: *The use of parent HRM integration mechanisms will be positively related to the age of the foreign subsidiary within the MNC.*

4.3. Number of expatriates

Expatriates themselves are widely considered to be a type of integration mechanism (e.g. Edström & Galbraith, 1977), but they can also act as a substitute or complement to other control functions, for example in facilitating headquarters control or shared values (Harzing, 1999) via their socialisation and networking capabilities (Legewie, 2002). Indeed, in the international HRM literature expatriates are described to play a number of important HRM integration-related roles, including ‘role models’, ‘boundary spanners’ and ‘coaches’ (Hetrick, 2002) as well as communicators of HRM-

related knowledge (Gamble, 2003). Accordingly, a greater similarity between subsidiary HRM practices and those of the parent is typically found in units with a high expatriate presence (e.g. Rosenzweig & Nohria, 1994; Björkman et al., 2007).

Less evident in extant research, however, is the impact of expatriate presence on the use of other HRM integration mechanisms. Whilst it is acknowledged that integration mechanisms are used in combination and at different levels of intensity (e.g. Kim et al., 2003) the presence of expatriates is likely to make the use of alternative integration mechanisms easier to carry out in foreign subsidiaries. For instance, in their capacity as mediator between corporate headquarters and the local HR department, expatriates occupy an influential position in terms of communicating, discussing and explaining the HRM decisions made by headquarters or the HR rules that have to be followed, hence facilitating centralisation- and formalisation-based integration. Particularly if the expatriate has come from the parent country, factors in addition to the managerial post they hold such as shared mindset and shared language will also result in more frequent contact with headquarters (i.e. facilitating people-based integration). In light of the above arguments we present the following hypothesis:

Hypothesis 3: *The use of parent HRM integration mechanisms will be positively related to the number of expatriates in the foreign subsidiary.*

4.4. Background of the subsidiary HR manager

In line with Björkman and Lu (2001) it is argued that the background of the HR manager is likely to affect the development of HRM in the subsidiary as well as the use of parent HRM integration mechanisms. More specifically, it is suggested that HR managers with a background of working in local Chinese firms or not having worked in

HR at all (e.g. university graduates) will affect the extent to which MNC headquarters can utilise the range of HRM integration mechanisms at their disposal. This is likely to occur since those HR managers' concepts of legitimate HRM practices, having had limited or no experience of working in an international firm, will be different from the parent's. Thus, their lower absorptive capacity and their corresponding low level of strategic HRM capabilities (Sumelius et al., 2007) will act as barriers to the transfer of parent HRM practices and to parent-driven attempts at HRM integration.

Following this line of argumentation, the recruitment of an HR manager from another MNC, who is likely to possess more knowledge and skills concerning HRM issues in international firms, will allow for the more extensive use of parent HRM integration mechanisms. Such managers in China are more likely to be in direct contact with the corporate or regional HR function as well as being more active in personal and/or professional HRM networks with other MNCs (Smale, forthcoming). We therefore advance the following hypothesis:

Hypothesis 4: *The use of parent HRM integration mechanisms will be greater in subsidiaries in which the most senior person for HR has been recruited from another MNC.*

4.5. Size of the MNC

Firm size, as opposed to subsidiary size, has also been found to be antecedent of integration mechanism usage. For instance, O'Donnell (2000) reveals how parent size is, to varying extents, related to the greater use of headquarters supervision, lateral integrating mechanisms and monetary incentives, and the lesser use of bureaucratic monitoring mechanisms. Harzing and Sorge's (2003) study produced a positive

relationship between firm size and the use of expatriates in the top five positions of the subsidiary.

Firms of larger size possess more resources and thus administrative potential to dedicate to the tighter control and coordination of foreign subsidiaries. Although HRM integration in larger firms is likely to be more complex and more difficult to enforce, larger firms can draw on a greater pool of resources in establishing organisational mechanisms that promote HRM integration, for example global HR policy frameworks (Ferner et al., 2004), social networks and knowledge transfer ‘spaces’ such as Centres of Excellence and Communities of Practice (Harris et al., 2003; Sparrow et al., 2004), and globally integrated HR information systems (Tansley et al., 2001; Stone et al., 2006). Accordingly, we predict the following relationship:

Hypothesis 5: *The use of parent HRM integration mechanisms will be positively related to the size of the MNC.*

4.6. Interdependence

Bargaining power and resource-dependency views draw on the ownership of key resources within a firm and how that ownership confers a powerful means for either enforcing or resisting change. More specifically, the degree of dependence of the MNC on a particular foreign subsidiary, which in turn will influence the extent of control it exerts over the subsidiary’s HRM practices, will be largely determined by the strategic role of the subsidiary within the MNC (Taylor, Beechler & Napier, 1996). Concomitantly, a high level of subsidiary autonomy will result in the lesser use of headquarters supervision and bureaucratic monitoring mechanisms (O’Donnell, 2000), and in instances of high parent-subsidiary and inter-unit interdependence behaviourally-

based forms of cultural integration will be used (Ghoshal & Nohria, 1989; O'Donnell, 2000).

