The effect of culture on the relationship between manufacturing strategy and manufacturing practices

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Abstract
The purpose of the article is to investigate the importance that differences in national culture characteristics have in explaining the relationship between competitive priorities and the investments in manufacturing practices. Empirical analyses are based in the GMRG dataset including data from 930 companies distributed in more than 15 countries.

Keywords: National culture; Manufacturing strategy; Manufacturing practices

Introduction
In the last decades attention has been paid on how companies decide to compete through manufacturing, thus on which elements influence their internal strategy. Recently, globalization has increased the role of culture in influencing this managerial area (Prasad and Babbar 2000) and culture has been analyzed under different perspectives, moving from the concept of "corporate culture" (Schein 1984) to that of national culture (Hofstede 1994). Here attention is paid on national culture since *"cultural influences on management are most clearly recognizable at the national level"* (Hofstede 1994).

Specifically, literature has addressed the issue concerning the best practices effectiveness: attention has been paid to the transferability of manufacturing practices from one country to another (Power et al. 2010, Rungutusanatham et al. 2005, Voss and Blackmon 1996 1998) and the key question has been whether manufacturing practices are equally effective across different countries.

The research question we aim to address is: given a specific set of competitive priorities does the plant's national culture moderates the relationship between competitive priorities and manufacturing practices?

The paper is structured as follow: a detailed literature review is provide, in order to allows us to understand why the research question is relevant and thus justifies the described research. The research framework is discussed and the empirical methodology is described. Empirical results are shown and their implications are properly explained. Finally, we draw conclusions and highlight possible areas of future research.

Literature review

The concept of manufacturing practices has attracted the attention of many scholars and researchers over time, leading to development of several perspectives and approaches. Specifically, three main paradigms have emerged: competing through manufacturing (capabilities), strategic choice (fit) and best practices (Voss 1995 2005).

Competing through manufacturing refers to the role of manufacturing as a competitive weapon (Voss 1995): manufacturing strategy should be defined in order to achieve a competitive advantage that is sustainable over time (Hayes and Pisano 1994). Strategic choice (fit) reflects the several choices that a company can make and it is related to the contingency theory "according to which internal and external consistency between manufacturing strategy choices increases performance" (Sousa and Voss 2008). Lastly, the concept of best practice is considered. First of all, manufacturing practices can be considered as an established process that firms have put in place in order to enhance their way to make business (Voss et al. 1997) and are clustered into quality practices, plant and equipment practices, innovation - new product development practices and logistics and concurrent engineering practices (Laugen et al. 2005, Voss et al. 1995 1998). However, in literature there is not a clear definition concerning what best practices are. Two streams of research have arisen: the first defines best practices as those practices that lead to superior performance (Camp 1989) and is related to the concept of the World Class Manufacturing (Hayes and Wheelwright 1984, Schonberger 1986). The second suggests that best practices are those practices adopted by the best performing companies (Davies and Kochhar 2002, Laugen et al. 2005) and take into account the contingency theory approach.

In the Operations Management (OM) literature, the contingency theory has given rise to the Operations Management Practice Contingency Research (OM PCR) addressed to analyze the effectiveness of the best practices adoption on the operational performance (Sousa and Voss 2008). According to these authors contingency variables can be clustered into four categories: (i) firm size, (ii) strategic context, (iii) context variables (iv) national context and culture. Specifically, the importance of national culture is widely recognized within the OM research, and articles dealing with national culture are typically associated to the International Operations Management (IOM) literature.

As suggested by Pagell et al. 2005, the IOM research is increasing in the last years. These authors advocate the relevance of national culture as construct able to explain differences in how, globally, the operations management decisions are carried out. Specifically, national culture is relevant in studies dealing with the best practices effectiveness. The idea behind these studies is that what is "best" in one country might not be so in another (Flynn and Saladin 2004, Vecchi and Brennan 2011, Wacker and Sprague 1998, Voss and Blackmon 1996 1998, Rungutusanatham et al. 2005, Wiengarten et al. 2011).

