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Developments, Opportunities and Challenges faced by Small Manufacturers in Brazil: An Exploratory Survey

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Abstract

Small manufacturing companies (i.e. with less than 100 employees) account for one third of employment and one fifth of overall production in Brazil. Despite their importance they are widely neglected by research. Most empirical research focuses on large enterprises and the few studies which focus on small to medium sized enterprises, are dominated by companies of medium size (i.e. with less than 500 employees). Thus, nothing is actually known about small manufactures in Brazil; their competitive environment, the way they plan and control production, their most important recent developments, which opportunities and challenges they see for the future. This study sets out to close this gap through an exploratory survey seeking to develop research issues and propositions for future enquiry. It further provides a first guide for future research to support small manufacturers to meet their objectives and stay competitive in the global market.

1. Introduction

Although there is a lot of talk on the so called BRIC countries (Brazil, Russia, India and China) almost nothing is known about the situation of their small production enterprises. In response, this study aims to take a first step and to cast light on recent developments, future opportunities and challenges faced by small manufacturers in Brazil.

Following Peres & Stumpo (2000) small manufacturing enterprises (i.e. with less than 100 employees) account for 30% of employment and 21% overall production in Brazil. Moreover, there is not only the economical value but also the important function these companies play in the economy serving small markets and providing services neglected by large companies. This is why they are considered important engines of growth and should not be neglected (e.g. Peres & Stumpo, 2000; Moreira, 2007).

Improving the competitiveness of small manufacturers is important as China caused a heavy loss in market share for Brazilian manufacturers which often do not have access to sufficient financing, incentives to invest and other governmental support, as many enterprises in South East Asia (Moreira, 2007). Thus this study seeks to assess how international competition affected small production enterprises and how they seek to face there challenges and take advantage of their opportunities.

Moreover, past research has assumed that small manufacturing companies are driven primarily by concerns of operational excellence, i.e. cost, due date compliance and quality (e.g. Kathuria, 2000). Yet, there is substantial anecdotal evidence that many are changing how they compete and the outcomes that they pursue and offer to their customers. For example, Melnyk *et al*. (2009) and (2010) argued that the new supply chain is strategically coupled and value driven focusing on a blend of outcomes including sustainability, responsiveness, resilience, security and innovation rather than strategically decoupled and price driven. Consequently, we are interested in determining if this is really the case in Brazil and, if so, what implications this shift has for both research and practice.

Summarizing, whereas small manufactures face a series of new challenges caused by global competition and changing competitive priorities within the supply chain, few is known about their actual situation. In response, Semi-structured interviews with managers in small manufacturing companies were conducted to provide some answers to the questions:

- What is the current competitive priority of small manufactures in Brazil?
- How do *they* plan and control production to achieve their operational objectives?
- What were the most important recent developments?
- What do *they* consider their most important future opportunities and challenges?

The objective is to identify research issues and propositions for future enquiry, developing a list of decision making criteria or factors that are critical to managers and that need to be addressed if

competitiveness is to be improved and both the survival and growth of these companies are to be ensured.

The remainder of the paper is organized as follows. The restricted literature on small manufacturers in Brazil is reviewed in Section 2 before the methodology applied is outlined in Section 3. Results are presented and discussed in Section 4, where also future research questions are outlined. Finally, conclusions are summarized in Section 5.

2. Literature Review

Following the Brazilian Institute of Geography and Statistics (IBGE - Instituto *Brasileiro de Geografia e Estatística*) small industrial enterprises are defined as having less than 100 employees and medium sized less than 500. The difference between small and medium sized enterprises is relatively large. For example, Miguel (2003) lists 15% of the top 500 companies as small to medium sized. Thus conclusions for small to medium sized companies are to be taken with care when applied to small manufacturers; in general one would assume different priorities and needs between a small standard manufacturer and a top 500 company.

A broad empirical literature on the state of large companies which operate in Brazil can be found in the literature (e.g., Rohr & Correia, 1998; Fleury, 1999; Miguel, 2003; Paiva *et al*., 2008; Pinto *et al*. 2008; Pedroso *et al*., 2009; Forrester *et al*., 2010). This includes an increasing interest on sustainability and implementation of ISO 14001 (Da Silva & De Medeiros, 2004; Jabbour, 2010; De Oliveira *et al*., 2010; Jabbour *et al*., 2011). Whereas some of these studies include small enterprises, they either neglected differences in results due to company size (e.g. Fleury & Fleury, 2003; Miguel, 2003; De Oliveira *et al*., 2010; Jabbour *et al*. 2011) or unnecessarily aggregate results (e.g. Barbosa & Musetti, 2010).

The major conclusions on small to medium sized and small manufacturers which can be derived from the literature are:

- Small to medium sized manufacturers (less than 500 employees): Among companies with ISO 14001 certification small to mediums sized present between 30% (Jabbour *et al*., 2012) and 60% (De Oliveira *et al*., 2010). Small to medium sized manufacturers have a lower level of adaptation of logistic information systems than large companies (Barbosa & Musetti, 2010).
- Small manufacturers (less than 100 employees): Among companies with ISO 14001 certification small companies present between 10% (Jabbour *et al*., 2012) and 20% (De Oliveira *et al*., 2010). De Oliveira *et al*. (2010) further suggest that small enterprises decide to certify in order to establish consumer trust as they start to export.

Summarizing, relatively little is known about the situation of small manufacturers in Brazil and there is a clear need to extend our knowledge seen their economical importance.