In the context of HRM in MNCs the power bargaining and resource-dependency views have shown how factors such as the nature of MNC headquarters-subsidary relationships (Nohria & Ghoshal, 1994), organisational politics (Martin & Beaumont, 1999; Ferner et al., 2004) and relative bargaining power (Björkman & Lu, 2001) are key determinants of HRM practices in foreign subsidiaries.

In terms of HRM integration, it has been shown empirically that the greater the dependence of the foreign subsidiary on the parent company, the more the HR decisions of the subsidiary will be controlled by headquarters (Martinez & Ricks, 1989). Furthermore, Hannon et al. (1995) demonstrate how subsidiary dependence on parent resources is conducive to globally integrated international HR strategies. Collectively, this leads us to the final hypothesis:

Hypothesis 6: *The use of parent HRM integration mechanisms will be positively related to the degree of interdependence between the subsidiary and the MNC.*

5. Method

5.1. Data collection

Data for the study were collected using a pre-tested questionnaire survey administered through standardised interviews with the General Manager and most senior person responsible for HR in Chinese subsidiaries of European MNCs. Data collection for the study took place between November 2005 and October 2006. It began with compiling lists of foreign owned subsidiaries in China from national Chambers of

Commerce and other similar foreign investment bodies. These lists were supplemented via the use of the authors' existing contacts and through the snowballing method. From a total sample of 311 subsidiaries contacted, 87 agreed to participate giving a response rate of 28%. However, due to absence of responses from the most senior person responsible for HR in 11 of the units, the present study is based on the remaining usable sample of 76. The units were mostly located in or nearby the city districts of Beijing and Shanghai. A more detailed breakdown of the sample characteristics is provided in Table 1.

- Insert Table 1 about here -

Interviews were carried out face-to-face, except in two cases where telephone interviews were used. The interviews were structured so that the interviewer and respondent first completed the questionnaire together then a semi-structured interview followed during which certain topics from the questionnaire were discussed in greater detail. The current study is based solely on the questionnaire data.

Adopting a key informant approach, the most senior person responsible for HRM in the foreign unit responded to questions comprising the dependent variable (i.e. the use of HRM integration mechanisms), whereas General Managers in the foreign unit responded to questions comprising the independent and control variables (i.e. information about MNC and subsidiary operations). In cases where the General Manager was not available (n=8) the most senior person responsible for HRM was used.

5.2. Measures

5.2.1. Dependent variable

The measure for HRM integration mechanism usage was based on Kim *et al.*'s (2003) four global integration modes, namely people-based, formalisation-based, information-based and centralisation-based. In the interviews, respondents were asked to state their level of agreement concerning the use of the different mechanisms in integrating four parent HRM practices (recruitment and selection, training and development, financial compensation, and performance appraisal) into their subsidiary.

Each mechanism type consisted of 3-item, seven-point Likert scales ranging from 1 (do not agree) to 7 (entirely agree). *People-based mechanisms* measured the extent to which parent HRM practices are integrated into the subsidiary via discussion, for example, in meetings with colleagues from headquarters. *Formalisation-based mechanisms* sought responses regarding the extent to which parent HRM practices are integrated into the subsidiary via, for example, fairly well-specified, worldwide standard procedures and manuals. *Information-based mechanisms* referred, for example, to the use of databases and worldwide communication systems to share HRM information internationally. Lastly, since Kim *et al.*'s (2003) centralisation mode used function-specific scales (e.g. for marketing and manufacturing), *centralisation-based* integration mechanisms in this study used a scale based on sub-dimensions of HRM practices found in earlier studies (Rosenzweig & Nohria, 1994; Hannon *et al.*, 1995). Example items included the extent to which the methods of recruitment and the delivery of training are decided by headquarters.

In the analysis the use of HRM integration mechanisms is an aggregate measure comprising mean scores across the four mechanism types and four HRM practices. At 0.88 the reliability value (Cronbach's alpha) for this construct was satisfactory.

5.2.2. Independent variables

Subsidiary size. Subsidiary size was measured by taking the natural logarithm of the total number of employees in the subsidiary in order to dampen the high variation in size (from 10 to 6400) and achieve a more normal distribution for the variable.

Subsidiary age in the MNC. Age was measured as the number of years the subsidiary has been part of the MNC.

