An International Study on Manufacturing Competitive Priorities

Marvin E Gonzalez
College of Charleston

Gioconda Quesada
College of Charleston

Carlo Mora-Monge
New Mexico State University

This study presents the results of an ongoing worldwide study in manufacturing competitive priorities. The main objective of this study is the examination of manufacturing competitive priorities, strategic directions and concerns of manufacturers around the world and to establish if differences exist among continents with regards to manufacturing strategy implementation. Data on the levels of adoption and relative payoff of strategic manufacturing-related activities, strategy integration and company performance priorities were analyzed to test for differences among continents. Results show that North America and Asia lead on manufacturing competitive priorities when compared to the rest of the continents.

INTRODUCTION

There has been a growing interest of manufacturing practices as a competitive factor for manufacturers worldwide. According to Avella et al., 2001 and Ardishvili and Hill, 1993 the importance on certain manufacturing competitive priorities and decisions or practices (on the key decision areas) and their internal consistency can represent the basis for achieving sustainable or lasting advantages over competitors, thus originating superior business performance. Regardless of the importance manufacturing strategy and the key role it plays on business performance, a few research is known with respect to the priority assignment of those strategies in order to understand the best manufacturing competitive priorities. Moreover, little evidence exist on the priority assignment to manufacturing strategy practices around different regions of the world. Therefore, we intend to close this gap by analyzing and comparing manufacturing practices among different regions in the world. Using a sample of 700 firms that span 23 countries, we investigate strategic differences among these regions.

Manufacturing strategy research has been criticized over the time for the lack of progress in aspects as; theory building, empirical studies and integration with other previous research (Ho, 1996; Leong et al., 1990; Martin-Pena and Diaz-Garrido, 2008). Recently, there has been an increase in the development of new theories and the design of empirical studies in the area. However, those studies lack the richness that a multi-country study could bring into the picture. In consequence, one of the strengths of this empirical

study is that we use a large sample size in many countries around the world and therefore, we can reach to conclusions that can be statistically significant comparing results among continents.

Some researchers consider manufacturing strategy from two perspectives: content and process ((Dangayach and Deshmukh, 2001; Swink et al., 2005; Minor III et al., 1994). In order to use and understand these two perspectives some tools and methods have been developed. An important fact is to understand the difference between the two perspectives. Slack, 1994, define the content of manufacturing strategy as "comprise[s] the specific decisions and actions which set the operations' role, objective and activities". Others authors like Acur et al., 2003 assure that a lot has been written on the content of manufacturing strategy, the majority being focused on a single content area. The process of manufacturing strategy makes an emphasis in the strategic formulation and in the justification and implementation of strategic decisions (Swink and Way, 1995; Sin-Hoon and Lay-Hong, 1996). Karim et al., 2008 shows an empirical study in Australia where they analyze different manufacturing competitive priorities. It is our intent to provide a wider sample of different countries to understand manufacturing practices in a global perspective.

Our contribution to the manufacturing strategy research from this study is to identify the strategic manufacturing practices among manufacturers worldwide, and identify differences, if any, among continents.

The paper is presented as follows. First, the background and literature review of the research is presented. Second, the research methodology is explained. Third, an analysis of the results is presented. Finally, the main contributions of the research are discussed.

BACKGROUND AND LITERATURE REVIEW

Manufacturing strategy is affected by a number of factors including global competition, rapidly changing technology (both product and process), shorter product life cycles, use of quality as a strategy, shorter time to market for new products, demands for increased production flexibility, "bundling" of options (variety in sets), design for manufacturability/ assembly/quality, Taguchi experimental design methods, group technology and cellular layout, new approaches to workforce teamwork and motivation (including self-directed teams), computerized dynamic scheduling systems, and the various elements of computer integrated manufacturing (Gonzalez et al., 2004; Kotha and Swamidass, 2000; Brown et al., 2007; Acur et al., 2003; Mikko and Schroeder, 2004). As evidenced by these factors, manufacturing strategy is complex and diverse in nature. While there is no generally accepted definition of manufacturing strategy, there are several definitions that use a single term to describe the broad concept of manufacturing strategy.

Theorists usually have the same opinion that strategy refers to the long-term future of the whole company, not its parts (Hayes and Upton, 1998; Hayes and Pisano, 1996 Peter T. Ward and Duray, 2000; Hongyi and Cui, 2002; Weir and Kochhar, 1999). Moreover, it is also usually accepted that strategy is about achieving a "unique positioning of a company in the market" (Ardishvili and Hill, 1993). Taking these contributions on strategic management and manufacturing strategy as points of reference, we view manufacturing strategy in this paper as a management discipline and argue that because it is affected by numerous factors previously mentioned; differences do exist in different regions of the world.