Several researchers (Cagliano et al. 2011, Flynn and Saladin 2004, Wacker and Sprague 1998, Wiengarten et al. 2011) have assessed national culture through the Hofstede's model (1980). National culture is assessed through four indexes: (i) power distance (PDI), (ii) individualism (IDV), (iii) masculinity (MAS), (iv) uncertainty avoidance (UAI). Each dimension is measured through a score. Power distance reflects the inequity within societies, individualism the attitude of people to act for their own interests, masculinity the degree to which the gender characteristics are well defined and uncertainty avoidance the degree to which people perceive uncertainty situations. Although several cultural models have been proposed, such as the GLOBE project (House et al. 2004) and despite all the criticism (McSweeney 2002), the replicability of the Hofstede's model for management research and its validity, compared to other cultural models, is still remarkable (Merrit 2000, Magnusson et al. 2008). Specifically, Hofstede's model it's been chosen for two reasons: we have decided to replicate Wiengarten et al. 2011 and it is commonly adopted in works concerning national culture comparisons (Magnusson et al. 2008, Merrit 2000).

Starting from these considerations, a scarcely investigated topic is the relationship between competitive priorities and the investments in manufacturing practices. Specifically, the link between strategic choice and best practice reflects the question if best practices are universal or context dependent (Voss 1995) and literature seems to be concentrated in analyzing this aspect by considering the best practices effectiveness. However, a firm must choose its improvement programmes in coherence with its competitive priorities (Hill 1993, Voss 1995) and in today economy, in which manufacturing is "no longer concentrated in one country, but it's spread across the globe" (Dangayach and Deshmukh 2001, p. 908), the fit between manufacturing objectives and the investments in manufacturing practices becomes relevant, advocating the role of the research in order to compare manufacturing strategies and practices across countries with the aim to "identify specific factors responsible for given competitive edge" (Dangayach and Deshmukh 2001, p. 908).

The article aims to contribute to OM PCR with a different point of view: we wish to take into account the relationship between manufacturing strategy and the investments in manufacturing practices. We will adopt the contingency theory approach and the concept of fit as moderation (Venkatraman 1989): the moderating variables will be the national culture Hofstede's indexes.

Research objectives and methodology

The cultural traits might influence how competitive priorities are defined and achieved, as well as the extent through which the investments in manufacturing practices are put in place: the research proposition we formulated is the follow: **RP.** *Given a set of competitive priorities and a set of manufacturing practices, the way through which companies have invested in manufacturing practices changes according to the cultural characteristics of the countries in which companies are operating.*

Data are obtained from the IV round of the GMRG survey, a worldwide project aimed to gather informations about manufacturing practices. Data are gathered among twenty countries and 930 companies. Based on the questionnaire, we were able to collect information concerning companies competitive priorities and investments in manufacturing practices.

The sample (Table 1) is limited to those companies whose answers were valid for the analysis and to those countries for which the Hofstede's indexes are available. Data concerning Albania, Croatia, Fiji, Ghana, Korea, Macedonia and Nigeria were removed, coherently to Wiengarten et al. 2011. We refer to Whybark (1997) for what concern the detail about the survey administration and the scale development.

Table 1 - Sample

Country	N	PDI	IDV	MAS	UAI	Country	N	PDI	IDV	MAS	UAI
Australia	44	36	90	61	51	Ireland	49	28	70	68	35
Austria	14	11	55	79	70	Italy	49	50	76	70	75
Brazil	29	69	38	49	76	Mexico	76	81	30	69	82
Canada	83	39	80	52	48	Poland	57	68	60	64	93
China	56	80	20	66	30	Sweden	24	31	71	5	29
Finland	138	33	63	26	59	Switzerland	30	34	68	70	58
Germany	54	35	67	66	65	Taiwan	47	58	17	45	69
Hungary	50	46	80	88	82	USA	45	40	91	62	46
Sample size: 845 – *Mean of Number employees:* 428											

Competitive priorities were measured through the extent to which goals such as cost (price), quality (conformance to specifications), delivery timeless, product variety-volume, new product design-innovation and environment-safety are evaluated by top management. Companies had to distribute a total score of 100 on these goals in order to describe the relative importance given to the different elements.

