

THE INTERNET'S IMPACT ON MANUFACTURERS: A SNAP-SHOT OF THE INDUSTRIAL SECTOR IN THE STATE OF SAO PAULO, BRAZIL

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**THE INTERNET'S IMPACT ON MANUFACTURERS: A SNAP-SHOT OF
THE INDUSTRIAL SECTOR IN THE STATE OF SAO PAULO, BRAZIL¹**

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ABSTRACT: The e-business hype is over. Companies have become much more conservative in their evaluation of Internet investments. Traditional financial targets are now associated with any new project from the start. A silent, much deeper revolution is, however, under way. Now that companies have a clearer idea of the miracles the Internet can perform - and of those that should not be expected -, they have grounds on which to redesign their processes, their structure and the value chains they are a part of, in order to take better advantage of the Internet's capabilities.

This paper presents the preliminary results of a survey that was carried out with over 650 Brazilian manufacturers, in which they pointed out the ways that the Internet and other IT (information technologies) are changing their businesses and the competitive environment.

The authors discuss their findings, relating the survey's results to previous expectations based on the literature and on prior research.

KEY WORDS: Internet, e-manufacturing, business transformation.

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INTRODUCTION

A few businesses are based solely on information products that are completely digitized. When that is the case, practically all the activities involved can be virtualized and carried out over the Web. Businesses that are based on physical products, however, will still require traditional manufacturing, warehousing and transportation activities to be performed, among other “physical” tasks. Changes in the patterns of demand, and the logistics involved in producing personalized items that have to be diligently delivered directly to the end customer, make these activities even more complex than in the past. Fortunately, many tasks required to produce and deliver “physical goods” can now take advantage of the Internet’s connectivity, in order to create more value to customers or simply to bring costs down.

There have been many studies and reports done on the use of the Internet to improve companies’ business propositions and overall results. Most of them, however, were contaminated by the e-commerce hype and focused on the possibility of selling products online. Much less attention has been paid to the changes in the way products are designed, manufactured and distributed, as a consequence of the use of the Internet and other IT.

THE INTERNET’S PROMISES FOR MANUFACTURING

One important activity manufacturing companies are involved with is the development of new products. KROO (1996), JONS (1997), GOLDIN, VENNERI AND NOOR (1998),

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BOSWELL (1998), FORD AND STERMAN (1999), KIRKMAN ET AL. (2002) among others, discuss the possibilities and advantages of collaborative design, carried out by teams of engineers using CAD and other software tools that allow for the creation of virtual models, prior to the execution of "physical" prototypes. Virtual prototyping, virtual reality and other techniques can be used to simulate situations that previously demanded concrete models and mock-ups. When those digital techniques are applied, computer files conveying design information are generated, which can be distributed through the Internet or other computer networks. It becomes possible for design team members to work together on a project, regardless of their physical location. That represents an important contribution to improve product design, using concurrent engineering (GRAEML AND CSILLAG, 2003).

THOMKE AND HIPPEL (2002) believe that R&D activities do not need to follow the same expensive and imprecise processes of the past. Companies would now be able to involve their customers in the development of their products, providing them with the required tools to help with the design activities.

Manufacturing processes, themselves, can be severely impacted by the new technologies. Customers can now customize products by choosing the desired configuration among the options made available from the company's web site. As a result, some production methods and techniques that have been around for quite some time become more relevant. That is the case of "modularization" (STARR, 1965) and "postponement", which suit well the current trend of online dynamic customization. It is also the case of attempts to better integrate

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participants of a value chain: the coordination of “milk-run” and “sequencing” operations becomes much easier and more effective, when the Internet or other electronic network is used to improve communication among the involved parties.

Another area of great interest for manufacturers is e-procurement. Many authors, among whom FISHER (2000) and GILBERT (2000), have called the attention to the benefits of transferring procurement tasks to the Internet. Procurement has become (or will become) central to many companies’ Internet strategies, according to those studies. At the same time the Internet provides good infrastructure to source materials and services, it also becomes an important way of selling products and services.