3. Methodology

The main objective of this study is to develop research issues and propositions for future enquiry. Therefore an exploratory survey has been applied (see e.g. Yin, 2003). For our study, semi-structured interviews have been conducted over the phone; a survey by phone is considered an adequate technique to retrieve information and discern opinions (Miller, 1970). Questions were mainly open-ended as we are looking for insights offered by the respondents. The approach followed combines the advantages of a personal interview and a mail survey. It allows for the identification of new information rather than confirmation of pre-established constructs. This section covers interview guide design, the sample selection process and the data collection process in Section 3.1 to 3.3 respectively.

3.1 Design of the Interview Guide

The first stage of the design process was to conduct some short interviews with managers of small manufacturing companies organized around a small number of themes as current problems, future

challenges, future opportunities and key performance indicators. This initial exploratory analysis confirmed the relevance of the topic to managers and sharpened our focus.

A set of interview questions were then developed through several iterations within the research group. A wide range of questions were developed and revised through several rounds within the research group before interview questions were piloted again.

The revised version of the interview guide was then pre-tested (see e.g. Forza, 2002) gaining feedback from several industry experts, colleagues and target interviewees to ensure that the questions are clear, that they give full coverage to our research topic, and that they are of relevance to managers. The interview guide was then revised according to the suggestions received before finished by a series of final rounds within the research group. Finally, a template has been designed to facilitate the data collection process.

The original guide was developed in English. To allow for its use in Brazil, it has been translated into Portuguese by several independent sources before the final Portuguese version has been established.

The final interview guide (see Appendix A) contains five main sections and about 30 mainly open ended questions about: (i) general company information; (ii) the competitive environment; (iii) production planning and control; (iv) recent developments; and (v) future opportunities and challenges.

3.2 Sample Selection Process

The sampling method applied is area sampling (Forza, 2002). The sample is restricted to the city of São Carlos. São Carlos has been selected due to its special position in the centre of São Paulo the economical motor of Brazil and as it is known as capital of technology within Brazil. The sample has been selected out of the catalogue of companies for the region of São Carlos provided by the Center of Industries of the State of São Paulo (CIESP - *Centro das Indústrias do Estado de São Paulo*). This catalogue lists 117 companies from which 46 could be identified as small manufacturers (i.e. less

than 100 employees). All of these companies have been contacted by phone and date and time for an interview marked. In total 23 companies agreed to participate in the research. No differences in terms of size or industry were found for companies which participated and which did not.

A number of different industries are represented within the sample which includes casted products, machined metal parts, medical equipment, electronic equipment and revisions & remanufacturing. The final sample is detailed in Table 1.

Table 1: Sample Characteristics

company	shop floor			% MTO[1]
	number of		type of machine	
	employees	machines		
medical equipment	47	10	majority general	100%
medical equipment	28	30	majority general	0%
medical equipment	20	25	majority general	2%
medical equipment	33	30	majority general	5%
ice cream machine	50	30	majority general	<10%
medical laboratory material	45	8	majority specialized	< 10%
equipment	100	40	majority specialized	20%
equipment for automation	40	40	specialized & general	100%
equipment for automation	20	40	majority specialized	20%
equipment for automation	6	13	majority general	100%
equipment (e.g. pumps and filter)	100	50	majority general	100%
coiling machines	20-25	7	majority general	100%
mold producer	100	30	majority general	100%
mold producer	16	20	majority general	100%
machining	70	70	majority general	100%
machining	30	64	majority general	100%
casting	48	15	majority general	100%
casting	60	20	majority general	100%
supplier of parts	100	>100	majority specialized	60%
supplier of parts	10	8	majority specialized	100%
supplier of parts	3	15	majority general	98%
revisions of pumps and motors	5	3	majority general	100%
solar heating systems	fixed position layout			100%

[1]) Percentage of production which is Make-to-Order (MTO)

As can be seen from Table 1, the majority of companies produces make-to-order indicating the type of machine (majority general) a job shop like production environment. This confirms previous

research on the link between job shops, make-to-order production and small manufacturers (see e.g. Stevenson *et al*., 2005).

3.3 Data Collection Process

The interviews took place by phone. After ensuring that responses offered during the course of this interview will be held in the strictest confidence, that there are neither right nor wrong answers and the respondent is free do answer any question or not, the questions where read to the interviewee. Each interview was assisted by a junior and a senior researcher which took separate notes. Data has been crossed after the interviews. The interviews took in average 25 minutes, taking the shortest 11 minutes and the longest 37 minutes. Crossing the data took about 20 minutes per interview.

4. Results

The presentation of results follows the structure of the interview guide. First, the competitive environment is discussed in Section 4.1. The way production is planned and controlled is addressed in Section 4.2. Section 4.3 then addresses the most important recent development before opportunities and challenges companies see for the future are discussed in Section 4.4 and 4.5, respectively. A final discussion of results is presented in Section 4.6, where also the most important future research directions are outlined.

4.1 Competitive Environment

As can be seen from Table 2, the majority of companies sees the market and their own market share as expanding. Main reasons include: investment in sales, broadening of the product spectrum, development of new products, growth of the market itself and favoring governmental policies. Eight companies reported a shrinking market share. The main reason for this development is national and international competition which negatively affects the business of the companies and/or their principal customers. In general market and market share development are congruent.

Table 2: Frequency: Market Development vs. Development of the Market Share

		Market development			
		Expand	Stable	Shrink	Sum
Development market share	Expand	10	2	2	14
	Stable	-	1	-	1
	Shrink	2	1	5	8
	Sum	12	4	7	

Two companies reported an increase in market share although the market is contracting. The main reason is the originality of their products and quality which led to new contracts.

