A contingency perspective on the impact of environmental uncertainty and organizational mechanism on flexibility

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Abstract

One of the recent business issues is the Internet of things. IoT and the big data from the Internet can support organizations in dealing with the uncertainty they face through the process of making available informational resources required to respond to customers' requirements. Such huge amount of data and information requires a certain balance between mechanistic and organic structures. Grounded on the contingency theory, this paper attempts to identify the feasible set of organizational mechanisms that have strong impact on the flexibility of organizations under different levels and sources of uncertainty, employing the survey data from Japanese companies.

Keywords: flexibility, environmental uncertainty, organizational mechanism

Introduction

The Internet of things (IoT) and the big-data analysis have been emergent and critical business issues for the evolution of manufacturing and service industries as well. They also have come hot research topics from the academia. Most of the companies show strong interest in the way to analyze the big data generated from IoT every moment. IoT and big-data analysis could support organizations in dealing with the uncertainty they face. In a certain way, they affect organizations through the process of making available informational resources required to respond to their customers' requirements. Such huge amount of data and information requires a certain balance between mechanistic and organic structures to be exploited properly. Then, this paper particularly focuses on the organizational mechanisms in handling with big data and information from their environments and adapting to the environments and evolving their business processes. The focus connotes the congruency between organizational mechanisms and their environments. Grounded on the contingency theory, this paper attempts to identify the feasible set of organizational mechanisms that have strong impact on the flexibility of organizations under different levels and sources of uncertainty.

Previous researches such as Souza and Voss (2008), in their technical note on contingency research in operations management practices investigate the shift of the tendency in Operations Management research. It is noticed that, as operations management best practices become mature, research on practices has begun to shift its interest from the justification of the value of those practices to the understanding of the contextual conditions under which they are effective. In other words, doubts raised on the best practices universal validity.

The best practice paradigm focuses on the continuous development of best practice on all areas within a company and is supported by research showing links between the adoption of best practice and improved performance. However, previous researches such as Dow et al. (1999) and Powell (1995) found that some practices did not have a significant impact on performance. A possible explanation of such findings is that, the best practices are context dependent. As Sousa and Voss (2002) stated that problem in implementing best practices may be the result from too great a mismatch between the proposed form of best practices and the organizational context.

The present research intends to address congruence between organizational mechanisms (OrM) and environmental uncertainty (EU) as one of the possible explanation of the mix findings concerning the impact of the best practices on performance. To clarify the impact of the congruence on new product introduction flexibility (NPF) and product modification flexibility (PMF), and by using the contingency theory, this research addresses the following research question: What is the impact of the congruence between EU and OrM on Flexibility?

The next section provides more information on the key theoretical constructs of contextual variables, use of practices, performance variables and on their respective operationalization based on the existing literature.

Contextual variables

One characteristic of the contextual variables is stated by Sousa and Voss (2008). They stated that contextual variables represent situational characteristics usually exogenous to the focal organization or manager. This research considers three source of EU as the contextual variables: supply uncertainty (SU), demand uncertainty (DU), and technology uncertainty. Such conceptualization of EU is consistent with Ganbold and Matsui (2017). From the resource-dependence theory, they examine the impact of environmental uncertainty on supply chain integration, more precisely on customer integration, internal integration, and supplier integration. Main findings are that collaborating closely with customers is a key to achieving better control over supply uncertainty. And, tight collaboration and integration with suppliers are of great importance in dealing with demand uncertainty. Such conceptualization is aligned with Patel et al. (2012) conceptualization and focus on the uncertainty sources: supply uncertainty, demand uncertainty, and technology uncertainty.

Response variables

The response variables also called use of practices are associated with the degree of use of practices as suggested by Ahire et al. (1996), Flynn et al. (1994), Koufteros et al. (1998), Sakakibara et al. (1993). This research considers as response variables the OrM associated with coordination mechanism (CM), system mechanism (SM), and socialization mechanism (SoM). The OrM as conceptualized by Jansen et al. (2006) is borrowed and extended to include other dimensions as they are expected to be relevant to answer the research question.