Number of expatriates. Due to the uneven distribution of expatriates in the data set (varying from 0 to 200) the number of expatriates was recalculated as the natural logarithm of total foreign employees, either from the parent country or a third country, in the subsidiary.

Background of the HR manager. This variable was measured by asking respondents whether the most senior person responsible for HR (typically the HR Manager) was recruited from another MNC or elsewhere (e.g. local Chinese company or university). Consequently, responses were coded into a dummy variable so that subsidiaries in which the HR manager had been recruited from another MNC were assigned the value 1, and subsidiaries in which the HR manager had been recruited from elsewhere were assigned the value 0.

MNC size. Size was measured as the natural logarithm of annual turnover for the whole MNC for the most recent financial year. In most cases the data were provided by respondents. Any missing values were replaced with figures from the company's published financial statements.

Interdependence. This variable sought to capture the level of interdependence between the subsidiary and the MNC by measuring the degree of transaction integration between the foreign subsidiary and the rest of the MNC. This is based on the argument by Gupta and Govindarajan (1991) that the amount and direction of resource flows between the parent and the foreign subsidiary will determine the subsidiary's strategic role. This, in turn, will determine its degree of dependence on and similarity to the parent HRM system (Taylor et al., 1996). Dependence was thus operationalised as a two-item measure which asked respondents to state approximately what percentage of the subsidiary's (a) sales and (b) purchases take place within the MNC (see e.g. Harzing & Sorge, 2003). The mean of the two percentage scores was used in the analysis.

5.2.3. Control variables

Firstly, since industry characteristics have been shown to moderate the relationship between HRM systems and organisational effectiveness (Datta, Guthrie & Wright, 2005) and to explain the use of headquarters control mechanisms (Harzing & Sorge, 2003), it was deemed necessary to control for the type of *subsidiary operations* – a simplified proxy for industry. This was measured by asking respondents to indicate on a 7-point scale the extent to which their subsidiary's operations were labour intensive (1) or capital intensive (7).

Secondly, we controlled for whether *MNC home region* would have an impact on mechanism usage since country of origin has been shown to influence the use of control mechanisms in MNCs (e.g. Harzing, 1999; Harzing & Sorge, 2003). Thus, a dummy variable was created where non-Nordic MNCs were given the value 0 and Nordic MNCs the value 1. This classification was adopted due to the composition of the

final sample and acknowledgement of a distinctive Nordic management style (see e.g. Lindell & Arvonen, 1996; Smith *et al*, 2003) that might produce a country-of-origin effect.

Lastly, the *mode of establishment* was controlled for in the analysis as this factor has been found to be associated with the HRM practices of MNC subsidiaries (Rosenzweig & Nohria, 1994; Björkman & Lu, 2001). This was measured by asking respondents to state whether the subsidiary had started its operations by (i) continuing ongoing operations undertaken by a local partner, (ii) partly continuing its operations (e.g. taking over some employees), or (iii) starting from scratch.

6. Results

6.1. Antecedents of HRM integration mechanism usage

Descriptive statistics and a correlation matrix of all the variables in the study are presented in Table 2. There were no correlations exceeding .90 in the model, which would have been an indication of substantial collinearity (Hair, Anderson, Tatham & Black, 1998). Variance inflation factor (VIF) values were low, between 1.077 and 1.939. This also suggests that there was no serious problem with collinearity in the regression model.

- Insert Table 2 about here -

The bivariate correlations show that the number of expatriates and the size of the MNC are positively related to the use of parent HRM integration mechanisms. Other correlations worth noting are firstly, that older subsidiaries employ more expatriates,

and secondly, that Nordic MNCs appear to have smaller and younger subsidiaries with fewer expatriates and are more inclined to recruit HR managers from other MNCs.

The hypotheses were tested using OLS multiple regression analysis. The statistical program used was SPSS 14.0. Table 3 presents the results of the regression model with the use of parent HRM integration mechanisms as the dependent variable. In order to separate the effects of the control variables and the independent variables two models were estimated; one baseline model in which only the control variables were included, and one full model in which the independent and control variables were included. Whereas the baseline model proved not to be significant ($F = 1.137, p > 0.1$), the full model was significant ($F = 2.766, p < 0.01$) and explained almost 20 percent of the variance in the use of HRM integration mechanisms.

- Insert Table 3 about here -

The results did not produce a significant relationship between subsidiary size and the use of HRM integration mechanisms, and it was in the opposite direction (std. $\beta = -0.216, p > 0.10$). Hypothesis 1 was therefore not supported.