When asking the interviewees why customers choose their company rather than the competition 19 indicated the quality of their products as one of the main reasons. This can be seen from Figure 1 where the main factors which are perceived as yielding competitive advantage are summarized. Quality is followed by attendance in terms of pre-sale and post-sale, the brand or market position (e.g. as being long time on the market) and the originality of the product.

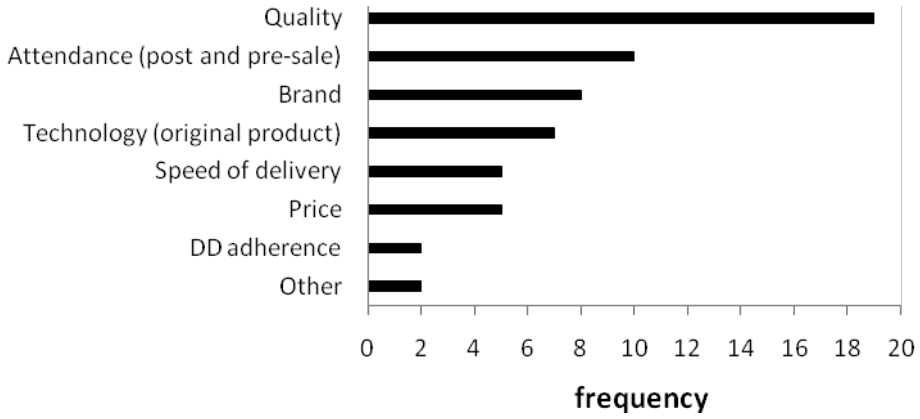

Figure 1: Competitive Factors of the Company

It should be noted that there was no co-relation observed between the market in which a company acts and their major competitive factors. Factors as attendance, brand, the existence of original products and technical know-how showed to be equally important for e.g. producer of parts, medical equipment or equipment for automation.

When asked why customers may choose the competition rather than their company, the main factor named was price. This can be seen from Figure 2 where the main factors which are perceived as yielding competitive advantage to competitors are summarized.

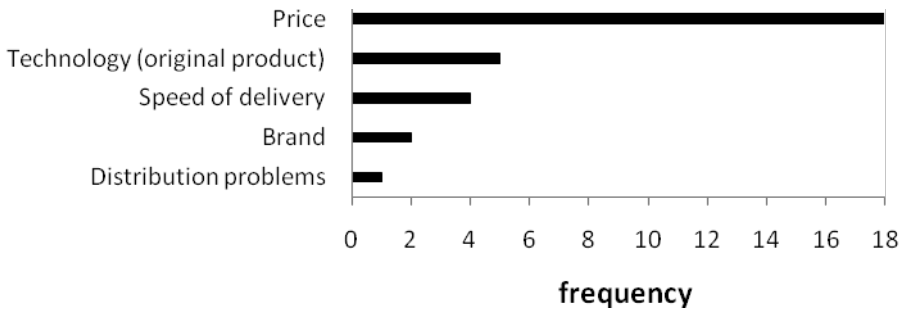

Figure 2: Competitive Factors of Competitors

The existence of original products and brand also appears to be of importance here. Companies which named these factors as competitive advantage for their company compete in quality being their major competitor international companies competing on price. On the other hand companies which see original products as competitive advantage for competitors compete on price being their major competitor international companies competing with high quality and established brand names.

4.2 Production Planning and Control (PPC)

The interview guide included a short set of question on how Production Planning and Control (PPC) tasks are accomplished in the companies. One of the main issues were the use of Information Technology (IT) and whether the IT system applied provides adequate support for PPC tasks or not. Figure 3 summarizes responses received from the interviewees.

Results suggest a relative broad use of IT which is considered to adequately support PPC tasks. Company size is an important factor which influences the implementation of IT – the larger the company the more common the use of IT. This is an expected outcome seen the increased information flow for larger companies.

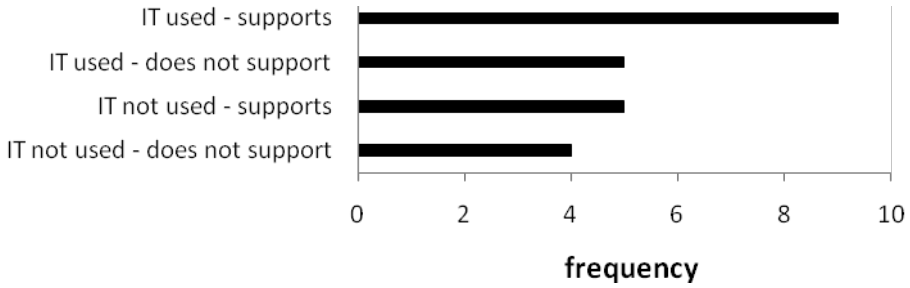

Figure 3: Use and Efficiency of IT in the Production Planning and Control Process

From the interviews it became clear that most companies which apply IT use some kind of Enterprise Resource Planning (ERP) tool which major focus is on the control of stocks and production planning through Manufacturing Resource Planning (MRP).

These results somehow seem to contradict the broader operations management literature which sees only a loose fit between MRP and a high variety planning environment as typical for job shops and MTOs (see e.g. Stevenson *et al*., 2005). However, our results have to be taken with care and are twofold. Interviewee responses suggested that IT is mostly used as planning rather than control tool. Production control decisions on 'When to release which order to the job floor?' or 'Which order to expedite on the shop floor?' to meet the production schedule are often taken manually thereby correcting (or neglecting) inappropriate production schedules from the upper level planning process. Therefore further research is required to assess the use of IT in the actual production control process and whether tools provided adequately support control decisions.