As more businesses start to happen on-line, models will have to be developed to take advantage of the opportunity of dynamically settling the price of products, based on the customers’ needs and profile, their loyalty to the company and even the evaluation of navigation patterns along the web-site (MOE, 2002).

The Internet also promises to become an important tool for pre-sale actions, in an attempt to increase sales and profitability, as well as for after-sale/support activities, aiming at improving the level of customer satisfaction. In FIGALLO’s (1998, p. 363) opinion, the Web can replace expensive 800-number help lines and paper manuals with easily updated online information and personalized service. This would save companies’ money and please customers at the same time.

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In many cases, an increased distribution of information may replace some of the flow of actual goods, which may be produced, or assembled, closer to the final customer (consumer). Impacts of the use of the Internet or other IT may also be noticed on decisions about quantities to be kept in stock (SKUs), the location of production and the location of inventory. Changes in the products themselves, the manufacturing processes or the way partners coordinate their activities may result. Sophisticated logistics schemes may be put in place, which are possible due to better coordination and integration of the parties involved in sourcing, manufacturing and distribution. Techniques such as “milk-run” for in-bound materials, “parts sequencing” in the production line and “cross-docking” for the distribution of final products become cost-effective and a must, in order to cope with the faster pace of business in Internet time. They all contribute to the goal of “just-in-time” production, which is even more relevant now that the customer helps design and customize the product he/she wants over the Web.

Trends like the adoption of CRM (Customer Relationship Management) may be leveraged by the increased use of the Internet. More data about customers will be available in a digital format, allowing for automated processing of their needs, while providing “personalized” service. Several authors emphasize that the Internet should be used to establish a two-way communication channel with customers. Their reasoning is based on the fact that it is considerably more expensive to attract new customers than to keep current customers satisfied. That has been known for a long time. Only very few companies, however, put the required effort into keeping current customers happy (WALKER, 1991, p. 123). Their sales

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goals usually refer explicitly to attracting new customers, not to pleasing current ones. According to WHITELEY (1996), acquiring new customers costs five times more.

In summary, the Internet infrastructure can be used to improve the value to customers or to make the operation more cost-effective, as has been argued by researchers and practitioners. Much of the previous research on the matter, however, emanated from anecdotal evidence or case studies.

Based on previous work of GRAEML, GRAEML AND EHRLICH (2002), who had summarized the value-adding activities that companies needed to carry out, highlighting those which could be virtualized - depending on the product, the production process, the degree of verticalization of the supply chain and the business model being adopted – the authors of this paper developed a questionnaire to study the actual impact of the Internet and other IT on the operation of Sao Paulo based manufacturing companies. The methodology used in the survey will be described in the next section.

METHODOLOGICAL APPROACH

The reason why the research project focused only on the manufacturing companies in the state of Sao Paulo, and not the whole of Brazil, was convenience. Sao Paulo is the most industrialized state in the country. As one can see in Table 1, Sao Paulo alone is responsible for 36.6% of the workplaces in the Brazilian industry sector. The state's Industrial

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Transformation Value (ITV)² also represents some impressive 49.1% of the country's total. Considering that the state's area is less than 3% of the country's 3.2 million sq. miles, there is a huge industrial concentration in the region. That means that, if at any stage the researchers decided to visit some of the surveyed companies, they wouldn't have to travel very far. In addition to that, researchers gained access to FIESP's³ database. Although the database contained information only about 15279 companies - a little more than 10% of the manufacturers accounted for by IBGE (2003), in the state of Sao Paulo - it was the largest database available to the researchers on industrial companies in Brazil. It also had the advantage of containing e-mail addresses for 11639 of those manufacturers, which allowed the survey to be carried out over the Internet.

² The Industrial Transformation Value (ITV) is a concept used to measure the difference between the Gross Value of the Industrial Production (GVIP) and the Costs incurred in the Industrial Production (CIP). GVIP is the total value of sales and inventory and CIP represents the expenditures with raw materials, fuel, energy, machinery and equipment, repair and maintenance. Measure is for 1997.