Hypothesis 2 that predicted a positive relationship between subsidiary age and HRM integration mechanism usage was also not supported by the results (std. $\beta = 0.098, p > 0.10$). Support was found, however, for the larger number of expatriates being an antecedent of HRM integration mechanism usage (std. $\beta = 0.402, p < 0.01$). Hypothesis 3 thus received support.

The background of the subsidiary HR manager was not shown to affect mechanism usage (std. $\beta = -0.102, p > 0.10$). Hypothesis 4 therefore could not be

supported. The size of the MNC, on the other hand, was positively related to the use of HRM integration mechanisms at the $p < 0.05$ level (std. $\beta = 0.238$). Thus, Hypothesis 5 was supported. Lastly, whilst MNC-subsidiary interdependence was not shown to be related to mechanism usage (std. $\beta = 0.003$, $p > 0.10$). Consequently, Hypothesis 6 was not supported.

Amongst the control variables included in the model, subsidiary operations were shown to affect HRM integration mechanism usage (std. $\beta = 0.254$, $p < 0.05$). This can be interpreted as the parent company using HRM integration mechanisms to a greater extent in subsidiaries with more capital intensive operations. In addition, the home region of the MNC was shown to affect the extent of mechanism usage (std. $\beta = 0.260$, $p < 0.05$). More specifically, Nordic MNCs use HRM integration mechanisms to a greater extent than MNCs from elsewhere in Europe in our sample.

6.2. Post-hoc analysis by mechanism type

Post-hoc analysis regarding antecedents of mechanism usage between mechanism types was also conducted. Prior to this, Varimax rotated factor analysis was conducted to test the discriminant validity the mechanism types. Analysis revealed that formalisation- and information-based integration mechanisms converged as one factor. In addition, one of the items in the formalisation-based scale (the use of monitoring to ensure policies are not violated) suffered from significant cross-loadings. As a result, the formalisation- and information-based mechanisms were combined and the monitoring item was removed. A subsequent factor analysis was performed. This analysis produced three factors. The first factor (formalisation-/information-based, $\alpha = .94$) explained 64.6% of the variance with factor loadings between .681 and .888, the

second factor (centralisation-based, $\alpha = .95$) 11.9% with factor loadings between .816 and .915, and the third factor (people-based, $\alpha = .87$) 7.9% with factor loadings between .673 and .884. Despite the third factor having an Eigenvalue slightly below 1, based on theoretical arguments and no further significant cross-loadings exceeding the .50 level (Hair et al., 1998) we decided to maintain the distinction between three mechanism types.

OLS multiple regression analyses were conducted with the three mechanism types as dependent variables. The results of the analyses are presented in Table 4.

- Insert Table 4 about here -

In terms of people-based mechanisms of HRM integration ($F = 2.377, p < 0.05$), the significant antecedents were shown to be somewhat similar to those for integration mechanisms as a whole. Indeed, people-based integration mechanisms are more common in more capital intensive subsidiaries with more expatriates and in Nordic MNCs. The notable exception is the significantly lesser use of people-based integration mechanisms in subsidiaries that have recruited the most senior HR manager from another MNC. With respect to formalisation-/information-based mechanisms ($F = 3.083, p < 0.01$) the background of the HR manager is not significant, but the same antecedents as above of subsidiary operations, number of expatriates and MNC home region are shown to be antecedents. In addition, however, formalisation-/information-based HRM integration mechanisms were used more extensively in larger MNCs. The model concerning the use of centralisation to integrate HRM in foreign subsidiaries was not significant ($F = 1.207, p > 0.10$) with only the number of expatriates appearing as

marginally significant. These results together with the results of the hypotheses are discussed next.

7. Discussion

The present study sought to investigate the antecedents of HRM integration mechanism usage in MNCs based on a sample of 76 European-owned subsidiaries located in China. The study focused its analysis on the explanatory power of universal contingencies and not contextual factors pertaining to the home or host country.

The main finding is that the number of expatriates in the subsidiary and MNC size were shown to be significant antecedents of greater HRM integration mechanism usage by the MNC parent. Whilst *expatriates* themselves have been shown to be instrumental in HRM integration efforts in foreign subsidiaries (e.g. Hetrick, 2002; Gamble, 2003), the study's findings indicate their additional significance in facilitating other forms of parent-driven integration. Indeed, greater numbers of expatriates were associated with the greater use of people-, formalisation-/information- and centralisation-based mechanisms. This would seem to suggest that expatriates not only represent a personal, direct form of integration (Harzing & Sorge, 2003), but are also important facilitators of the more impersonal, bureaucratic and indirect forms used to integrate HRM practices.