Investments in manufacturing practices are evaluated through the extent to which a plant has invested resources in improvement programmes (Laugen et al. 2005, Voss et al. 1995 1998, Wiengarten et al. 2011) over the last two years, coherently with the timeframe in which the survey was administered. Responses are assessed through a likert scale ranging from 1 (not at all) to 7 (to great extent). Two latent factors, named "*investments in manufacturing plant and equipment practices"* and *"investments in manufacturing quality practices"*, have been identified similarly to Wiengarten et al. 2011.

Lastly, national culture was measured through the Hofstede's indexes and the size of company (logarithm of the total number of employees) and the percentage of international ownership have been added as control variables. Each variable were mean centered (Aiken and West 1991, Preacher et al. 2006).

In order to identify strategic groups a taxonomy of manufacturing strategy has been conducted (Miller and Roth 1994). A cluster analysis (k-means) was performed and three manufacturing strategic groups have been identified (Table 2). Companies belonging to the first group ("innovators") are more customer-oriented: they pay great attention to product variety-volume, new product design-innovation and environment-safety. Companies belonging to the second group ("marketeers") are more quality oriented and companies belonging to the third group ("caretakers") are more efficiency oriented. Manufacturing strategic groups are named coherently to Miller and Roth 1994, and each companies has been assigned through a dummy variable to the relative manufacturing strategy group.

Table 2 - Manufacturing strategic groups

Manufacturing strategic group	Innovators (n=439) 51.9%	Marketeers (n=246) 29.11%	Caretakers (n=160) 18.93%	F-value; P-value
Cost				
Mean	18.88	22.45	49.01 (2;3)	795.19
Rank	2	2	1	0.0000
SE	6.85	8.58	11.09	
Quality				
Mean	19.71	35.8(1;3)	18.56	409.77
Rank	1	1	2	0.0000
SE	5.28	10.16	8.24	
Delivery timeliness				
Mean	18.24	18.89	13.13(1;2)	25.46
Rank	3	3	3	0.0000
SE	8.04	10.19	7.29	
Product Variety-Volume				
Mean	13.31 (2;3)	6.94	6.95	91.05
Rank	6	6	4	0.0000
SE	7.99	5.52	5.04	
New Product Design-Innovation				
Mean	15.82(2;3)	7.54	6.48	141.42
Rank	4	5	5	0.0000
SE	8.93	5.52	5.78	
Environment-Safety				
Mean	14.01(2;3)	8.33(3)	5.84	112.51
Rank	5	4	6	0.0000
SE	7.35	6.57	4.36	

Empirical analysis and results

The research proposition is tested through a set of OLS models where clusters are independent variables ("caretakers" is the reference group), manufacturing practices the dependent ones and the Hofstede's indexes the moderators. A simple slope analysis at low level of the moderator (one SD below the mean) and at high level of the moderator (one SD above the mean) is been implemented in order to understand the interaction effect (Aiken and West 1991, Preacher et al. 2006). VIF is always lower than 4 on a cut-off point between 5 and 10 (Hair et al. 1998, Menard 2002, Neter et al. 1989) whereas the condition index is on average below 6 (Besley et al. 2004). Therefore, multicollinearity is not an issue for any model.

Table 3 shows that both "innovators" and "marketeers" have significantly invested in manufacturing plant and equipment practices and doesn't shows a statistical significance for what concern the extent through which the same companies have invested in quality programmes (in comparison with the "caretakers" organizations).