The content aspect of manufacturing strategy can be traced back to Skinner's significant paper, which describes the use of manufacturing as a competitive weapon, as opposed to a function that is passive with respect to its aggressive environment (Skinner, 1969; Chan, 2005; Vokurka and Davis, 2004). Between 1950 and 1960, researchers were concerned in industrial and factory management. In the middle of the 60s and 1970s the range was broadened to operations management. After that, in the 1980s, operations strategy began to appear as a functional field of management (Acur et al., 2003). Today, manufacturing is recognized as tactically important and operations management is becoming more integrated with other areas of research (Kapiriri and Martin, 2007; Christiansen et al., 2003; Dangayach and Deshmukh., 2001 and Acur et al., 2003).

Despite the pivotal role of manufacturing, previous research has pointed out different reasons as to why industries have not brought the manufacturing concept into play in their corporate strategy. Some claim that the powerful instincts and mind-sets associated with the conventional functional organization of business had simply been cloned into generations of managers while others blame missing conceptual links in the theory of manufacturing strategy (Skinner, 1969). Hill, 1995, meanwhile, has asserted that the misalignment between manufacturing and business can be responsible on two misconceptions: (1) Manufacturing is everything. (2) Manufacturing contributes to the accomplishment of efficiency, not to the effective support of market needs.

In order to understand these misconceptions, a number of different research efforts investigated the content of manufacturing strategy, viewing it as the basis for strategic choices related to processes and infrastructure. Fine and Hax, 1985; Hayes and Wheelwright, 1984 and Hull and Wu, 1997 maintain that a company's competitiveness depends on the ability to choose the appropriate, i.e. market-relevant, corporate and operational objectives. Companies should focus on narrow, specific strategy, the heart of which is their specific market. Therefore, we are presenting a study that will fulfill the need of global empirical studies focused on understanding manufacturing practices worldwide and finding differences, if any, among continents.

Research Variables

The present study focus on manufacturing competitive priorities worldwide, by analyzing the following constructs:

Strategy Integration (SI)

We defined strategy integration (SI) with four items where respondents were asked to indicate on a 5-point Likert scale: a) the extent to which the organization translates corporate/business goals into a manufacturing strategy, b) the extent to which the organization translates marketing goals into a manufacturing strategy, c) the extent to which manufacturing influence the development of corporate/business strategies and goals and d) the extent to which manufacturing influence the development of marketing strategies and goals.

Level of Adoption of Manufacturing-Related Activities (LAMRA)

To measure the level of adoption of Manufacturing-Related Activities (LAMRA), 37 items were used and grouped into nine different factors. Respondents were asked to answer in a 5-point Liker scale the degree of use of manufacturing-related activities. The factors that emerged from the factor analysis are: process automation, production organization, management practices, lean manufacturing, IT applications, green programs, new product development, process control and IT infrastructure.

Relative Payoff of Manufacturing-Related Activities (REPAMRA)

As in the previous case, the 49 items used for the level of adoption of manufacturing-related activities grouped in 9 variables are used for relative payoff of manufacturing-related activities (REPAMRA). However, as we will see, the results differ from level of adoption to relative payoff. This can be explained by a non-linear relationship between these two variables, which can be further explored in future research.

Company Performance Priorities (COPER)

This construct consisted of 17 items related to company performance priorities grouped in 5 factors. This construct captures performance measurement in an organization. A brief description of the 5 variables is given below. Lean manufacturing is a variable composed by average unit manufacturing costs, materials and overhead total costs, manufacturing lead time, delivery lead time, supplier quality and worker/direct labor productivity. Green performance is formed by items that concern with environment protection such as energy consumption, product recyclability and waste/by-product recyclability. New product development contains aspects such as product variety, speed of product development and number of new products developed. Company-wide performance refers to return on investment, equipment

changeover time and inventory turnover (sales/inventory). Finally, the last variable under company performance priorities is customer satisfaction measured by the customer service (after sales and/or technical support) and customer satisfaction. All of these measures were obtained using a 5-point Likert scale, where 1 is very important to measure and 1 is very low importance for measuring the performance item in the organization.