In terms of *MNC size*, larger MNCs reported the greater use of HRM integration mechanisms, in particular the greater use of formalisation- and information-based mechanisms. This supports the argumentation that larger firms have more extensive resources to draw from when designing their tools of integration, which can be deployed consistently amongst large numbers of foreign subsidiaries. Our data suggests that this

is most likely to be the case with regards to the use of global HRM policies, rules and guidelines as well as the provision of HRM information via electronic databases and integrated HR information systems.

Subsidiary size, on the other hand, was not a significant antecedent of mechanism usage and in fact demonstrated a negative relationship. Possible explanations for the unexpected direction of this relationship could be that as the subsidiary increases in size it is likely to have a greater pool of resources dedicated to the creation of new knowledge (Gupta & Govindarajan, 2000) and thus a greater bargaining platform from which to resist attempts at parent-driven HRM integration (e.g. Taylor et al., 1996; Ferner et al., 2004). Alternatively, Gooderham et al. (1999) argue that larger subsidiary firms are more likely to adopt socially responsible HRM practices due to their greater visibility, and are hence subject to greater pressures for local as opposed to MNC legitimacy and integration.

The *background of the HR manager* proved only to be a significant predictor of people-based integration, but surprisingly demonstrated a negative relationship. This can be interpreted as subsidiaries that have recruited HR managers from other MNCs have less people-based contact with corporate headquarters concerning HRM issues. Based on recent studies on HRM in MNC subsidiaries in China (see e.g. Björkman & Lu, 1999; Sumelius et al., 2007), one explanation for this could be that those HR managers who have been working for MNCs in China place more importance on and are more involved in personal networks with HR managers from other MNCs. In short, these types of external networks involving the sharing of HRM knowledge and best practices are perceived as more effective in developing appropriate HRM practices than internal networks with the parent.

Turning to the control variables in the study, the nature of *subsidiary operations* and *MNC home region* explained the use of HRM integration mechanisms. Subsidiaries engaged in more capital intensive operations were subjected to the greater use of parent HRM integration mechanisms. One reason for this might be that capital intensive operations are easier to integrate than operations involving many employees, especially from an HRM perspective. Alternatively, capital intensive operations might be regarded as more strategically important within the MNC and thus more tightly integrated with the rest of the MNC. Reflecting findings elsewhere on the effect of country of origin on integration mechanisms usage (e.g. Harzing & Sorge, 2003), Nordic-based MNCs were shown to use HRM integration mechanisms more extensively in their foreign subsidiaries.

The study's findings must be viewed, however, in light of its limitations, which if addressed open up interesting avenues for future research. Although the study narrowed its focus on universal and not contextual antecedents of HRM integration mechanism usage, it is possible that the findings at least partly reflect the peculiarities of the Chinese host business and institutional environment, especially given the reported effects that the host-country can have on HRM integration mechanism selection (Gomez & Sanchez, 2005). More research is thus needed in other host settings in order to corroborate the conclusions drawn above. The study did not control for MNC strategy (cf. Gomez & Sanchez, 2005) or, more specifically, for the MNC's strategic international HRM orientation (see e.g. Taylor et al., 1996). Inclusion of such variables would ideally require responses from MNC headquarters representatives. This would provide an important complement to the subsidiary perspective and is much needed in studies of HRM in MNC subsidiaries which rarely combine the two perspectives.

Although the typology of integration mechanisms did not perform as expected in our data sample, the study's findings support the continued investigation of HRM integration mechanism usage across different mechanism types. Furthermore, this approach could be extended to explain the use of mechanisms in integrating other business functions (see e.g. Engelhoff, 1984; Kim et al., 2003). Collectively, it is hoped that the above avenues of research will deepen our understanding about how HRM integration takes place within MNCs and why. It is argued here, that this line of enquiry will help to explain further the patterns of HRM practices observed in MNC subsidiaries.