³ FIESP stands for the Federation of Industries of the State of Sao Paulo, an entity sponsored by industrialists of Sao Paulo, to promote the industrial development of the state and to increase competitiveness in national and international markets.

Table 1 Relevance of Sao Paulo's industry in the Brazilian scenario

	Sao Paulo	Brazil	Percentage (Sao Paulo/Brazil)
Population (IBGE, 2000)	37,032,403	169,799,170	21.8%
Area (IBGE, 200?)	248,209.426 sq. km (95,833.66 sq. miles)	8,514,876.599 sq. km (3,287,593.85 sq. miles)	2.9%
Workplaces in the industry⁴ (IBGE, 2003)	2,128,716	5,821,711	36.6%
Number of manufacturers⁵ (IBGE, 2003)	144,047	488,664	29.5%
Number of ISO9000 Certificates⁶ (MDCI, 2003)	3,029	5,857	51.7%
ICMS⁷ (FUNDAP, 2001)	R\$ 26.8 billion (US\$ 13.8 billion)	R\$ 71.9 billion (US\$ 37.1 billion)	37.3%
ITV (PACHECO, 1999)	-	-	49.1%
Gross product (MDIC, 2003)	R\$ 370.8 billion	R\$ 1,101.3 billion	33.7%

⁴ As for December 31, 2001. Numbers are for the transformation industry.

⁵ As for December 31, 2001. Numbers are for the transformation industry.

⁶ Up to December 31, 2002.

⁷ ICMS is a value added (non-cumulative) tax somewhat similar to the European VAT, except that the Brazilian version is primarily concerned with goods. The amount of ICMS collected by any state gives an idea of how its economy compares to other states and to the country as a whole. Values shown in Table 1 are aggregate for year 2000 and were converted to Dollars using the rate for January 2, 2001 (US\$1.00 = R\$1.9384), to provide an idea of figures.

Companies were contacted through an e-mail message that had an attached MS Word automated form. Although the questionnaire had 75 structured questions and 60 other fields for optional information, it was conceived in a way that it would not take more than an average of 15 minutes to complete. This procedure allowed for a very good return rate (approximately 7% of the addressed companies returned valid answers).

The structured questions followed a Likert scale, when appropriate. In other cases, they were just check boxes, which could be easily selected or rejected, increasing the speed of answering the questionnaire. The authors wanted the questionnaire to be simple enough to be filled-in at the time the respondents were checking their e-mail. If it were left to be answered at a later time, the authors believed chances of obtaining an answer would dramatically decrease. In fact, that was noticeable: most reply e-mails would arrive in a matter of one or two days. Only a small percentage would spread over the next few weeks and very seldom a message took more than month to be answered. Each company that did not answer after two weeks was sent a second message, in which the authors asked again for their contribution.

A “digital questionnaire” like the one that was used for this e-survey has an important advantage: it is easy to compile and tabulate the data, making the whole process cheaper, faster and reducing the incidence of errors.

The questionnaire was pre-tested, with respect to the content, having been presented to a group of executives working in the field, who conveniently happened to be taking a course at the university. They gave important contributions in order to make the questions more

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accessible and understandable to the "real" participants in a later stage. With respect to the format, the authors randomly separated one per cent of the whole database and sent the questionnaire to those companies a month in advance. No changes in format were found necessary, after the pre-test answers arrived and, by the time the larger group of companies was invited to participate in the survey, the researchers already had a reasonable idea of the return rate that would be achieved, based on the return rate of the pre-test sample.

The questionnaire was sent to the 11639 e-mail addresses included in FIESP's data-base. About 30% of those e-mails returned because the e-mail addresses or servers didn't exist, the mail-box was full, or the server didn't accept relayed messages. By the time data were tabulated for this paper, 655 complete questionnaires had been returned to the researchers, representing ca. 8% of the approximately 7800 messages that were assumed to have been delivered accordingly.

Respondents belonged, therefore, to a convenience sample formed by those companies that answered the questionnaire. Demographic data of the companies comprising the convenience sample were roughly compared to data for the population of manufacturing companies contained in FIESP's database. Unfortunately, FIESP's database used a different classification with respect to the size of companies, which makes it impossible to perform a statistically acceptable validation of the sample as belonging to the population.