Research Questions

The research questions to be answered here can be summarized as follows:

- Are there differences among continents in the level of adoption of strategic manufacturing-related activities (LAMRA)?
- Are there differences among continents in the relative payoff of strategic manufacturing-related activities (REPAMRA)?
- Are there differences among continents in the strategy integration level (SI)?
- Are there differences among continents in the company performance priorities (COPER)?

In case we find differences among continents in any of the four constructs, we will perform ANOVA for the different variables in those constructs and finally, t-tests on the item level until we find real causes of the differences. The results from this study will show us the effect of cultural issues in the manufacturing strategy practices and priorities. And also, will help us determining best practices for manufacturing strategy in a global perspective.

DATA COLLECTION

Survey Instrument

The data used in this study was drawn from the International Manufacturing Strategy Survey II (IMSS II). The London Business School and Chalmers University (Sweden) initiated the IMSS to study manufacturing strategies on a global scale and to establish a common database on manufacturing strategies, practices and results.

Sample

The survey was distributed in 23 countries worldwide. Plant managers were targeted as the appropriate respondents since they are most familiar with their plant's operating practices and performance outcomes. Of the 5,000 mailed surveys, 700 completed surveys were returned, which corresponds to a 14% response rate. The sample is distributed by continent as follows: Asia (123), Europe (304), North America (110), Australia (87) and South America (76). Detailed distribution of respondents by country is presented in Table 1.

TABLE 1
SAMPLE DISTRIBUTION BY CONTINENT AND BY COUNTRY

Continent	Country	Frequency	Total
North America	Canada	40	110
	Mexico	29	
	USA	41	
Europe	Denmark	27	304
	Finland	14	
	Germany	28	
	Hungary	38	
	Italy	71	
	Netherland	29	
	Norway	13	
	Spain	33	
	Sweden	27	
	UK	24	
Australia	Australia	55	87
	New Zealand	32	
Asia	China	30	123
	HongKong	14	
	Japan	29	
	South Korea	50	
South America	Argentina	31	76
	Brazil	27	
	Chile	10	
	Perú	8	

The data cover firms classified by the ISIC (rev. 2) Division 38 – Manufacture of Fabricated Metal Products, Machinery and Equipment (this is equivalent to the current ISIC (rev. 3.1) sectors 28–35). The actual SIC codes were selected from the companies in the 3400 to 3700 range of industries, which represents fabricated metal products, industrial machinery and equipment, electronic and other electric equipment, and transportation equipment. Table 2 shows the distribution of SIC codes in this study.

TABLE 2 SAMPLE DISTRIBUTIONS BY SIC CODE

SIC Code Description	Frequency	Percent
Manufacture of metal products, except machinery & equipment	208	29.7
Manufacture of machinery, except electrical	100	14.3
Man.of electrical equipmet. apparatus,appliances and supplie	157	22.4
Manufacture of transportation equipment	83	11.9
Man.professional & scientific & measuring & controlling equipment	48	6.9
Other	104	14.9
Total	700	100

According to the responses to the demographic question regarding plant size, South America, Australia and Europe present an average of smaller plant sizes (less than 800 employees) compared to North America and Asia (more than 3,000 employees). The average plant size for the whole sample is 1,884 employees. A summary of these demographics is depicted in Table 3.

TABLE 3
SAMPLE DISTRIBUTIONS BY COMPANY SIZE AND BY CONTINENT

Continent / Size	SMEs	Large	Missing
North America	12 (11%)	82 (75%)	16 (15%)
Europe	89 (29%)	183 (60%)	32 (11%)
Australia	64 (74%)	15 (17%)	8 (9%)
Asia	24 (20%)	80 (65%)	19 (15%)
South America	20 (26%)	27 (36%)	29 (38%)
Total	209	387	104
Percentage	30%	55%	15%

As can be seen in Table 3, North America, Europe and Asia show higher percentages of large firms (75%, 60% and 65% respectively) than South America (36%) and Australia (17%). We used the widely accepted cut-off point of 250 employees to split the sample between SMEs and large firms (Caloghirou et al., 2004).

ANALYSIS AND RESULTS

We began the measurement analysis by first establishing the convergent validity and discriminant validity of the four key constructs – strategy integration (SI), level of adoption of manufacturing-related activities (LAMRA), relative payoff of manufacturing-related activities (REPAMRA) and company performance priorities (COPER). The researchers then proceeded to assess the instrument's reliability or the ability of its scales to consistently yield the same response. Then, we assessed construct validity or extent to which the items in the scale measured one dominant dimension. Once the scales were determined to be reliable and valid, a comparison analysis was conducted. The comparison among different continents (North America, South America, Europe, Australia and Asia) was done using ANOVA.