Concerning the relationship between manufacturing plant and equipment practices and competitive priorities, the two way interaction term concerning MAS and "innovators" is weakly significant (Table 7) and the simple slope (Figure 4) is significant for high level of masculinity ($\beta_{SLOPE-MAS}$= 0.3585, p-value=0.005). Concerning the relationship between the manufacturing strategic groups and the investments in manufacturing quality practices, the two way interaction term concerning PDI (Table 4), IDV (Table 5), UAI (Table 6) and "innovators" is significant. Figure 1 and Figure 2 shows how "innovators" have invested less in manufacturing quality practices when PDI is low ($\beta_{SLOPE-PDI}$= -0.3463, p-value=0.0058) and when IDV is high (β_{SLOPE-}

$_{IDV}$= -0.3109, p-value=0.0056), whereas Figure 3 shows how "innovators" have invested less in manufacturing quality practices when UAI is low ($\beta_{SLOPE-UAI}$= -0.227, p-value=0.069).

Table 3 – Results: Universal Model

	Manufacturing plant and equipment practices		**Manufacturing quality practices**	
Size	0.18***	(0.024)	0.26***	(0.022)
International ownership	0.15*	(0.082)	0.35***	(0.078)
Innovators Vs Caretakers	0.26***	(0.092)	-0.09	(0.087)
Marketeers Vs Caretakers	0.24**	(0.102)	0.05	(0.096)
Constant	-0.21***	(0.070)	0.03	(0.075)
Number of Obs	763		753	
R-squared	0.1039		0.2112	
Adj R-squared	0.0992		0.2070	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 4– Results: PDI

	Manufacturing plant and equipment practices				**Manufacturing quality practices**			
Size	0.19***	(0.024)	0.20***	(0.024)	0.24***	(0.023)	0.24***	(0.022)
International ownership	0.14*	(0.082)	0.14*	(0.083)	0.36***	(0.077)	0.35***	(0.077)
Innovators Vs Caretakers	0.25***	(0.092)	0.26***	(0.093)	-0.05	(0.086)	-0.01	(0.086)
Marketeers Vs Caretakers	0.25**	(0.102)	0.27***	(0.102)	0.02	(0.095)	0.05	(0.094)
PDI	-0.003*	(0.002)	-0.005	(0.005)	0.009***	(0.001)	-0.001	(0.004)
PDI x Innovators			0.005	(0.005)			0.017***	(0.005)
PDI x Marketeers			-0.002	(0.006)			0.003	(0.005)
Constant	-0.22***	(0.079)	-0.22***	(0.079)	0.04	(0.074)	0.03	(0.074)
Number of Obs	763		763		753		753	
R-squared	0.1080		0.1116		0.2365		0.2533	
Adj R-squared	0.1022		0.1034		0.2314		0.2463	
R-squared change	0.0042*		0.0036		0.025***		0.016***	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