References

- Baliga, B.R. & Jaeger, A.M. (1984). Multinational corporations: control systems and delegation issues, *Journal of International Business Studies*, 15/2, 25-40.
- Björkman, A. (2007). *Towards explaining the use of control mechanisms in foreign subsidiaries of MNCs*. Unpublished doctoral dissertation, Swedish School of Economics and Business Administration, No.168., Helsinki, Finland.
- Björkman, I. & Lu, Y. (1999). The management of human resources in Chinese-Western joint ventures, *Journal of World Business*, 34/2, 1-19.
- Björkman, I. & Lu, Y. (2001). Institutionalization and bargaining power explanations of HRM practices in international joint ventures – The case of Chinese-Western joint ventures, *Organization Studies*, 22/3, 491-512.
- Björkman, I., Smale, A., Sumelius, J., Suutari, V., & Lu, Y. (forthcoming, 2007). Changes in institutional context and MNC operations in China: subsidiary HRM practices in 1996 versus 2006, *International Business Review*.
- Braun, W.H. & Warner, M. (2002). Strategic human resource management in western multinationals in China: The differentiation of practices across different ownership forms, *Personnel Review*, 31/5, 553-579.
- Braun, W., Sparrow, P. & Schuler, R. (2003). SIHRM orientations and functional HRM practice integration in MNEs with RHQs regarding their affiliates in the PRC, *proceedings of the 19th Workshop on Strategic HRM*, Paris.
- Brewster, C., Sparrow, P. & Harris, H. (2005). Towards a new model of globalizing HRM, *International Journal of Human Resource Management*, 16(6): 949-970.
- Child, J. (1973). Strategies of control and organizational behavior, *Administrative Science Quarterly*, 18/1, 1-17.
- Child, J. (1974). Predicting and understanding organizational structure, *Administrative Science Quarterly*, 19, 168-185.
- Edström, A. & Galbraith, J. (1977). Transfer of managers as a coordination and control strategy in multinational organizations, *Administrative Science Quarterly*, 22/2, 249-263.
- Edwards, P., Ferner, A. & Sisson, K. (1996). The conditions for international human resource management: two case studies, *International Journal of Human Resource Management*, 7/1, 20-40.
- Farley, J.U., Hoenig, S. & Yang, J.Z. (2004). Key factors influencing HRM practices of overseas subsidiaries in China's transition economy, *International Journal of Human Resource Management*, 15/4, 688-704.
- Ferner, A. (2000). The underpinnings of 'bureaucratic' control systems: HRM in European multinationals, *Journal of Management Studies*, 37/4, 521-539.
- Ferner, A., Almond, P., Clark, I., Colling, T., Edwards, T., Holden, L. & Muller-Camen, M. (2004). The dynamics of central control and subsidiary autonomy in the management of human resources: case-study evidence from US MNCs in the UK, *Organization Studies*, 25/3, 363-391.

- Ferner, A., Almond, P. & Colling, T. (2005). Institutional theory and the cross-national transfer of employment policy: the case of 'workforce diversity' in US multinationals, *Journal of International Business Studies*, 36/3, 304-321.
- Gamble, J. (2003). Transferring human resource practices from the United Kingdom to China: the limits and potential for convergence, *International Journal of Human Resource Management*, 14/3, 369-387.
- Ghoshal, S. & Bartlett, C.A. (1996). Rebuilding behavioural context: a blueprint for corporate renewal, *Sloan Management Review*, 37/2, 23-36.
- Ghoshal, S. & Gratton, L. (2002). Integrating the enterprise, *Sloan Management Review*, 44/1, 31-38.
- Ghoshal, S. & Nohria, N. (1989). Internal differentiation within multinational corporations, *Strategic Management Journal*, 10/4, 323-337.
- Gomez, C. & Sanchez, J.I. (2005). Human resource control in MNCs: a study of the factors influencing the use of formal and informal control mechanisms, *International Journal of Human Resource Management*, 16/10, 1847-1861.
- Gupta, A.K. & Govindarajan, V. (2000). Knowledge flows within multinational corporations, *Strategic Management Journal*, 21/4, 473-496.
- Hair, J., Anderson, R. E., Tatham, R. L. & Black, W. (1998). *Multivariate Data Analysis with Readings*, New Jersey: Prentice-Hall.
- Hannon, J., Huang, I-C. & Jaw, B-S. (1995). International human resource strategy and its determinants: the case of subsidiaries in Taiwan, *Journal of International Business Studies*, 26/3, 531-554.
- Harris, H., Brewster, C. & Sparrow, P. (2003). *International Human Resource Management*. London, UK: CIPD.
- Harzing, A-W. (1999). *Managing the Multinationals: An International Study of Control Mechanisms*, Edward Elgar: Cheltenham.
- Harzing, A-W. (2001). An analysis of the functions of international transfer of managers in MNCs, *Employee Relations*, 23/6, 581-598.
- Harzing, A-W. & Sorge, A. (2003). The relative impact of country of origin and universal contingencies on internationalization strategies and corporate control in multinational enterprises: worldwide and European perspectives, *Organization Studies*, 24/2, 187-214.
- Hennart, J-F. (2005). Control in multinational firms: the role of price and hierarchy, in S. Ghoshal & D.E. Westney (eds.) *Organization Theory and the Multinational Corporation* (2nd edition), Palgrave MacMillan: Basingstoke, pp.149-171.
- Hetrick, S. (2002). Transferring HR ideas and practices: globalization and convergence in Poland, *Human Resource Development International*, 5/3, 333-351.
- Kiessling, T. & M. Harvey (2005). Strategic global human resource management research in the twenty-first century: an endorsement of the mixed-method research methodology, *International Journal of Human Resource Management* 16/1, 22-45.