Future research will also be required to assess the use of performance measures. The interviews suggested that whereas a broad set of measures is collected it often seems not clear what they mean. Instead of providing a vital language to diagnose the production process, performance measures seem often be collected to fulfill certification requirements and further neglected. Further research is required to assess whether this really is the case and which impact the adequate knowledge and collection of performance measures has on overall performance across different companies.

4.3 Recent Developments

The most important recent developments in the companies as perceived by the interviewees are summarized in Figure 4. 15 different developments were listed by the companies which underlined the broad spectrum of developments and the heterogeneity within the group typically categorized as small manufacturer.

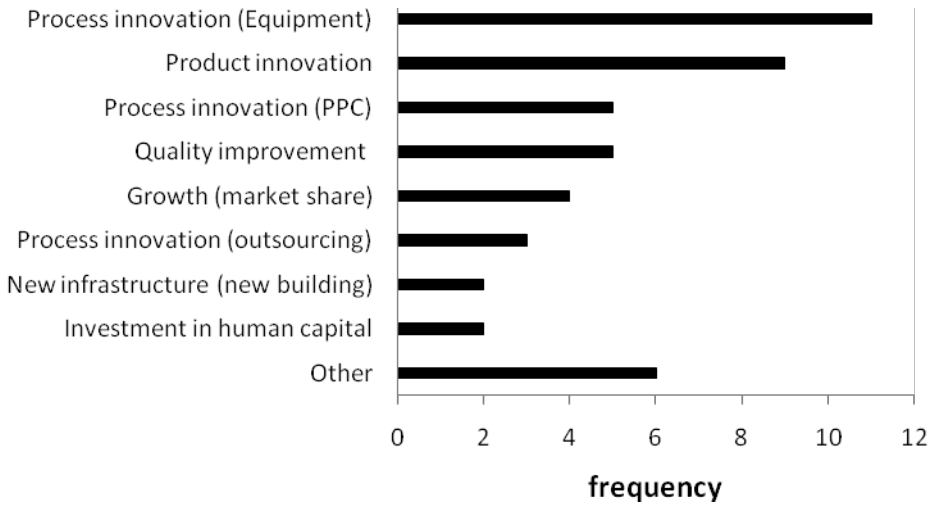

Figure 4: Important Recent Developments

Major developments include investment in equipment, product innovation – i.e. development of new products and broadening of the product spectrum –, process innovation in terms of Production Planning and Control (PPC) and investment in quality improvements. These developments are in line with the major competitive factors identified in Section 4.1 above. Developments summarized under the category 'Others' include: organizational restructuring; growth in terms of company size; change in suppliers; the introduction of Computer Aided Design and Manufacturing (CAD/CAM); projects with Universities; and programs to reduce costs.

Asked what originated these developments most companies indicated the need to meet market requirements or factors related to this issue. This can be seen from Figure 5 where the main factors which originated recent developments are summarized.

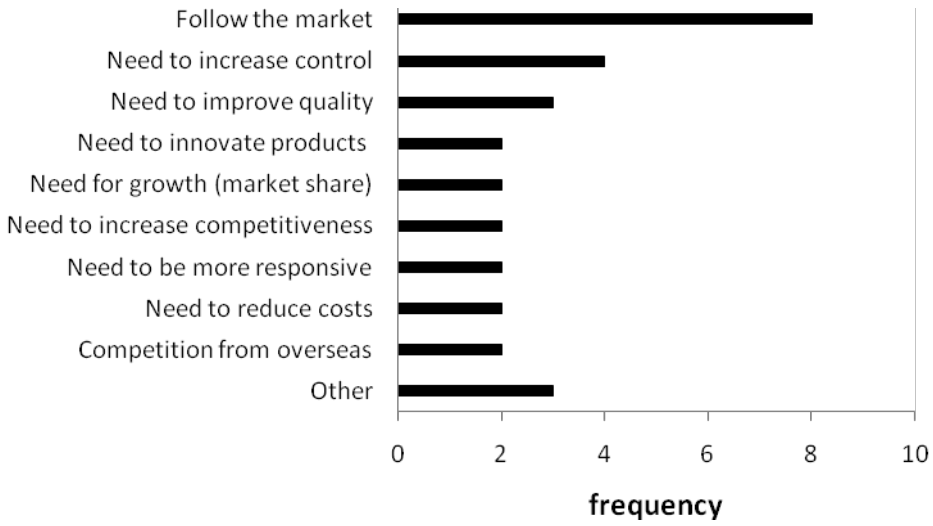

Figure 5: Factors which Originated Recent Developments

The interviews suggested that there is a strong pressure to follow market developments due to change in the market itself and growing competition from national companies and overseas. Responses further suggest that operational excellence in terms of quality, price and due date compliance became a must (i.e. an order qualifier) rather than an order winner. Therefore, companies had to strive for operational excellence itself thereby focusing on quality and due date compliance to a reasonable price – competing on low price was seen as impossible by many companies seen the (often entitled '*unfair*') competition from overseas.

In general, our results support Kathuria (2000) which sees small manufacturer mainly competing on operational excellence. Further, companies integrated in the supply chain (i.e. not producing for an end customer) showed to be strategically coupled and price driven as suggested by Melnyk *et al*. (2009) and (2010). Whether these developments will find its continuation in the future will be discussed in the next two sections which discuss future opportunities and challenges as perceived by the companies.

4.4 Future Opportunities

The previous three sections sought to shed light on the current situation of small manufacturers. The next two sections seek to shed light on the strategy for the future. Opportunities seen by the interviewees are summarized in Figure 6.