Coordination Mechanism brings together different sources of expertise and increase lateral interaction between areas of functional knowledge, as stated by Jansen et al. (2005). The dimension of CM considered here are cross-functional interfaces (CFI) and job rotation (JR). CFI relates to lateral forms of communication that deepen knowledge flows across functional boundaries and lines of authority. JR is the lateral transfer of employees between jobs (Campion et al. 1994).

System Mechanism programs behaviors in advance of their execution and provide a memory for handling routine situations (Galbraith, 1973). Two dimensions of SM are considered, formalization and centralization.

The first dimension of SM, formalization, refers to the use of rules in an organization. The concept of formalization is consistent with Jansen et al. (2005) and borrowed respectively from Hage and Aiken (1967b:79), Aiken and Hage (1968). Job codification (JC) is the degree to which job descriptions are specified. Rule observation (RO) is the degree to which job occupants are supervised in conforming to the standards established in job codification. Job specificity (JS) is the degree to which procedures defining jobs are spelled out.

Concerning the second dimension of SM, centralization, it refers to the delegation of decision-making authority throughout an organization and the participation of managers in decision making (Aiken and Hage 1968). Accordingly, two dimensions of centralization are considered. Participation in decision making (PDM), referring to the extent to which an individual and his colleagues participates in decisions involving their work and work environment (Pennings 1973, p. 689). Hierarchy of authority (HOA), measuring the degree to which the organization member participates in decision involving the tasks associated with his position (Hage and Aiken 1967, pp. 78-79).

Socialization mechanism (SoM) creates broad and tacitly understood rules for appropriate action (Volberda, 1998). SoM refers to two aspects of social relations: the structural aspect, or connectedness, and the cognitive aspect. The structural aspect is operationalized as the interdepartmental connectedness (IDC) which refers to the degree of formal and informal direct contact among employees across departments, consistent with Jaworski and Kohli (1993). IDC is operationalized as the extent to which individuals in a department were networked to various levels of the hierarchy in other departments. On the other hand, the cognitive aspect refers to socialization tactics that offer newcomers specific information and encourage them to interpret and respond to situations in a predictable way (Jones, 1986). Such cognitive aspect is operationalized through two dimensions: formal socialization tactics (FST), and sequential socialization tactics (SeqSoT). Informal and formal tactics, as operationalized by Jones (1986), deal with the context in which information is presented to newcomers. More precisely, with formal tactics, organization segregates newcomers from other organizational members while they learn the responsibilities of their roles as opposed to informal tactics, where newcomers become part of work groups, and learning takes place on the job. Concerning sequential and random tactics, again as operationalized by Jones (1986), they deal with the content of the information given to newcomers via socialization. More precisely, with sequential tactics, organization provides newcomers with explicit information concerning the sequences of activities they will go through in their organizations as opposed to random tactics, where no information is given to newcomers neither concerning the stage they reached on a learning process nor the sequences of such process.

Performance variables

The performance variables are the dependent measures and represent specific aspects of effectiveness that are appropriate to evaluate the congruence between contextual variables

and responses variables. This research considers new product introduction flexibility (NPF) and product modification flexibility (PMF) as the associated performance outcomes of the congruence between EU and OrM. NPF is operationalized as the number and heterogeneity of new products which are introduced into production without incurring high transition penalties or large changes in performance outcomes (Koste and Malhotra, 1999, p. 81). On the other hand, PMF allows for uncertainties that exist at the time of product design as to which product attributes customers desire, and it gives a potential for implementing minor design changes in a given product (Sethi and Sethi, 1990, p. 312).

Environmental uncertainty and organizational mechanism congruence

As stated by Schoonhoven (1981) the contingency theory asserts that there is no one best way to organize, and any way of organizing is not equally effective under all conditions. All conditions refer here to the different congruencies between OrM and EU. It is intended to measure different congruencies between OrM and EU, and then measure how those different measures of congruence relate with NPF and PMF. Concepts and findings from existing literature are borrowed to operationalize the measure of the congruence between EU and OrM. Venkatraman and Prescott (1990) stated that, if an ideal profile is specified for an environment, a business unit degree of adherence to such an ideal profile will be positively related to performance. Deviation from the ideal profile implies a weakness in environment-structure congruence, resulting in a negative effect on performance. Such deviation is conceptualized as MISALIGN and operationalized as a weighted distance between the ideal profile, in each EU, and the significant OrM variables within such EU, as shown in the Equation (1) derived from Venkatraman and Prescott (1990). To get the evidence of congruence, between a given EU variable and OrM variables, the correlations of the MISALIGN and NPF/PMF should be negative and significant. In other words, the greater the deviation becomes, the lower the performance is.