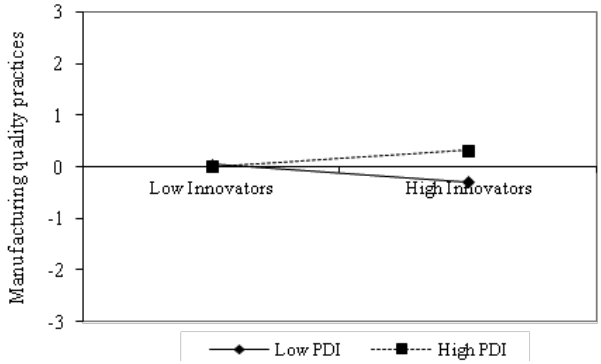

Figure 1 - Interaction slopes: Investments in quality practices and PDI

Table 5– Results: IDV

	Manufacturing plant and equipment practices				Manufacturing quality Practices			
Size	0.16***	(0.025)	0.16***	(0.025)	0.22***	(0.023)	0.22***	(0.023)
International ownership	0.15*	(0.082)	0.15*	(0.082)	0.35***	(0.076)	0.35***	(0.076)
Innovators Vs Caretakers	0.24***	(0.092)	0.22**	(0.094)	-0.12	(0.085)	-0.08	(0.087)
Marketeers Vs Caretakers	0.21**	(0.101)	0.19*	(0.103)	-0.008	(0.094)	0.03	(0.095)
IDV	-0.004***	(0.001)	-0.009**	(0.003)	-0.010***	(0.001)	-0.003	(0.003)
IDV x Innovators			0.004	(0.004)			-0.01**	(0.004)
IDV x Marketeers			0.006	(0.004)			-0.005	(0.004)
Constant	-0.19**	(0.079)	-0.16**	(0.082)	0.08	(0.073)	0.04	(0.075)
Number of Obs	763		763		753		753	
R-squared	0.1149		0.1172		0.2592		0.2656	
Adj R-squared	0.1091		0.1090		0.2542		0.2587	
R-squared change	0.011***		0.0023		0.047***		0.006**	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

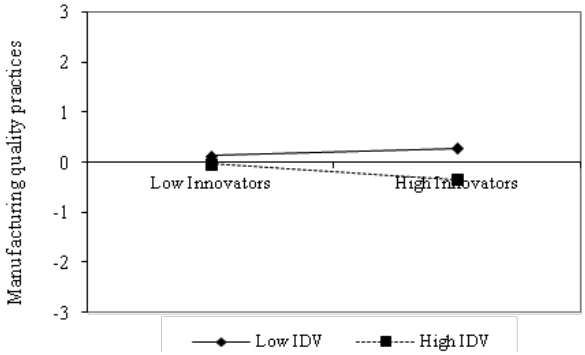

Figure 2 - Interaction slopes: Investments in quality practices and IDV

Table 6– Results: UAI

	Manufacturing plant and equipment practices				Manufacturing quality Practices			
Size	0.17***	(0.024)	0.18***	(0.024)	0.26***	(0.023)	0.27***	(0.022)
International ownership	0.08	(0.084)	0.07	(0.084)	0.35***	(0.080)	0.35***	(0.080)
Innovators Vs Caretakers	0.23***	(0.092)	0.23**	(0.092)	-0.09	(0.088)	-0.08	(0.087)
Marketeers Vs Caretakers	0.23**	(0.101)	0.22**	(0.101)	0.052	(0.096)	0.04	(0.096)
UAI	-0.007***	(0.001)	-0.01**	(0.004)	-0.0007	(0.001)	-0.002	(0.004)
UAI x Innovators			0.0059	(0.005)			0.008*	(0.004)
UAI x Marketeers			0.0028	(0.005)			-0.005	(0.005)
Constant	-0.20***	(0.079)	-0.19**	(0.079)	0.03	(0.075)	0.04	(0.075)
Number of Obs	763		763		753		753	
R-squared	0.1192		0.1209		0.2114		0.2227	
Adj R-squared	0.1134		0.1127		0.2072		0.2154	
R-squared change	0.0153**		0.0017		0.0002		0.0112***	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