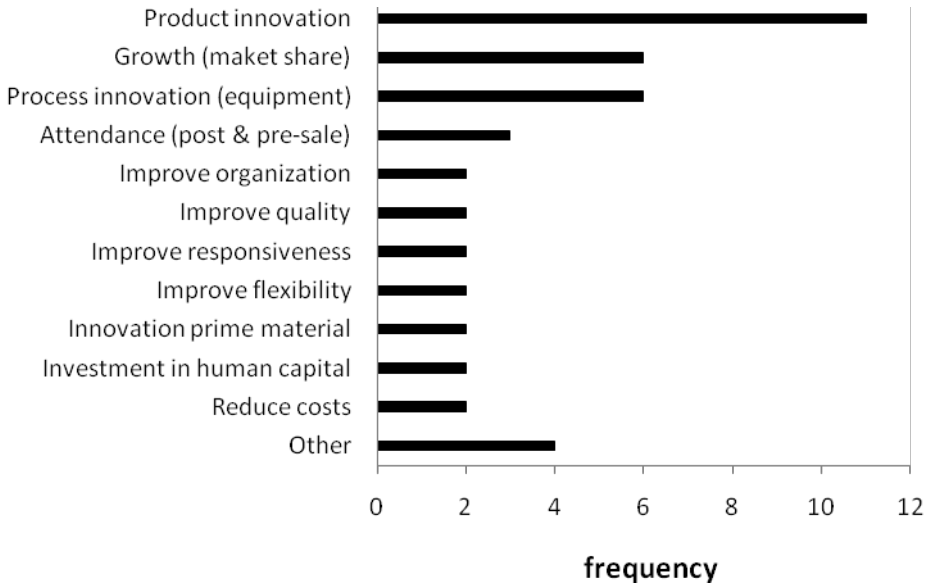

Figure 6: Future Opportunities

A first interesting change compared to recent developments can be observed – was process innovation in terms of new equipment and improved PPC the major focus in the recent past, product innovation seems to be the focus for the future. Product innovation is hereby often perceived as linked with growth in market share and process innovation. Several companies named competition from overseas (often named with high taxes for national companies) as main reason for product innovation striving for independence from the market and assemblers for which they provide supply.

The question remains whether the companies already achieved operational excellence. Most importantly – is it necessary to have operational excellence to initiate innovation (i.e. by freeing financial and human resources)? Both questions need to be assessed to provide guidance to

companies on "Which strategy to follow? and 'Which operational objectives are the most important?'.

Finally, whereas there is a clear tendency in terms of future opportunities, ways how to take advantage of these are less focused. This can be seen from Table 3 which gives the most important future opportunities (as specified by the interviewees) and how the company plans to take advantage of these opportunities. Most important issues are investment in Research and Development (R&D) and new equipment. This is in line with the major opportunities (product and process innovation) identified above.

Table 3: Frequency: Most important Opportunities - How to get there ?

		Most important Future Opportunities									
		Product innovation	Process innovation	Growth	Attendance	Improve organization	Prime material	Improve quality	Reduce costs	Fast delivery	All linked
How to get there?	Investment R&D	4	-	1	-	-	2	-	-	-	-
	Investment in equipment	-	4	-	-	-	-	-	-	1	-
	Investment in quality	-	-	-	1	-	-	-	-	-	-
	Investment marketing	-	-	1	-	-	-	-	-	-	-
	Investment human capital	-	-	-	-	-	-	-	-	-	1
	Hire know-how	1	-	-	-	-	-	-	-	-	-
	Improve service; Engineered-to-Order	-	-	-	1	-	-	-	-	-	-
	External consultants	-	-	-	-	1	-	-	-	-	-
	Improve production process	-	-	-	-	-	-	1	-	-	-
	Restructuring of organization	-	-	-	-	1	-	-	-	-	-
	Distributional channels	-	-	1	-	-	-	-	-	-	-
	Cost reduction program	-	-	-	-	-	-	-	1	-	-
	Analysis consumer satisfaction	1	-	-	-	-	-	-	-	-	-

4.5 Future Challenges

Asked about future challenges, lack of *skilled* labor dominates. Whereas Brazilian companies have broad access to labor most of this labor is unskilled or possesses low skills. This can be seen from Figure 7 where the major challenges for the future of the company are summarized.

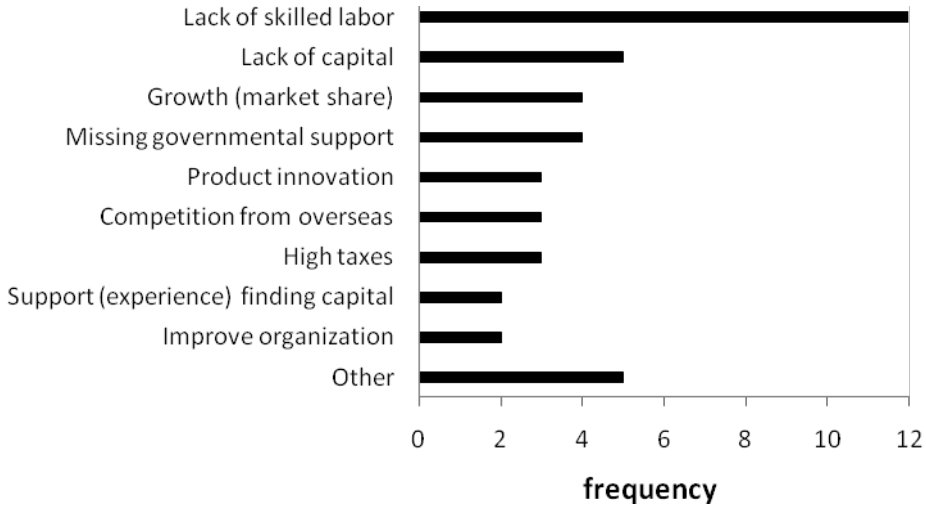

Figure 7: Future Challenges

Lack of skilled labor is followed by lack of capital, the need to growth – i.e. extend the market share –, and missing governmental support.

