The Impact of New Technological Practices on Professionalism

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Abstract: This study chooses four technological elements (customized design, modular design, process automation and process flexibility) from among a number of best practices to study their impact on professionalism; Process Automation is related to professionalism at a U-shape form.

Keywords: Customized design, modular design, process automation, process flexibility, Professionalism

I. Introduction

1.1 Best Practices

In the area of Production and Operations management, there are many countermeasures were brought forward and best practices were concluded as quickly as possible, such as TQM(Total quality management) & LP(lean production), WCM (world class manufacturing), AMT(advanced manufacturing technology) & FMS(flexible manufacturing system), MC (Mass customization) & SCM(supply chain management) and so on. Almost all of these best practices are used as strategic weapons once a time in global competition by both researchers and company managers.

Researchers in WCM paid more attentions on the competitive results in global market.
Hayes and Wheelwright (1985) firstly used the term "world-class manufacturing" to express the manufacturing capabilities as a strategic weapon in a global competitive environment, They cited six basic elements of WCM as best practices, including Workforce skills and capabilities, Management technical competence, Competing through quality, worker participation, Rebuilding manufacturing engineering, and Incremental improvement approaches.
And then many scholars follow this research topic with more detailed data survey, but different focused were chosen. Schonberger (1986, 1996) enlarged Hayes and Wheelwright's concept with continuous improvement. Gunn (1987) paid more emphasis on the role of technology in world-class Manufacturing. Schroeder group (Schroeder and some of his co-workers) gave a new name "High Performance Manufacturing" (HPM) based on a four-round research series (Voss & Blackmon,1996; Flynn et al,1997; Flynn et al,1998; Schroeder & Flynn,2001), they addressed six areas of plant management practices: (1) manufacturing strategy, (2) TQM, (3) JIT, (4) human resources (HR), (5) information systems, and (6) technology management.
And more recently, sixteen factors of world class manufacturing (top management commitment, knowledge management, employee training, innovation and technology, employee empowerment, environmental health and safety, supplier management, production planning and control, quality, flexibility, speed, cost, customer involvement, customer satisfaction, customer services and company growth) were developed and tested based on a survey manufacturing industries in India (Digalwar & sangwan, 2007).

Scholars on AMT and FMS investigated computer-aided design (CAD), computer- aided manufacturing (CAM), and computer integrated manufacturing (CIM), computer numerical control (CNC), robotics (R), and other automated technologies. Many researchers have defined various types of manufacturing flexibility and provided methods for measuring them, but there are lots of confusions about FMS (Belassi & Fadlalla,1998), new product design, multiple-function machine , and employee training were recognized as basic source of flexibility (D'Souza & Williams, 2000; Hallgren & Olhager,2009) .
Information system and automated tools are used to provide increasing variety of products and services, there will be some alternative facilities (machines and tools) which can do the same operations but cannot be equally capable to perform same operation, so there are a lot of questions such as operations scheduling and re-sequences, the manufacturing or service operations management system will face the complexity of operations management, which requires more effective design, planning, scheduling and control of operations process on the shop-floor (lack,1983, 1987; Shnits et al,2004;Chan et al, 2007).
And in this topic, most of the researches paid more attentions on the output flexibility of operations system (D'Souza & Williams, 2000).

On 1980s, best practices refer mainly to total quality management (TQM) and Lean production (LP) with cultural differences (Womack et al. 1990; Womack & Jones, 1996). On 1990s, the paradigm shifted to mass customization, which can offer customized product and services with near mass production efficiency and cost， so the operations

system suffer new pressures to be confronted with increasing product variety at almost the same facility. Rajput and Bennett (1989) emphasize the need of greater flexibility, shorter cycle times and reduced inventory levels, the ordinary enabling technologies supporting mass customization are AMTs or FMS (Pine & Victor, 1993; McCarthy, 1997; Da Silveira et al, 2001), excluding information technology, two important technical tools are mentioned publicly, one is modularity (Pine, 1993; Jiao et al 1998; Shilling, 2000; Baldwin & Clark, 2001), another is postponement (Feitzinger & Lee, 1997).

1.2 Best Practices & organizational structure

Even now, there are no confident results about the relationship of the best practices (WCM & HPM, AMT & FMS, LP & MC and so on) and organizational performance and organizational structure. Some scholars believed a positive contribution of best practices to organizational performance (Dean et al., 1992; Gordon & Sohal, 2001; Davies & Kochhar, 2002; Ungan, 2007; Koc & Bozdag, 2009). But other researchers found no relationship or negative contribution (Boyer et al., 1997; Swamidas & Kotha, 1998)

Although, at the very beginning of the researching on all of the best practices, organizational structure and organizational culture are mentioned as important factors to implementation of best practices (Pine,1993; Womack et al., 1990; Schroeder & Flynn,2001), it was found that organization structure (e.g., professionalism of decision making) changes following the introduction of any best practices, but the impacts of best practices on organizational structure from different studies have mixed results---considerable confusion between two alternative patterns, the Marxist perspective believe that the best practices may lead to centralized decision making, and high levels of formalization, and The Idealist perspective think over less differentiation, decentralized decision making, and limited formalization (Dean et al., 1992; Ahlstrom, 1999; Gupta et al.,1997; Ghani & Sugumar, 2002).
Which one is nearer to social reality? Especially, two decades has passed since the important research on AMT and organizational structure with both supports for Marxist and Idealist (Dean et al., 1992).