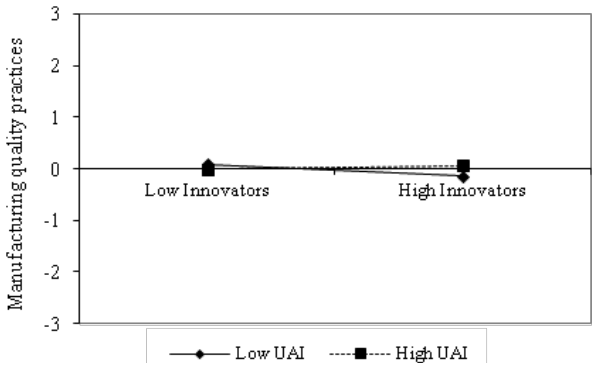

Figure 3 - Interaction slopes: Investments in quality practices and UAI

Table 7– Results: MAS

	Manufacturing plant and equipment practices				**Manufacturing quality Practices**			
Size	0.19***	(0.024)	0.18***	(0.024)	0.26***	(0.022)	0.25***	(0.022)
International ownership	0.15*	(0.082)	0.16*	(0.082)	0.34***	(0.077)	0.36***	(0.077)
Innovators Vs Caretakers	0.20**	(0.097)	0.14	(0.103)	0.036	(0.091)	0.021	(0.096)
Marketeers Vs Caretakers	0.23**	(0.101)	0.17	(0.112)	0.072	(0.095)	0.078	(0.105)
MAS	-0.003**	(0.001)	-0.012**	(0.005)	0.007***	(0.001)	0.002	(0.004)
MAS x Innovators			0.01*	(0.005)			0.008	(0.005)
MAS x Marketeers			0.007	(0.006)			-0.003	(0.006)
Constant	-0.18**	(0.081)	-0.113	(0.089)	-0.025	(0.076)	0.016	(0.083)
Number of Obs	763		763		753		753	
R-squared	0.1088		0.1133		0.2294		0.2367	
Adj R-squared	0.1029		0.1051		0.2242		0.2295	
R-squared change	0.0049**		0.0045		0.0181***		0.0073**	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1								

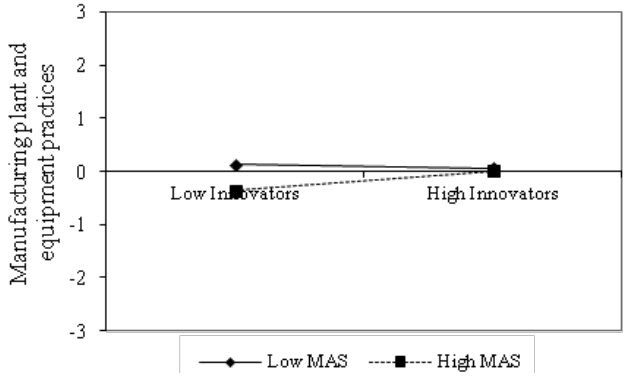

Figure 4- Interaction slopes: Investments in manufacturing plant and equipment practices and MAS

Discussion and conclusion

Results have shown how the cultural traits moderate the relationship between competitive priorities and the degree through which companies have invested in manufacturing practices. Specifically, the more a company aims to be an "innovator" the more the cultural characteristics should be taken into account.

A "compensation" mechanism is suggested (Vecchi and Brennan 2011): innovators aim to be costumer-oriented and companies might have invested coherently with the cultural

characteristics of the plants in order to mitigate the cultural traits, that might inhibit the global competitiveness.

Let's consider the investments in manufacturing plant and equipment practices. The stronger competition that characterized an high MAS country, may have conducted companies to invest to a greater extent in such practices in order to guarantee more flexibility and more attention to the customer's needs rather than to the competitors' behavior. Similarly, investing in quality programmes might be a strategy put in place with the aim to reduce the issues concerning a highly centralized power. Emphasis on quality might enhance the degree to which employees perceive this priority as well as standardization might conduct employees to be more autonomous and to solve the issues on their own. Moreover, "innovators" have invested lower in manufacturing quality practices when UAI is low, indeed to invest in these practices means to invest in standardization that might "compensate" the lack of clarity that an high UAI environments involves (Flynn and Saladin, 2006, Wiengarten et al. 2011). Lastly, "innovators" have invested less in quality programmes in more individualistic countries: this result is consistent to the fact that the effectiveness of quality programmes is negative related to individualism (Anwar and Jabnoun 2006, Flynn and Saladin 2006).

The article has shown how the more companies aim to be "innovators" the more the cultural traits should be taken into account. However, data doesn't allow us to understand the specific decision making process that companies adopt when decide how to invest in manufacturing practices. Future studies could provide interesting inside on this issue.

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