- Kim, K., Park, J-H. & Prescott, J.E. (2003). The global integration of business functions: a study of multinational businesses in integrated global industries, *Journal of International Business Studies*, 34/4, 327-344.
- Lawrence, P.R. & J.W. Lorsch (1967). *Organization and Environment*. Boston: Harvard Graduate School of Business Administration.
- Legewie, J. (2002). Control and co-ordination of Japanese subsidiaries in China: problems of an expatriate-based management system, *International Journal of Human Resource Management*, 13/6, 901-919.
- Lindell, M. and Arvonen, J. (1996). The Nordic management style in a European context. *International Studies of Management & Organization*, 26/3, 73-91.
- Lu, K. & Björkman, I. (1997). HRM practices in China-West joint ventures: MNC standardization versus localization, *International Journal of Human Resource Management*, 8/5, 614-628.
- Martin, G. & Beaumont, P. (1998). Diffusing 'best practice' in multinational firms: prospects, practice and contestation, *International Journal of Human Resource Management*, 9/4, 671-695.
- Martin, G. & Beaumont, P. (1999). Co-ordination and control of human resource management in multinational firms: the case of CASHCO, *International Journal of Human Resource Management*, 10/1, 21-42.
- Martinez, J.I. & Jarillo, J.C. (1989). The evolution of research on coordination mechanisms in multinational corporations, *Journal of International Business Studies*, 20/3, 489-514.
- Martinez, Z. & Ricks, D. (1989). Multinational parent companies' influence over human resource decisions of affiliates: U.S. firms in Mexico, *Journal of International Business Studies*, 20/3, 465-488.
- Monks, K. (1996). Global or local? HRM in the multinational company: The Irish experience, *International Journal of Human Resource Management*, 7/3, 721-735.
- Myloni, B., Harzing, A-W.K. & Mirza, H. (2004). Host country specific factors and the transfer of human resource management practices in multinational companies, *International Journal of Manpower*, 25/6, 518-34.
- O'Donnell, S.W. (2000). Managing foreign subsidiaries: agents of headquarters, or an independent network, *Strategic Management Journal*, 21/5, 525-548.
- Roberts, K., E.E. Kossek & C. Ozeki (1998). Managing the global workforce: challenges and strategies, *Academy of Management Executive*, 12/4, 93-119.
- Rosenzweig, P. & Nohria, N. (1994). Influences on human resource management practices in multinational corporations, *Journal of International Business Studies*, 25/2, 229-251.
- Smale, A. (2007). *Mechanisms of global HRM integration in multinational corporations*, unpublished dissertation, No.181, University of Vaasa, Finland.
- Smale, A. (forthcoming). Foreign subsidiary perspectives on the mechanisms of global HRM integration. *Human Resource Management Journal*, 18/2.
- Smith, P.B., Andersen, J.A., Ekelund, B., Graversen, G. & Ropo, A. (2003). In search of Nordic management styles. *Scandinavian Journal of Management*, 19/4, 491-507.

- Sparrow, P. (2006). Global knowledge management and HRM. In: *Handbook of Research in International Human Resource Management*, 113–138. Eds G.K. Stahl & I. Björkman. Cheltenham: Edward Elgar.
- Sparrow, P., Brewster, C. & Harris, H. (2004). *Globalizing Human Resource Management*, Routledge: London.
- Stone, D.L., Stone-Romero, E.F. & Lukaszewski, K. (2006). Factors affecting the acceptance and effectiveness of electronic human resource systems, *Human Resource Management Review*, 16, 229-244.
- Sumelius, J., Björkman, I. & Smale, A. (2007). The influence of internal and external social networks on HRM capabilities in MNC subsidiaries in China, *proceedings of the 9th Conference on International Human Resource Management*.
- Tansley, C., Newell, S. & Williams, H. (2001). Effecting HRM-style practices through an integrated human resource information system, *Personnel Review*, 30/3, 351-370.
- Taylor, S. (2006). Emerging motivations for global HRM integration. In: *Multinationals, Institutions and the Construction of Transnational Practices*, 109–130. Eds A. Ferner, J. Quintanilla & C. Sánchez-Runde. Basingstoke: Palgrave Macmillan.
- Taylor, S., S. Beechler & N. Napier (1996). Toward an integrative model of strategic international human resource management, *Academy of Management Review*, 21/4, 959–985.
- Tempel, A. (2001). *The Cross-National Transfer of Human Resource Management Practices in German and British Multinational Companies*, Munich: Hampp.
- Van de Ven, A.H., Delbecq, A.L. & Koenig, R. (1976). Determinants of coordination modes within organizations, *American Sociological Review*, 41/2, 322-338.
- Wolf, J. (1997). From “starworks” to networks and heterarchies? Theoretical rationale and empirical evidence of HRM organization in large multinational corporations, *Management International Review*, 37/1, 145-169.