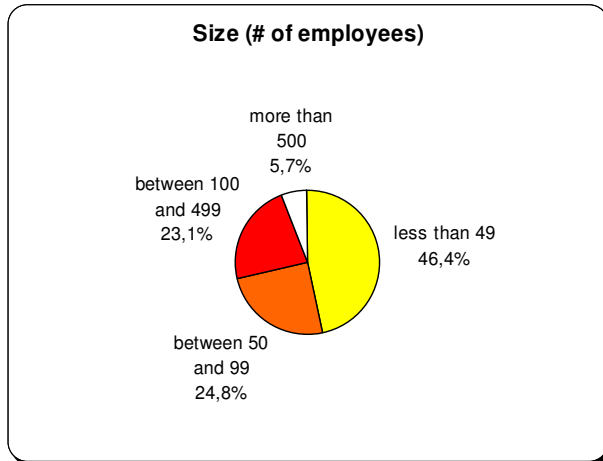


Figure 1: Sample

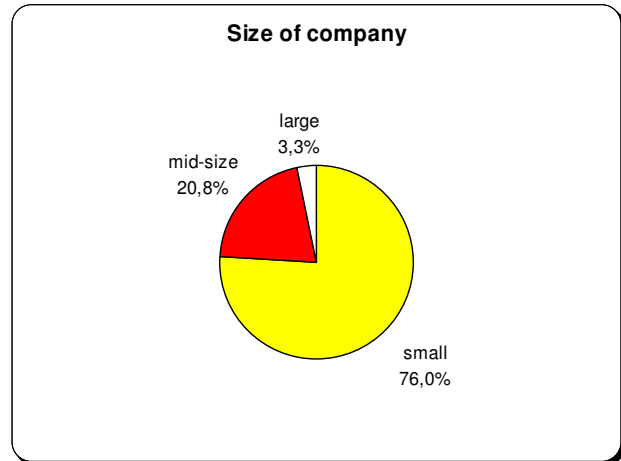


Figure 2: Population

As can be depicted from Figures 1 and 2, the majority of the companies in the sample - as well as in the population - were small (regardless of the criteria being used to determine size). That, of course, has an important impact on the results of this study, because smaller companies tend to adopt new technologies at a different rate and intensity, when compared to larger organizations.

BRAZILIAN MANUFACTURERS' EXPERIENCE WITH THE INTERNET

This section presents aggregate data of the survey, which help understand the stage of adoption of the Internet, other IT and the techniques and methodologies that support its effective use by manufacturing companies in Brazil.

Questions for the survey aimed at measuring:

- the intensity of use of several different tools made available by the Internet;
- recent impact of the Internet and other information/communication technologies on the company's processes and activities (over the last 3 years);
- interest in using technologies, methods and techniques in the near future (next 3 years), which relate or increase the benefit of using the Internet for business purposes.

Questions about what changed over the last 3 years and what respondents expect to change over the next 3 years had the purpose to uncover transformations that are currently taking place in the companies.

It was important to know how manufacturers connect to the Internet. There are several different ways of doing so. The cheapest and most basic form of connection is the one through a regular telephone line. To use that type of connection, one needs to dial the telephone number of the Internet access provider and connect using a modem. Some Internet access providers offer free service, while others charge a monthly fee. The dial-up connection is usually very slow and unsuitable for companies that make intensive use of the web. Alternatives to a dial-up connection include xDSL, cable or ISDN, which provide faster connections, usually referred to as "broad band". The broader the band, i.e., the higher the bit rate the connection can handle, the fastest it is, allowing for seamless data transmission.

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Most companies that participated in the survey have broadband connections. As can be seen on Figure 3, only about 20% (1.7% + 18.2%) of the respondents use dial-up connections.