If differences were identified, we then performed another ANOVA for the variables within the significantly different constructs. And finally, we performed t-tests between the pair of continents that showed statistical differences in the corresponding variables of the constructs. This type of analysis is an approach from general to specific, which help us in exploring to the deepest level (items) what differences exist among continents.

TABLE 4
RESULTS OF FACTOR AND RELIABILITY ANALYSIS

Construct		Item Description	Factor Loading*		Cronbach's Alpha	
Strategy Integration (SI)	Extent to which…					
		the organization translates corporate/business goals into a manufacturing strategy	0.747		0.760	
		the organization translates marketing goals into a manufacturing strategy	0.765			
		manufacturing influence the development of corporate/business strategies and goals	0.787			
		manufacturing influence the development of marketing strategies and goals	0.752			
Level of Adoption (LAMRA) and Relative Payoff (REPAMRA) of Manufacturing Related Activities			Level of Adoption (LAMRA)	Relative Payoff (REPAMRA)	Level of Adoption (LAMRA)	Relative Payoff (REPAMRA)
	Process Automation	single minute exchange of dies (SMED)	0.544	0.623	0.810	0.828
		robotics	0.586	0.745		
		automated tool changes	0.614	0.641		
		automated parts loading/uploading	0.676	0.770		
		automated storage/retrieval systems (AS/RS)	0.697	0.768		
		automated guided vehicles (AGVs)	0.661	0.682		
	Production Organization	materials requirement planning (MRP)	0.794	0.647	0.795	0.797
		manufacturing resource planning (MRP II)	0.739	0.659		
		pull scheduling (i.e. Kanban)	0.593	0.632		
		design for assembly/manufacturability (DFA/DFM)	0.362	0.690		
		value analyses/redesign of products	0.357	0.702		
		reorganize to "plant-within-a-plant"	0.647	0.560		
		business process reengineering (BPR)	0.563	0.713		
	Management Practices	benchmarking	0.305	0.629	0.769	0.766
		simultaneous/concurrent engineering	0.688	0.725		
		defining a manufacturing strategy	0.662	0.703		
		implementing team approach (work groups)	0.612	0.748		
		total preventive maintenance (TPM)	0.315	0.733		
	Lean Manufacturing	total quality management (TQM)	0.461	0.707	0.809	0.823
		statistical process control (SPC)	0.389	0.691		
		zero defects programs	0.483	0.735		
		continuous improvement (Kaizen)	0.403	0.723		
		just-in-time (JIT) manufacturing / lean production	0.765	0.666		
		just-in-time (JIT) / frequent deliveries to customers	0.693	0.705		
	IT Applications	computer-aided manufacturing (CAM)	0.662	0.903	0.788	0.773
		computer-integrated manufacturing (CIM)	0.529	0.903		
	Green Programs	energy conservation programs	0.628	0.764	0.701	0.717
		environmental protection programs	0.689	0.850		
		health safety programs	0.710	0.786		
	New Product Development	quality function deployment (QFD)	0.760	0.894	0.768	0.772
		quality policy deployment (QPD)	0.777	0.894		
	Process Control	computer-aided engineering (CAE)	0.406	0.889	0.702	0.766
		computer-aided design (CAD)	0.444	0.889		
	IT Infrastructure	local area networks (LAN)	0.532	0.852	0.752	0.701
		wide area networks (WAN)	0.597	0.734		
		shared databases	0.319	0.780		
Company Performance Priorities (COPER)	Please indicate the importance of measuring the following performance items:					
	Lean Manufacturing	average unit manufacturing costs	0.622		0.735	
		materials and overhead total costs	0.729			
		manufacturing lead time	0.603			
		delivery lead time	0.587			
		supplier quality	0.465			
		worker/direct labor productivity	0.501			
	Green Performance	energy connsumption	0.707		0.778	
		product recyclability	0.813			
		waste-by-product recyclability	0.840			
	New Product Development	product variety	0.680		0.758	
		speed of product development	0.778			
		number of new products developed	0.825			

*Factor loadings of 0.3 are considered significant for a large sample size (Hair, Anderson, Tatham et al. (1998))

Reliability and Validity of the Scales

A confirmatory factor analysis was conducted to address the convergent and discriminant validity of the constructs. Results are presented in Table 4. We examined the convergent and discriminant validity of the key constructs -strategy integration with 4 indicators, level of adoption of manufacturing related activities with 39 indicators and company performance priorities with 24 indicators. The criteria for dropping indicators from the analysis include eliminating those indicators that contained communalities lower than 0.5 and factor loadings less than 0.6. In case the communalities were higher than 0.5, then we followed the criteria for the statistical significance of factor loadings described by Hair et al., 1998. Having a valid sample size greater than 350 in all tested items, we could consider statistically significant factor loadings higher than 0.30. However, most factor loadings presented values higher than 0.5. From this first screening of the data, we dropped some indicators from further analysis. The corresponding deleted indicators for the different constructs are: 2 indicators from level of adoption of manufacturing-related activities and 2 indicators from company performance priorities. All those items that did not fit the criteria were subsequently dropped from further analysis.