$$\text{MISALIGN} = \Sigma_{j=1} (b_j (DIST_j))^2 \quad (1)$$

DISTj = the deviations of the business unit score of the j_c-th OrM variable from the regression line L_{sj};

L_{sj} = the best-fitting least-squares line obtained by regressing the calibration sample j_c-th OrM variable on the NPF/PMF score of the calibration sample;

b_j = unstandardized *B* coefficient of the OLS regression equation for the j_c-th OrM variable;

j= 1, n where *n* is the number of OrM variables that are significantly related to NPF/PMF in a given EU.

Hypotheses development and research framework

According to Sousa and Voss (2008), this research adopting a contingency perspective examines the relationships between contextual variables, the use of practices, and the associated performance outcomes. More precisely, contingency theory suggests that when there is a fit between the internal aspects of an organization and the external environment, firm performance should increase. The following hypotheses are stated:

H1: Congruence between high SU and OrM impacts positively (a) NPF and (b) PMF.
H2: Congruence between low SU and OrM impacts positively (a) NPF and (b) PMF.
H3: Congruence between high DU and OrM impacts positively (a) NPF and (b) PMF.

H4: Congruence between low DU and OrM impacts positively (a) NPF and (b) PMF.
H5: Congruence between high TU and OrM impacts positively (a) NPF and (b) PMF.
H6: Congruence between low TU and OrM impacts positively (a) NPF and (b) PMF.

The congruence here is hypothesized considering single contextual variables at a time. This is consistent with Child (1975 and 1977) findings, in his study of manufacturing firms and airlines, affirming that high-performing organizations had structures that were internally consistent, and such consistent organizations adopted structures matched to a single contextual variable. Considering the stated hypothesis based on the contingency theory, the following research framework is built in Figure 1.