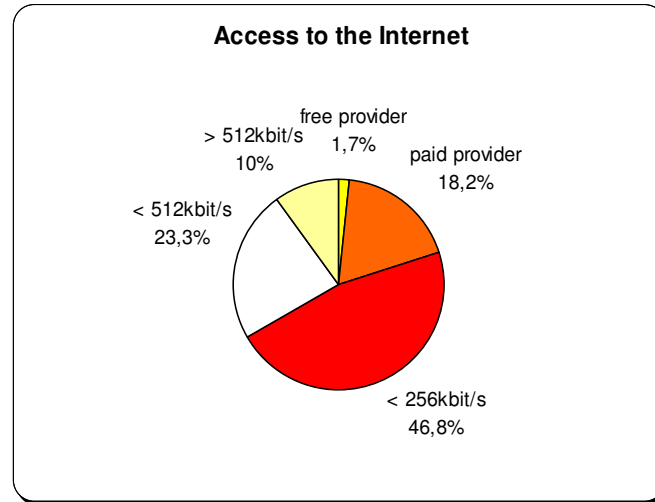


Figure 3

Companies were asked if they had a web-site and if it was hosted in its own domain. Researchers also wanted to know if the company had its own e-mail server, i.e., if the e-mail addresses of its employees were followed by @name_of_the_company. The existence of an intranet and an extranet were also questioned. Figure 4 shows the results to those questions: almost half the companies have intranets, for internal information sharing; extranets, which are extensions of companies' intranets that can be accessed by customers and suppliers, as well as by the organization's own staff from outside the company haven't yet become as popular. Nevertheless, almost one fourth of the companies have already developed some extranet initiative. A very high percentage of companies have their own domain (82.9%), an active web-page (85%) and an e-mail server (79.2%). That is particularly interesting,

considering that more than 70% of the companies are relatively small (less than 100 employees).

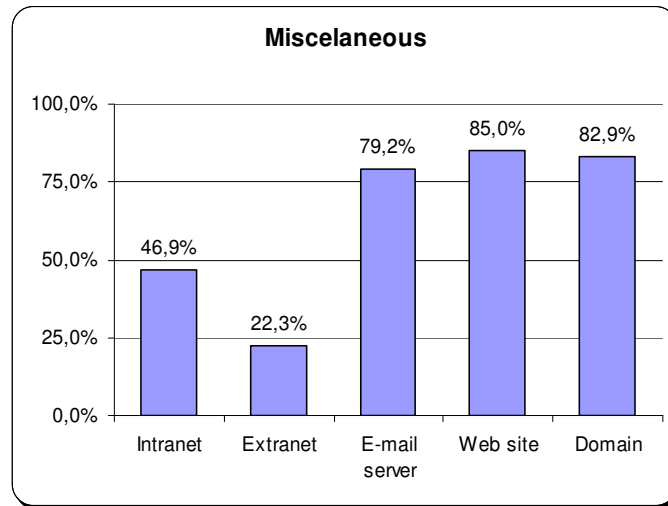


Figure 4

ALBERTIN (1999) argues that displaying products and services is one of the first efforts of companies that decide on using the Internet for business, in a stage when they haven't yet figured out or are still not prepared to develop the full potential of the new business channel. At that stage, according to GRAEML, GRAEML AND STEIL (2001), web-sites work more often as "display windows" than as "cash registers". That still seems to be the case for the manufacturing companies surveyed in Brazil, as can be seen in Figure 5. They use their web pages, primarily, to build their image and to advertise products (85.3% and 81.1%, respectively). That same behavior had previously been observed by GRAEML, BEER AND CSILLAG (2003) when they surveyed software companies in California, to understand the use they made of the Internet. According to BROWN (2003), companies' web-sites miss the mark

when it comes to supporting revenue-generating transactions, because they put a lot of emphasis on displaying institutional data and on advertising their products and services. Only afterwards, they start thinking of effective ways in which the web can be integrated to their business processes and practices.

At least, there is some attempt to use web sites to improve support (after-sale) and feedback from customers. These two areas are very promising. Manufacturing companies may discover that providing more service to customers may represent an effective weapon, used to differentiate their product from the competition.