Then, our focus was turned to examine more closely the reliability and validity of the scales. We accepted the results of the confirmatory analysis and left out the 4 indicators that lacked convergent validity. We examined the internal consistency of all constructs first by a factor analysis, and second, by reliability testing of Cronbach's alpha. According to this criterion, all the items that reached this point are accepted based on the previous analyses.

ANOVA Results

Table 5 contains the results obtained from the analysis of variance (ANOVA). The table presents descriptive statistics (mean and sample size) for each of the constructs in different continents. Then, on the right, it presents the p-values of the post-hoc ANOVA results. The following section of the paper discusses these results.

TABLE 5
ANOVA RESULTS FOR CONSTRUCT DIFFERENCES AMONG CONTINENTS

Construct	Continent	N	Mean	Std Deviation	p-values				
					North America	South America	Asia	Australia	Europe
Strategy Integration (SI)	North America	103	3.44	0.786	-	0.924	0.000*	1.000	0.008*
	South America	73	3.35	0.903	0.924	-	0.000*	0.933	0.286
	Asia	122	3.93	0.744	.000*	0.000*	-	0.000*	0.000*
	Australia	86	3.44	0.77	1.000	0.933	0.000*	-	0.016*
	Europe	300	3.15	0.72	.008*	0.286	0.000*	0.016*	-
	Total	684	3.39	0.809	-	-	-	-	-
Level of Adoption of Manufacturing-Related Activities (LAMRA)	North America	101	3	0.816	-	0.001*	0.189	0.001*	0.001*
	South America	71	2.52	0.822	.001*	-	0.000*	0.999	0.769
	Asia	121	3.23	0.759	0.189	0.000*	-	0.000*	0.000*
	Australia	85	2.55	0.835	.001*	0.999	0.000*	-	0.883
	Europe	299	2.64	0.752	.001*	0.769	0.000*	0.883	-
	Total	677	2.77	0.82	-	-	-	-	-
Relative Payoff of Manufacturing Related Activities (REPAMRA)	North America	99	3.25	0.838	-	0.000*	0.930	0.000*	0.016*
	South America	68	2.67	0.889	0.000*	-	0.000*	0.974	0.050
	Asia	120	3.33	0.76	0.930	0.000*	-	0.000*	0.000*
	Australia	83	2.6	0.765	.000*	0.974	0.000*	-	0.002*
	Europe	290	2.96	0.751	.016*	0.050	0.000*	0.002*	-
	Total	660	3	0.819	-	-	-	-	-
Company Performance Priorities (COPER)	North America	104	3.78	0.633	-	0.933	0.023*	0.006*	1.000
	South America	64	3.85	0.558	0.933	-	0.382	0.002*	0.860
	Asia	119	4.01	0.613	.023*	0.382	-	0.000*	0.002*
	Australia	81	3.49	0.491	.006*	0.002*	0.000*	-	0.001*
	Europe	285	3.78	0.55	1.000	0.860	0.002*	0.001*	-
	Total	653	3.79	0.586	-	-	-	-	-

*Significant at 0.05 level.

Strategy Integration (SI)

As indicated by Table 5 Asia presents higher scores than the rest of the continents in all items for SI. We also see found significantly higher scores in all items in North America when compared to Europe. Finally, Europe is significantly lower than Australia in the extent to which manufacturing influence both in the development of corporate/business strategies and goals and in the development of marketing strategies and goals. The findings that indicate higher scores in Asia may be due to the enormous pressure from Asia to respond to today's volatile and highly diversified market demands that are creating more and more competitive environments where only agile, flexible, cost efficient and high quality producers can survive. Those who define their strategies in a unified way, from marketing to manufacturing to corporate goals and strategies are the companies seeking for world-class manufacturing practices. Results also show that opportunities exist for European companies, since they scored less in this construct. European companies should focus more in integrating their strategy definition and in consolidating their goal definitions and translating them into corporate strategies.