Interesting is the strong feeling of missing governmental support or support from society we perceived in almost all interviews. Many companies had bad experiences with governmental institution, educational institution or Universities. This includes failed projects with engineering schools to provide worker training or joint projects with Universities which never reached the finish line due to missing student commitment. This maybe one reason why the creation of a well trained and committed workforce is seen as a major challenge for the future. During the interviews, the few companies which had a flexible, multi-skilled and committed workforce confirmed high satisfaction with the overall production process.

Another important issue mentioned was the '*inexperience*' of small companies to apply for e.g. financial support from the government. Information on funding possibilities is often missing and applying for support often seems too time consuming or complicated to be done by the owner of a small manufacturing enterprise nor exist financial or human resources to outsource application for funding.

When asked about how to face their future challenges – as for opportunities – a broad set of responses were received. This can be seen from Table 4 which gives the most important future challenges (as specified by the interviewees) and how the company plans to face these challenges.

Table 4: Frequency: Most important Challenges - How to face them ?

		Most important Future Challenges										
		Lack of skilled labor	Product innovation	Lack of capital	Governmental support	Competition overseas	Improve organization	Financial missmanag.	Reduce costs	Quality requirements	Survive	Not specified - all linked
How to face?	Training of workforce	6	1	-	-	-	-	-	-	-	-	1
	Organization – PPC	-	-	1	-	2	1	-	1	1	-	-
	Innovation (equipment)	-	1	-	-	1	-	-	1	-	-	1
	Introduce IT	-	-	-	-	-	1	-	-	1	-	-
	External financial support	-	-	2	-	-	-	-	-	-	-	-
	Hire know-how	-	1	-	-	-	-	-	-	-	-	-
	Investment R&D	-	1	-	-	-	-	-	-	-	-	-
	Reduce costs	-	-	-	-	1	-	-	-	-	-	-
	Improve accounting	-	-	1	-	-	-	-	-	-	-	-
	External consultants	1	-	-	-	-	-	-	-	-	-	-
	New quality norms	-	-	-	-	-	-	-	-	1	-	-
	Impr. recruitment process	1	-	-	-	-	-	-	-	-	-	-
	Not specified	1	-	-	-	-	-	1	-	-	1	1

As expected, the major issue for the future is the internal training of the workforce i.e. investment in human capital. This is followed by improvements in production planning and control. This underlines the need for more research into effective PPC solutions for small enterprises (see Section 4.2 above).

In general, challenges are faced continuing recent developments – i.e. investment in PPC and equipment – whereas opportunities include the investment in R&D. Thus companies seem to follow a double headed strategy – on the one hand striving for operational excellence and on the other invest freed resources in product innovation to become independent from the market.

Finally, we asked the interviewees to evaluate whether a set of issues indentified from the literature is perceived as a challenge now, in the future or is not perceived as a challenge for the company. Responses are summarized in Figure 8.

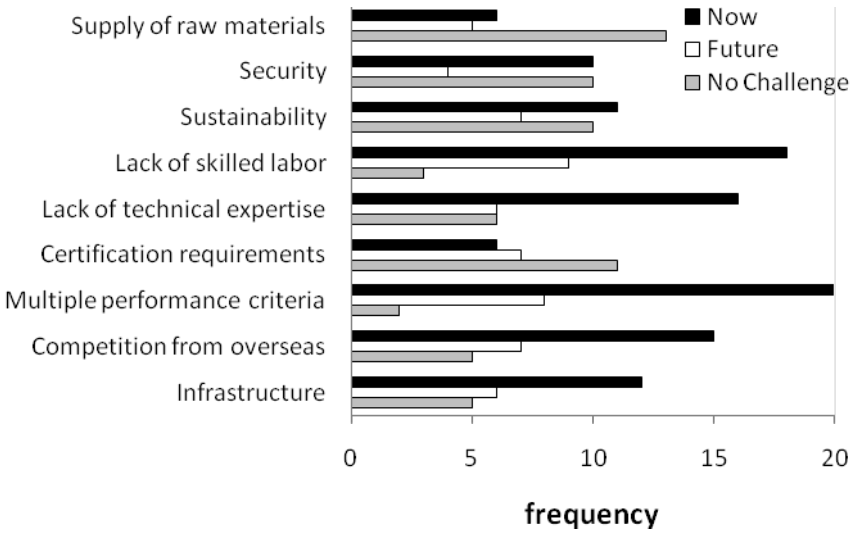

Figure 8: Challenges – Now and in the Future

The interviews suggested:

- Supply of raw material: This is not seen as a major challenge.
- Security (process, components, intellectual): Security in terms of intellectual property is an interesting issue. The two companies which touched this issue both confirmed they gave up patents '*as it is not worth it*'. This issue links back to missing governmental support. It is an important issue seen the focus of many companies on product innovation – security of the new achieved intellectual property seems, so far, not ensured in Brazil.
- Sustainability: This issue, on which a lot of the existing research about Brazilian economy focuses, is not perceived as major problem. Moreover, these interviewees which sought to invest in sustainability designated it as '*heroic act*' seen the missing support by city and government. In general, results suggest that certification in ISO 14001 is seen as necessary prerequisite for

exportation rather than real commitment. This finding may enhance the findings by De Oliveira *et al*. (2010) on the implementation of ISO 14001 in small companies.