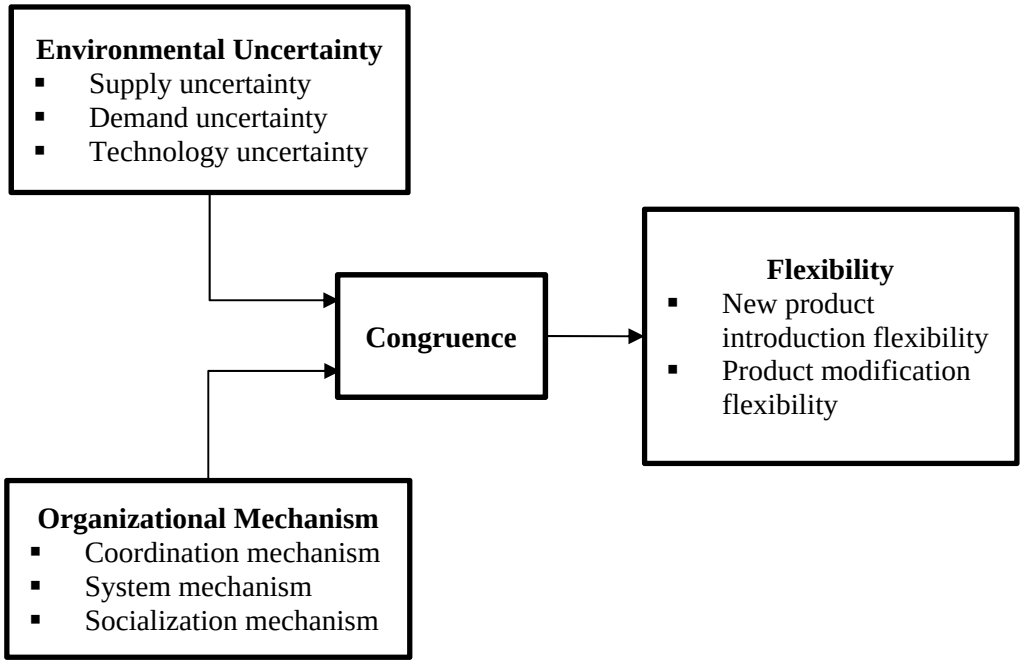

Figure 1 – Research framework

Sampling and data collection

The present research uses the survey method to collect data among the targeted company in Japan from late December 2017 to early April 2018. The targeted companies are listed on the first section of the Tokyo Stock Exchange, and include manufacturing, construction, and service industries. Those companies are targeted for their assumed maturity in term of use of practices. This is consistent with Sousa and Voss (2008) recommendation that the assessment of congruence in Operations Management practices contingency research should concern the match between context and practices when the practices have reached a stable level of development. The mail survey package included the survey instrument, a return envelope with postage pre-paid and an introduction letter to provide a brief description of the research purpose, and to ensure the confidentiality of the data collected. The survey instrument was sent to 2029 companies. Reminding e-mails were sent after approximately two months, and web-survey link was sent as well to increase response rate. Thus, 115 responses were collected, with four non-valid, giving 111 usable responses, corresponding to a response rate of 5.47%. Such relatively low response rate was anticipated due to the fact the survey targeted top level manager, which is consistent with Devaraj et al. (2007).

Questionnaire development

For building the survey questionnaire, the original question items were modified with respect to the unit of analysis, the targeted company business units. Moreover, the instruments were designed with respect to consistent respondents, more precisely the company President, CEO, COO or Head of Business Unit. Finally, with consideration of the measurements scale, all questions in the instruments were designed to be answered with the same Likert scale format. The answers are on a 7-point scale ranging from 1=strongly disagree to 7=strongly agree, with 4=neither agree nor disagree. The modified questionnaire items were finally translated to Japanese, and content validity was assessed by academic people as well.

Measurement validation

The measurement instruments were examined in terms of reliability and unidimensionality. Cronbach' alpha was computed for all the 84 items to assess scale reliability. The generally agreed threshold value of .60, consistent with Flynn et al., (1990) is adopted. Items from SU, RO, PMF, have lower value of Cronbach's alpha, respectively .520, .528, and .521, however they were kept as they are expected to be relevant measure, the other items with alpha lower than 0.6 were discarded. The unidimensionality of the remaining items is examined using factor analysis. The value of 0.5 is used as the factor loadings threshold value, which is consistent with Hair et al. (2006). As the respective items load only on one factor each, and as the loadings range is between .512 and .892, the factor analysis confirmed the items unidimensionality for all thirteen factors.

Hypotheses testing

Table 1 and *Table 2* below show the recapitulations of the MISALIGN score for each environment. The MISALIGN scores are computed with the significant OrM variables in each of the six environments for NPF and PMF.

As mentioned earlier, to get the evidence of congruence, between a given EU variable and OrM variables, the correlations of the MISALIGN and NPF/PMF should be negative and significant. In other words, the greater the deviation from the ideal profile, the lower the performance.

Discussion and implications

This research intends to contribute to the body of knowledge by adopting contingency theory to clarify the impact of congruence between organizational mechanisms and environmental uncertainty on new product introduction flexibility and product modification flexibility.

The result may bring some insight on the issue of the mix findings in the existing literature concerning the impact of practices on performance in the field of Operations Management.

Moreover, by specifying different environments, and conducting analysis by considering a bundle of practices, this research could identify a set of practices that are effective in a given environment with a certain level of uncertainty, but may be not effective in another environment. This is the case for the participation in decision making, which impact significantly of new product introduction when the organization faces high supply uncertainty or high technology uncertainty, but the same practice does not have the same impact when the organization face high demand uncertainty, instead participation in decision making impact on product modification flexibility when the organization is facing high demand uncertainty.

Another interesting result is possibly the unexpected impact of rule observation in none of the environment except the high demand uncertainty environment. This may be explained by the type of rule established. In a certain way, rule observation and formalization process support the orientation of the organization's effort to be more customer oriented in such highly uncertain demand. This is consistent with the observed impact of interdepartmental connectedness on flexibility in almost all levels of uncertainty. This provides more support to the fact that socialization mechanism plays an important role in building ties between department and function inside the company and reducing the gap between what the customers need and what is provided by the organization.