Table 1. Sample characteristics

N = 76	Category	%
Subsidiary size (no. employees)	<100	31.6
	100-500	43.4
	501-1000	5.3
	>1000	19.7
No. expatriates	<5	31.6
	5-10	44.7
	>10	23.7
Subsidiary age (in the MNC)	<2 years	9.2
	2-5 years	38.2
	>5 years	52.6
MNC size (€ million)	<200	22.4
	200-500	21.0
	501-1000	13.2
	>1000	43.4
Mode of establishment	Continuing ongoing operations	18.4
	<i>Partly</i> continuing ongoing operations (e.g. some employees)	11.8
	Starting from scratch	69.8

Table 2. Means, standard deviations and Pearson correlations

Variables	1	2	3	4	5	6	7	8	9	10
Means	3.44	5.26	8.05	1.61	0.47	6.71	20.49	3.64	0.80	2.51
sd	1.26	1.65	6.44	1.29	0.50	2.20	21.23	1.54	0.40	0.79
1. HRM integration mechanisms										
2. Subsidiary size (log.)	0.07									
3. Subsidiary age in the MNC	0.12	0.48***								
4. Number of expatriates (log.)	0.36**	0.60***	0.43***							
5. HR manager recruited from another MNC	-0.05	0.02	0.04	0.03						
6. MNC size (log.)	0.27*	0.29*	0.23*	0.40***	0.00					
7. Interdependence	-0.06	0.01	-0.15	-0.09	0.19	-0.09				
8. Subsidiary operations	0.17	0.18	0.03	0.06	-0.11	-0.08	-0.02			
9. MNC home region	0.09	-0.40***	-0.38**	-0.23*	0.27*	-0.24*	0.10	-0.20		
10. Establishment mode	-0.03	-0.17	-0.17	-0.10	0.01	-0.13	0.00	-0.29*	0.16	

All two-tailed tests. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3. Regressions on the use of HRM integration mechanisms

	Model 1. Controls only			Model 2. Full model		
	Std. B	Std. error	<i>t</i> -statistic	Std. B	Std. error	<i>t</i> -statistic
Subsidiary size				-0.216	0.111	-1.481
Subsidiary age in the MNC				0.098	0.025	0.755
Number of expatriates				0.402	0.138	2.848**
HR manager recruited from another MNC				-0.102	0.285	-0.900
MNC size				0.238	0.068	2.009*
Interdependence				0.003	0.007	0.026
Subsidiary operations	0.197	0.100	1.620	0.254	0.094	2.224*
MNC home region	0.131	0.372	1.104	0.260	0.400	2.050*
Establishment mode	0.006	0.193	0.047	0.054	0.179	0.484
R ²	0.045			0.274		
Adjusted R ²	0.005			0.175		
F	1.137			2.766**		

All two-tailed tests. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 4. Regressions on the use of people-, formalisation-/information- and centralisation-based HRM integration mechanisms

Variables	Model 3. People-based			Model 4. Formalisation-/information-based			Model 5. Centralisation-based		
	Std. B	Std. error	t-statistic	Std. B	Std. error	t-statistic	Std. B	Std. error	t-statistic
Subsidiary size	-0.226	0.138	-1.518	-0.189	0.129	-1.315	-0.155	0.120	-0.974
Subsidiary age in the MNC	0.127	0.031	0.958	0.039	0.029	0.306	0.161	0.027	1.143
Number of expatriates	0.354	0.171	2.455*	0.415	0.160	2.982**	0.260	0.148	1.690 [†]
HR manager recruited from another MNC	-0.253	0.353	-2.195*	0.026	0.331	0.230	-0.155	0.306	-1.262
MNC size	0.141	0.084	1.162	0.281	0.079	2.412*	0.140	0.073	1.085
Interdependence	-0.006	0.008	-0.050	-0.007	0.008	-0.066	0.050	0.007	0.423
Subsidiary operations	0.262	0.116	2.247*	0.241	0.109	2.142*	0.133	0.101	1.072
MNC home region	0.232	0.495	1.789 [†]	0.229	0.464	1.833 [†]	0.220	0.430	1.594
Establishment mode	0.043	0.221	0.373	0.042	0.208	0.376	-0.016	0.192	-0.129
R ²	0.245			0.296			0.141		
Adjusted R ²	0.142			0.200			0.024		
F	2.377*			3.083**			1.207		

All two-tailed tests: [†] p < .10, * p < 0.05, ** p < 0.01, *** p < 0.001