- Lack of skilled labor: As discussed above, this issue is perceived as one of the most important challenges in the present and for the future.
- Lack of technical expertise: As for lack in skilled labor, this issue is seen as important now and for the future.
- Certification requirements: Most companies which have sufficient certification reported that they see this issue not as a challenge – '*we have all required*'. Companies which have insufficient certification see it is a major challenge. Therefore, certification requirements may become a major issue once new certifications (e.g. ISO 14001) are required to stay competitive.
- Multiple performance criteria: The most important challenge now and in the future is to meet a set of simultaneous performance criteria demanded by the customer. Customers demand short and reliable lead time, high quality and low price at the same time – i.e. operational excellence. The only companies which did not identify it as a challenge have highly original products. Therefore, results confirm Melnyk *et al*. (2010) in the sense that rather than focusing on one performance measure, companies have to compete on a blend of outcomes.
- Competition from overseas: Is seen as an important challenge which showed its impact in recent market developments. Another issue often named here are high taxes, missing incentives and missing protection compared to competition from overseas which often receives strong governmental support.
- Infrastructure: Is seen as a major challenge. Companies are either looking for space to grow or simply require access to decent roads.

4.6 Discussion of Results

The main research issues and propositions for future enquiry raised during the interviews can be summarized as follows:

- Company properties: Yes, Virginia, there is a job shop – whereas interest in job shop research seems to decline many companies seem to perform still in a job shop like production environment.
- Competitive environment: There is a clear link between market development and development of market share. Only two companies reported a shrinking market and expanding market share. The low sample size makes it impossible to derive conclusions on what enabled these companies to counter-act the negative market development. There seems to be a link to the originality of the product and a high level of operational excellence. However, future research is required to establish any link and provide guidance for a successful operational strategy – Which should be the order winners and which the qualifiers?
- Production Planning and Control: A high percentage of companies uses IT to plan and control production. However, the interviews suggest that the IT system applied often represents some kind of ERP system which accomplishes: management of stock, management of the information flow and overall production planning. The actual production control task seems often accomplished manually correcting inappropriate production schedules. Future research is necessary to assess whether this really is the case. Does the applied IT system adequately support production control decisions? Most importantly, the use of IT for the control function of PPC should be assessed apart from the planning functions. This also includes the question on the use of performance measures. How does the adequate knowledge of performance measures (i.e. their potential to diagnose the production process) impact overall shop floor performance. We perceived a strong link between this knowledge and effective production control.
- Recent developments: There has been a strong investment in equipment and IT for production planning and control. Following Barbosa & Musetti (2010) this may be due to governmental support. However, on the other hand missing governmental support was named as one of the major challenges. The most important question is, whether the investment actually paid of? –

investment in equipment is often seen as necessary to face upcoming challenges and not as major opportunity for the future of the company. Moreover, most cases which saw new equipment as opportunity see it as a way to enhance product properties and their product spectrum, thus directly linked to product innovation.

- Future Opportunities: Product innovation is indicated as the key opportunity for the future – innovation is often thought to provide more independence from the market. However, the question remains where to put the operational objective seen the scarce financial resources of many companies. There are companies with high innovational potential in terms of their product but inefficient production process and companies close to operational excellence but with low level of product innovation: both types struggle or succeed. Is there any sequence to follow? Is strong R&D possible without a strive for operational excellence? The way how major challenges are thought to be faced indicates a continuing struggle for operational excellence apart from investment in R&D.
- Future Challenges: The main challenge is the creation of a skilled and committed workforce. Many companies consider in-house training due to missing governmental support or previous failed projects with e.g. engineering schools. Not labor is the problem but how to train labor. One open question here is whether multi-skilled or committed should be the objective? For example, assuming an open market for labor, the higher the skill level the less committed to a company a worker maybe as he/she may gain more at another company. Therefore – 'Up to which level is training done in the companies?' and 'How is commitment to the company and its objective ensured?'. This should provide guidance for other companies which consider to start a training program.

Remains the question how future research can support small manufacturing companies to stay competitive and ensure growth. The main issues raised by the interviewees itself are summarized in Figure 9.

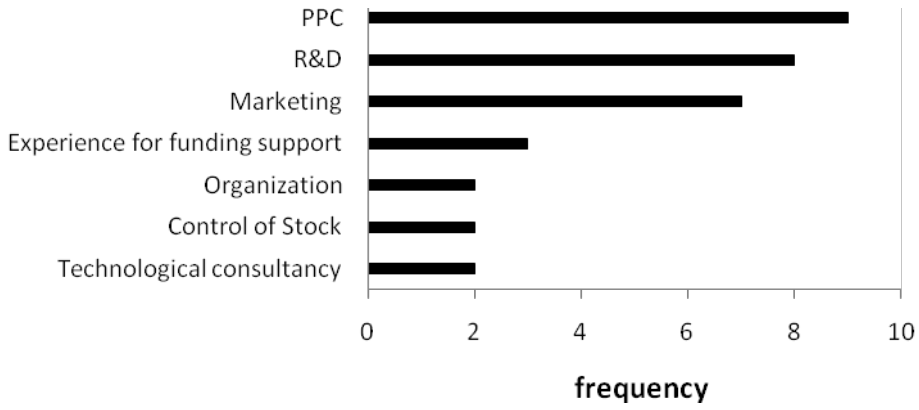

Figure 9: Fields for Future Research

The interviews mainly centered around three issues:

- *Where are the markets of the future? Which services should be provided to ensure growth?* Research should assess how to define the right blend of outcomes or provide a market analysis for small manufacturers.
- *How to enter the markets?* Research should provide tools for marketing and sales for small manufactures with restricted financial resources. It also should provide support for innovation in terms of new products and processes. This includes the issue of how to effectively protect intellectual property – i.e. new product developments.
- *How to stay in the market?* Research should provide tools to integrate production and sales providing effective production control. Many Brazilian companies compete on operational excellence but often miss the know-how and the necessary technology. This includes Lean implementation, Total Quality Management (TQM) and adequate PPC systems, but also advances in manufacturing technology.