These findings can give important implications to the business practitioners responsible for designing their organizational mechanisms and business processes in the different environments. The organizational mechanisms should be converted dynamically or adjusted continuously for those companies running their businesses in a highly dynamic and uncertain environment.

Table 1 – MISALIGN-NPF correlation

		New Product Flexibility					
		high_SU	low_SU	high_DU	low_DU	high_TU	low_TU
MISALIGN	Pearson Corr.	-.775**	-.665**	-.789**	-.538**	-.783**	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
CFI	b coeff.	.266	-.06	**.298**	-.044	**.275**	.059
	Sig.	.055	*.710*	*.034*	*.758*	*.049*	*.686*
JR	b coeff.	.091	.025	-.032	**.264**	.158	.003
	Sig.	.439	*.846*	*.794*	*.015*	*.145*	.984
JC	b coeff.	-.127	-.037	-.267	-.137	-.129	-.133
	Sig.	.441	*.839*	*.086*	*.435*	*.439*	*.449*
RO	b coeff.	.021	-.025	**.541**	-.166	.254	-.115
	Sig.	.904	*.863*	*.013*	*.151*	*.079*	*.493*
PDM	b coeff.	**.427**	-.163	.226	.129	**.336**	.145
	Sig.	.021	*.370*	*.274*	*.420*	*.035*	*.539*
HOA	b coeff.	.127	.147	.130	-.023	.067	.257
	Sig.	.466	*.341*	*.428*	*.887*	*.628*	*.228*
IDC	b coeff.	.421	.025	**.41**	.155	**.407**	.008
	Sig.	.073	*.532*	*.034*	*.549*	*.038*	*.976*
SeqSoT	b coeff.	.198	.256	.303	-.058	.285	-.237
	Sig.	.248	*.016*	*.115*	*.682*	*.082*	*.212*
		H1a	**H2a**	**H3a**	**H4a**	**H5a**	**H6a**
		Supported	Supported	Supported	Supported	Supported	Not supported

**. Correlation is significant at the .01 level (2-tailed).

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Table 2 – MISALIGN-PMF correlation

		Product Modification Flexibility					
		high_SU	low_SU	high_DU	low_DU	high_TU	low_TU
MISALIGN	Pearson Corr.		-.520**	-.837**			-.594**
	Sig. (2-tailed)		.000	.000			.000
CFI	b coeff.	.209	-.003	.190	.025	.108	0115
	Sig.	*.060*	*.977*	*.107*	*.787*	*.322*	*.243*
JR	b coeff.	-.019	-.123	.001	-.011	.022	-.07
	Sig.	*.851*	*.123*	*.989*	*.881*	*.788*	*.430*
JC	b coeff.	-.214	-.036	**-.312**	-.005	-.058	**-.315**
	Sig.	*.120*	*.777*	*.015*	*.967*	*.658*	*.013*
RO	b coeff.	.016	-.049	.135	-.127	-.010	.049
	Sig.	*.908*	*.611*	*.427*	*.112*	*.922*	*.662*
PDM	b coeff.	.301	-.035	**.402**	-.010	.173	.138
	Sig.	*.092*	*.788*	*.028*	*.934*	*.175*	*.442*
HOA	b coeff.	.008	.081	-.064	.076	.102	-.096
	Sig.	*.955*	*.388*	*.621*	*.493*	*.329*	*.470*
IDC	b coeff.	.099	**.224**	**.322**	-.005	.193	.067
	Sig.	*.616*	*.038*	*.015*	*.977*	*.182*	*.652*
SeqSoT	b coeff.	.084	-.031	.129	.026	.101	-0.05
	Sig.	*.589*	*.829*	*.444*	*.809*	*.465*	*.724*
		H1b	H2b	H3b	H4b	H5b	H6b
		Not supported	Supported	Supported	Not supported	Not supported	Supported

**. Correlation is significant at the .01 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

Conclusions

This research uses the profile deviation approach to identify the feasible set of organizational mechanisms that impact on flexibility under different external conditions associated to different levels of uncertainty, from different sources, suppliers, customers, and the technologies used. Eight different profiles were identified to have positive impact on flexibility. However, further investigation could be conducted by considering a bundle of environmental contexts at a time. Such approach may help to identify which profiles

are consistent and which are not when facing multiple sources of uncertainty at the same time.

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