1.3 New Technological Practices

Why only technological elements of best practices are chosen in this study?

In the history of technology-structure research, empirical studies also supplied a lot of mixed and conflicting results (Scott, 1998). The misunderstanding of technology is one of the important factors (Fry, 1982; Miller, Glick, Wang & Huber 1991).

As soon as the new term of mass customization was given name, product modularity was identified as its main enabler (Pine, 1993).

On the reference to literatures mentioned all above, four concepts (customized design, modular design, process automation and process flexibility) are chosen to represent the new technological practices in this study.
In the field of product technology, customized design (or customer involved design) and modular design are marked phenomena; process automation and process flexibility are emphasized even more than before in the area of operations technology.

2. Model Delineation

This study explores the impacts of four groups of new technological practices on professionalism based on the literature. Organization size, environmental uncertainty, and organization age are used as control variables.

Modular design, in comparison, is based on modular product architecture, the scheme by which a product's functional elements are arranged into physical chunks, including how they interact (Ulrich, 1995).
Automaticity is the degree of automation of equipment, considered the self-acting capacity of a device (Hickson et al., 1969).

Professionalism refers to the level of formal education and training of employees.

The most recent research on best practices and professionalism concludes that advanced manufacturing technology accompanies greater professionalism (Dean et al., 1992). Technological advance and mass customization are positively related to professionalism (Pine, 1993).

H: New Technological Practices are positive related to professionalism.

3. Method and measurement

Our study obtained 374 original questionnaires, 338 were used in this paper. Others were discarded because of too many missing values and mismatched answers on related questions.
According to SIC division structure, 129 samples (38.2%) arise from division D: manufacturing industry, 66 (19.5) from division E: transportation, communications, electric, gas, and sanitary services, 63 (18.6%) from division I: services; 48 (14.2%) from division H: finance, insurance, and real estate. None from division A: agriculture, forestry, and fishing.

From the ownership, there were 174 (51.5%) SOEs (state-owned enterprises), 71(21%) domestic collectively or privately owned enterprises, 76 (22.5%) foreign-invested enterprises, 17(5%) with missing values at the ownership items.

In this study, the items to measure product customization are adopted from the work of (Lin, 2003; Worren et al., 2002; Duray et al., 2000) and enlarged to suit both manufacturing and services.

Modular design is adopted from the items of modularity through fabrication and standardization in the work of Duray et al. (2000). Reliability assessments were made using Cronbach's Alpha coefficients. Product customization achieved a Cronbach's alpha of 0.730; product modularity achieved a Cronbach's alpha of 0.832. These values both exceed the generally agreed upon lower limit of 0.7 (Hair, Anderson, Tatham & Black, 1998, ed.5, P118)

The means of measurement of operations technology in this study are mainly the two-item Amber-Amber automation scale and Aston workflow rigidity.

Our variant of professionalism scale is the level of degree of most staff in average.

4. Results

Table1: Partial correlation

	custom	modular	automa	flexibl	profess
custom	1				
modular	-0.006	1			
automa	-0.044	0.076	1		
flexibl	0.035	0.107	0.057	1	
profess	0.068	-0.002	0.149**	0.069	1

** P<0.05

When the three control variables company size, environmental uncertainty, and company age are controlled only process automation in technology variables is positively related with professionalism significantly at the 5 percent level (See table 1).

Table 2: Regression coefficients in a simple equation*

Model		Unstandardized Coefficients		Standardized	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.587	.345		10.393	.000
	env	-.104	.075	-.099	-1.391	.166
	lsize	-.047	.036	-.098	-1.310	.191
	age	-.003	.003	-.083	-1.173	.242
	custom	.074	.068	.073	1.083	.280
	modular	-.020	.068	-.021	-.295	.768
	automa	.063	.028	.154	2.250	.025
	flexibl	.413	.463	.059	.894	.373

*Regression in enter method.

Table 3: Regression coefficients in a quadratic equation*

Model		Unstandardized Coefficients		Standardized	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.882	.264		14.698	.000
	env	-.119	.072	-.112	-1.652	.100
	lsize	-.056	.035	-.118	-1.619	.107
	age	-.003	.003	-.084	-1.187	.237
	custom2	.012	.054	.014	.217	.828
	modular2	-.022	.043	-.033	-.500	.618
	automa2	.006	.002	.172	2.506	.013
	flexibl2	.447	.572	.052	.781	.436

*Regression in enter method, and only the technological variables are quadratic.

The regression model of professionalism on New Technological Practices in a single equation is significant at the 5 percent level, only process automation significant in the regression model (see table 2).

When we regress professionalism on the squares of four technological variables, and include company size, age and environment as control variables in a enter method, the quadratic model is also significant at 0.05 levels, and one more, only the square of process automation is significant in the regression model(see table 3).

So we us ridge regression method with the single and square of process automation together, and following equation is found:

Professionalism = – .025Automation + .06Automation^2 (R^2 = .003)

The relationship between professionalism and process automation is quite complex. As a non-linear relationship, its form is U-shaped, that exposes both higher process automation and lower process automation which are related to higher professionalism, compared to the middle level automation.

Hypothesis of this study is partly supported. Only process automation is related to professionalism controlled for company size, environmental uncertainty or company age, but no significant relationships are founded between other technological factors and professionalism.

This result partly supports Pine's ideas about specialization and professionalism in mass customization (Pine, 1993).

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