Level of Adoption of Manufacturing-Related Activities (LAMRA)

The continents that had higher results are Asia and North America. Further analyses were done to find out that no significant differences are present between the following pairs of continents: North America and Asia, South America and Europe, South America and Australia and finally, Australia and Europe. For simplicity, we formed 2 groups for further analyses in this construct: group 1 (North America and Asia) and group 2 (South America, Australia and Europe). Using these groups, we performed t-tests to find out in which variables and items are significantly different. The results are presented in the following paragraphs.

Process automation is related to those activities such as single minute exchange of dies (SMED), robotics, automated tool changes, automated parts loading/unloading, automated storage/retrieval systems (AS/RS) and automated guided vehicles (AGV's). In these activities, the respondents showed that group 1 is implementing them more frequently than group 2. However, the mean values are not high (2.52 to 3.23), therefore, we could conclude that the degree of use of process automation activities is relatively low in all continents, even more for the three continents that correspond to group 2. Production organization is a variable that contains items such as materials requirement planning (MRP), manufacturing resource planning (MRP II), pull scheduling (i.e. Kanban Systems), design for assembly/manufacturability (DFA/DFM), value analyses/redesign of products, reorganize to "plant within a plant" and business process reengineering (BPR). As expected, these activities have been very popular in the development of the competitive manufacturers in group 1; most of them are highly implemented in these continents when compared to group 2. Management practices are represented by the following activities: benchmarking, simultaneous/concurrent engineering, defining a manufacturing strategy, implementing team approach (work groups) and total preventive maintenance (TPM). The t-tests showed that group 1 is significantly higher than group 2 in implementing the mentioned activities, except for defining a manufacturing strategy in which the difference is not significant.

Lean Manufacturing contains activities such as total quality management (TQM), statistical process control (SPC), zero defects programs, continuous improvement (Kaizen), just-in-time manufacturing/lean production and just-in-time (frequent) deliveries to customers. Most of these activities have their origins in Asia and North America and it is well known that these two continents (group 1) are the pioneers in these activities, both in philosophy and implementation. Therefore, the results are expected, since group 1 present significantly higher levels of adoption of lean manufacturing activities than group 2. IT applications are defined by the use of computer-aided manufacturing (CAM) and computer-integrated manufacturing (CIM). The implementation of these activities is very expensive and it is expected that their degree of use is conservative (means range from 1.73 to 2.68). In both activities, group 1 is higher than group 2, since it the economic power of Asia and North America is higher than the rest.

Green programs are activities that deal with the environment care and conservation. These activities include energy conservation programs, environmental protection programs and health and safety programs. All of these activities are significantly higher in group 1 than in group 2. And also, within this construct, the item that is implemented the most is health and safety programs, followed by environmental protection programs. New product development activities are briefly analyzed by quality function deployment and quality policy deployment. Again, we see a superior implementation in group 1. There is so much improvement opportunities for South America, Europe and Australia in all of these activities. Interesting future research can be to perform individual comparisons between pairs of continents so that the total variance is not affected. Process control is the only construct in which there are no significant differences between the two groups of continents. This variable includes activities such as computer-aided engineering (CAE) and computer-aided design (CAD). IT infrastructure is defined with activities as local area networks (LAN), wide area networks (WAN) and shared databases. Information technology is growing fast and it is expected that those continents with higher economic resources are implementing them the most. The results show that group 1 is the pair of continents that implement more these technologies.

Relative Payoff of Manufacturing-Related Activities (REPAMRA)

There are no significant differences between North America and Asia, South America and Australia and South America and Europe. We performed a similar analysis as in the previous case using groupings, for example group 1 (North America and Asia) and group 2 (South America, Australia and Europe).

However, we will specify the internal differences that exist in group 2 between Australia and Europe. In general, group 1 present higher score than group 2 in relative payoff of manufacturing-related activities. The results from LAMRA support the previous findings. It is expected that those continents that have higher levels of adoption of the manufacturing-related activities, are those continents that will collect higher benefits from them (higher payoffs). Therefore, Asia and North America have higher LAMRA and also have higher REPAMRA. Again, the relationship between these two constructs is subject for further research. In the case of Australia and Europe that don't have any evidence of significant differences in LAMRA, present significantly higher scores for Europe in REPAMRA. This means that the users of manufacturing-related activities in Australia haven't received as much feedback and success as those in Europe.