Most managers we talked to showed interest in co-operation with Universities. However, only 5 actually were involved in a joint project or received support. Many managers complaint about

missing interest in small enterprises, a too strong focus on theory, missing commitment from the University, complicated and slow process to start any project, low qualification level and so on.

This research sought to take a first step to close this gap trying to give some insight into the heterogeneous and challenging world of small manufacturing companies raising more interest in the academic world.

5. Conclusion

Small manufacturing companies are an important economical and social factor in Brazil. Despite their importance they are widely neglected by research. In response this research set out to shed some light on recent developments, future opportunities and challenges as perceived by small manufacturers. Through an exploratory survey it could be confirmed that China had an important impact on the Brazilian economy and the way small manufacturers perform. It also could be confirmed that there is a focus on operational excellence as suggested by Kathuria (2000) and a shift in focus as suggested by e.g. Melnyk *et al*. (2009). However, in many cases decoupling from the supply chain seems to be thought as leaving the supply chain (looking for an end customer) rather than becoming independent players within the supply chain.

In addition, this research sought to outline major research issues and propositions for future enquiry. Questions raised include: Is there a job shop?; What is the degree to which IT is used to accomplish actual production control tasks?; What is the impact of knowledge about performance measures on performance?; What is the link between operational excellence and product innovation to ensure survival or even growth if financial resources are restricted?; Up to which level worker training should be provided?; and How can worker commitment be ensured?.

Future research directions to support small manufacturers include: development of marketing strategies for small enterprises with restricted financial resources; PPC solutions and manufacturing technology for small manufacturers; product development and security of intellectual property. The

most important issue, however, is to create interest and possibilities for future co-operation with small manufactures.

The main limitation of this study is its restriction to one area (São Carlos) which does not allow for a broader generalization. Therefore further research is necessary to confirm findings and address questions raised.

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Appendix A: Interview Guide

1. Company Background Information

Where possible, the following information will be obtained through an Internet search prior to the interview and quickly confirmed with the respondent.

1.1 Tell me about your company. Please touch on the following issues:

1.1.1 Location

1.1.2 How long you have been in business

1.1.3 The size of your shop(s)

1.1.3.1 People

1.1.3.2 Equipment

1.1.3.3 Equipment mix (specialized, general purpose)

1.1.4 What type of manufacturing does your company perform? – if more than one please identify (e.g. fabrication, machining, plating)

1.1.5 What percentage of orders are made or engineered to order?

1.2 Any other comments?

2. Competitive Environment

2.1 Now we are going to ask you about what has happened to your share of the market.

2.1.1 Is the pie expanding/shrinking?

2.1.2 What is happening to your share of the pie?

2.1.3 Would you be willing to share the reasons behind this trend?

2.2 Who are your top 5 or most important customers by the type of manufacturing (e.g. fabrication, distribution, machining, plating etc.)?

2.3 Why do companies choose to do business with you rather than with the competition?

2.4 Why do companies choose to do business with the competition rather than with you?

3. Production Planning and Control

3.1 How do you currently plan and schedule your operations?

3.1.1 If computer based planning – what system are you using (e.g. SAP)?

3.2 Is your existing production planning and control approach or system able to help you achieve your performance targets? Please explain.

3.3 Is your current workforce able to help you achieve your performance targets? Please explain.

3.4 Which performance measures do you monitor for:

3.4.1 Cost?

3.4.2 Delivery?

3.4.3 Quality?

3.4.4 Sustainability?

3.4.5 Responsiveness?

3.4.6 Others? Please specify

4. Recent Developments

4.1 We are soon going to ask you a few question about opportunities and challenges facing your company, but first we will ask you about the recent past:

4.1.1 What have been the most significant changes or developments in your company in recent years (e.g. new IT, new machine, outsourcing)

4.1.2 What has prompted them?

5. Opportunities and Challenges

5.1 As you look to the future (e.g. the next three to five years):

5.1.1 What do you see as your major opportunities to generate competitive advantage (e.g. flexibility, responsiveness, delivery reliability, innovation)?

5.1.2 Which opportunity do you see as being the most important, and why?

5.1.3 How is the company going to realize this, or any other opportunity?

5.1.4 What do you see as your major challenges (e.g. lack of skilled labor, lack of capital)?

5.1.5 Which challenge do you see as being the most important, and why?

5.1.6 How is the company going to respond to its challenges?

5.2 What is it that you don't know that you wish you did? Why is that important?

5.3 Do you consider any of the following to be major challenges for your company (either now or in the foreseeable future)?

5.3.1 Supply of raw materials

5.3.2 Security (process, component, intellectual property)

5.3.3 Sustainability

5.3.4 Lack of skilled labor

5.3.5 Lack of technical expertise

5.3.6 Certification requirements

5.3.7 Customers asking you to meet multiple performance criteria simultaneously (i.e. quality, fast delivery and low cost)

5.3.8 Competition from overseas

5.3.9 Infrastructure

6. And Finally

6.1 What are the key areas in which you feel you would benefit from help or support? What can we do as researchers to help your business?

6.2 Did you ever contact, co-operate with or receive support from a University? Please explain.