Company Performance Priorities (COPER)

There are no significant differences in the importance for measuring lean manufacturing, however, differences were found in green performance and new product development priorities among continents. No significant differences were found in green performance measures between Asia and South America. However, we found that these two continents are above the rest in assigning priorities to energy consumption, product recyclability and waste/by-product recyclability. Europe is found significantly higher than Australia in all three items for green performance. Similar results are found for new product development. Asia presents the highest scores for the variable new product development. Australia and North America present significant differences only in speed of product development, where North America is faster than Australia in this process. South America and Europe present significantly higher scores than Australia in product variety and speed of product development; however, there are no significant differences in number of new products developed.

CONCLUSIONS

This study is set out to explore differences in manufacturing competitive priorities among North America, South America, Asia, Australia and Europe. The findings show that both North America and Asia lead in their focus on manufacturing strategy. Those continents (predominantly Asia) show higher SI, LAMRA, REPAMRA and COPER constructs. It is well known that North America and Asia have been leaders in developing quality and manufacturing philosophies and procedures to improve their performance. However, we can also present a hint for future research in testing the same differences but counting for the factor "company size", since both North America and Asia have a larger company size than the rest of the continents, with the exception of Europe. We can conclude from the results of this empirical study, that Europe, Australia and South America have a wide range of opportunities for improvement in assigning priorities to their manufacturing strategy. Europe, followed by Australia, should emphasize in assigning higher priorities to SI, since integration in strategy definition and implementation is crucial for achieving goals and objectives. We found out that Asia and North America are implementing more manufacturing-related activities, since they show higher LAMRA, except in Process Control in which all continents are using this kind of technology into their manufacturing processes. As expected, the continents that use higher LAMRA, present higher REPAMRA (relative payoff of manufacturing-related activities). The only exception is Europe that presents significantly lower results than Australia even though these continents don't present significant differences in LAMRA. And finally, most continents assign similar priorities to company performance (COPER), except for two constructs that are relatively new, green performance (related to environment protection and safety) and new product development (related to number of products developed and speed of product development). In these two constructs, Asia shows higher priorities assigned to them, and therefore, we can perceive the

interest in Asian companies for preserving our planet, even though it costs a little more money for their budgets.

In general, we could conclude that Asia and North America are an example to follow and we could perceive which are their priorities in manufacturing strategy in order to provide improvement opportunities for those continents that don't show the same interest in important constructs such as strategy integration, level of adoption and relative payoff of manufacturing related activities and non-traditional company performance priorities. Future studies must support these findings and must provide further research questions so that we can broaden our knowledge in best practices in manufacturing strategy.

For further analyses, it would be recommended to examine differences between SMEs and large companies. Also, the non-linear relationship between level of adoption and relative payoff ought to be investigated in further research which is not in the scope of this paper. However, it can be considered analysis for further research.

REFERENCES

Acur, N., F. Gertsen, H. Sun and J. Frick (2003). The Formalization of Manufacturing Strategy and Its Influence on the Relationship between Competitive Objectives, Improvement Goals, and Action Plans. *International Journal of Operations Production Management*, 23,(10), 1114-1141.

Ardishvili, A. and A. V. Hill (1993). Manufacturing practices in the commonwealth of independent states. *International Journal of Operations and Production Management*, 13, (10), 60-75.

Avella, L., E. Fernández and C. J. Vázquez (2001). Analysis of manufacturing strategy as an explanatory factor of competitive in the large Spanish industrial firm. *International Journal of Production Economics,* 72.

Brown, S., S. Brian and B. Kate (2007). The contribution of manufacturing strategy involvement and alignment to world-class manufacturing performance. *International Journal of Operations and Production Management,* 27, (3), 282-302.

Caloghirou, Y., A. Protogerou, Y. Spanos and L. Papagiannakis (2004). Industry- versus Firm-specific Effects on Performance: Contrasting SMEs and Large-sized Firms. *European Management Journal,* 22, (2), 231-243.

Chan, J. W. K. (2005). Competitive strategies and manufacturing logistics: An empirical study of Hong Kong manufacturers. *International Journal of Physical Distribution & Logistics Management*, 35, (1), 20-43.

Christiansen, T., W. L. Berry, P. Bruun and P. Ward (2003). A mapping of competitive priorities, manufacturing practices, and operational performance in groups of Danish manufacturing companies, *International Journal of Operations & Production Management*, 23, (10), 1163-1183.

Dangayach, G. S. and S. G. Deshmukh (2001). Manufacturing strategy. Experiences from Indian manufacturing companies. *Production Planning and Control*, 12,(8), 775-786.

Dangayach, G. S. and S. G. Deshmukh. (2001). Manufacturing strategy: Literature review and some issues. *International Journal of Operations and Production Management*, 21, (7), 884-932.

Fine, C. H. and A. C. Hax (1985). Manufacturing strategy: a methodology and an illustration. *Interfaces*, 15, (6), 28-46.

Gonzalez, M., G. Quesada and C. Mora-Monge (2004). Determining the Importance of Supplier Selection Process in Manufacturing: A Study Case. *International Journal of Physical Distribution and Logistics Management*, 34, (6).

Hair, J. F., R. E. Anderson, R. L. Tatham and W. C. Black (1998). *Multivariate Data Analysis*. Englewood Cliffs, NJ.

Hayes, R. and G. Pisano (1996). Manufacturing strategy: at the intersection of two paradigm shifts. *Production Operations Management,* 5, (1), 25-41.

Hayes, R. and D. M. Upton (1998). Operations based strategy. *California Management Review*, 40, (4), 8–25. 40(4): 8-25.

Hayes, R. H. and S. C. Wheelwright (1984). *Restoring our Competitive Edge: Competing Through Manufacturing*. New York.

Hill (1995). *Manufacturing Strategy; Text and Cases.* Basingstoke.

Ho, C. F. (1996). A contingency theoretical model of manufacturing strategy. *International Journal of Operations and Production Management,* 16, (5).

Hongyi, S. and H. Cui (2002). The alignment between manufacturing and business strategies: its influence on business performance. *Technovation*, 22, 699-705.

Hull, R. and B. Wu (1997). The definition of a manufacturing strategy analysis/manufacturing systems design interface. *Proceeding of the International Conference on Manufacturing Automation*, Hong Kong.

Kapiriri, L. and D. K. Martin (2007). A Strategy to Improve Priority Setting in Developing Countries. *Health Care Analysis,* 15, (3), 159-167.

Karim, M. A., A. J. R. Smith and S. Halgamuge (2008). Empirical Relationships Between Some Manufacturing Practices and Performance. *International Journal of Production Research*, 46, (13), 3583-3613.

Kotha, S. and P. M. Swamidass (2000). Strategy, advanced manufacturing technology and performance: empirical evidence from U.S. manufacturing firms. *Journal of Operations Management,* 18.

Leong, C. K., D. L. Snyder and P. T. Ward (1990). Research in the process and content of manufacturing strategy. *Omega*, 12, (2).

Martin-Pena, M. L. and E. Diaz-Garrido (2008). A taxonomy of manufacturing strategies in Spanish companies. *International Journal of Operations & Production Management*, 28, (5), 455-477.

Mikko, K. and R. Schroeder (2004). Manufacturing practices, strategic fit and performance A routine-based view. *International Journal of Operations & Production Management*, 24, (2), 171-191.

Minor III, E. D., R. L. Hensley and D. R. Wood Jr (1994). A Review of Empirical Manufacturing Strategy Studies. *International Journal of Operations and Production Management*, 14, (1).

Peter T. Ward and R. Duray (2000). Manufacturing strategy in context: environment, competitive strategy and manufacturing strategy. *Journal of Operations Management,* 18, 123-138.

Sin-Hoon, H. and L. Lay-Hong (1996). Strategic manufacturing effectiveness: An empirical study based on the Hayes-Wheelwright framework. *International Journal of Operations & Production Management,* 16, (4), 4-18.

Skinner, W. (1969). Manufacturing - missing link in corporate strategy. *Harvard Business Review*, 73, (3), 136-145.

Slack, N. (1994.). The importance-performance matrix as a determinant of improvement priority. *International Journal of Operations and Production Management,* 14, (5), 59-75.

Swink, M., R. Narasimhan and S. W. Kim (2005). Manufacturing Practices and Strategy Integration: Effects on Cost Efficiency, Flexibility, and Market-Based Performance, *Decision Sciences,* 36, (3), 427-457.

Swink, M. and H. M. Way (1995). Manufacturing strategy. Propositions, current research, renewed directions. *International Journal of Operations and Production Management*, 15, (7), 4-26.

Vokurka, R. J. and R. A. Davis (2004). Manufacturing strategic facility types. *Industrial Management & Data Systems*, 104, (6), 490-504.

Weir, K. A. and A. K. Kochhar (1999). Strategic Integration in UK Manufacturing Companies. *Computer and Industrial Engineering,* 37, 417-420.