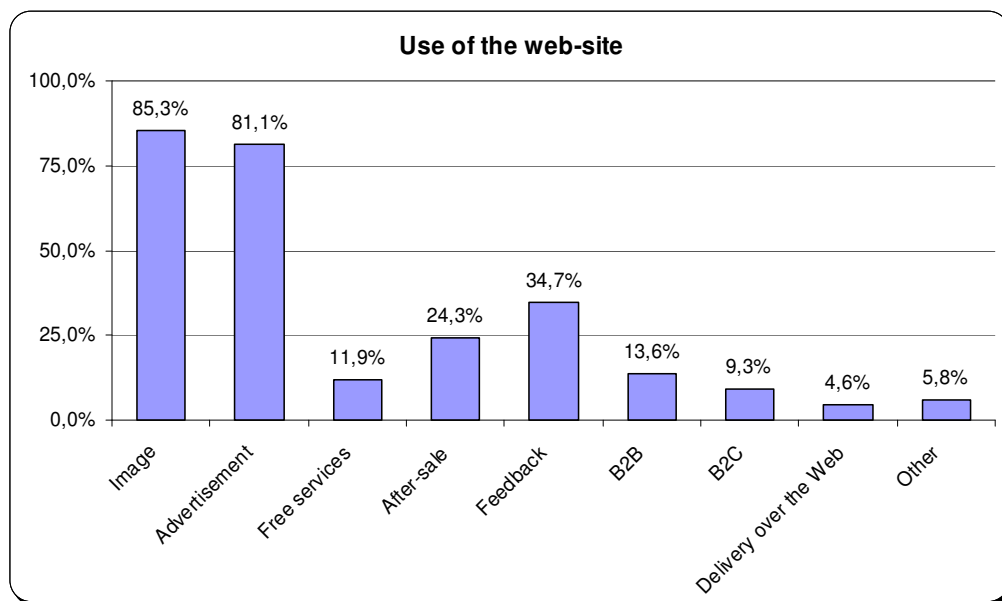


Figure 5

Companies were asked about the intensity with which they used several tools made available in the Internet. E-mail was, by large, the most disseminated tool. Participants were offered a drop-

down set of choices, for each of the tools, from which they could choose: “no use”, “very small use”, “small use”, “moderate use”, “large use”, “very large use” or “essential to the business”. Figure 6 shows the percentage of respondents that claimed to have at least a “moderate use” of the tool. Web conferencing and chat (text and voice) are promising tools for the communication with colleges, partners and customers. They haven’t quite developed yet, however.

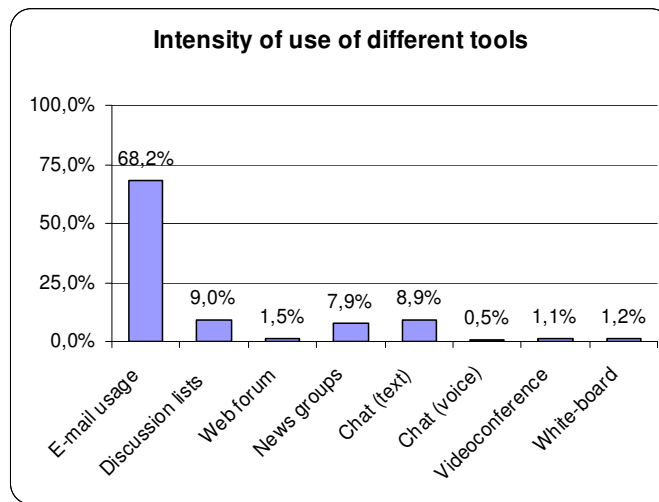


Figure 6

Then, respondents were asked if the Internet and other information/communication technologies resulted in changes on the way several processes and activities were carried out, over the last 3 years. A drop-down set of choices was made available, including the following alternatives: “no change”, “very little change”, “little change”, “reasonable change”, “significant change”, “very significant change” or “radical change”. Figure 7 shows the percentage of companies that claimed that at least “reasonable change” occurred. For the majority of processes and activities, at least 20% of the respondents considered their companies had faced considerable change.

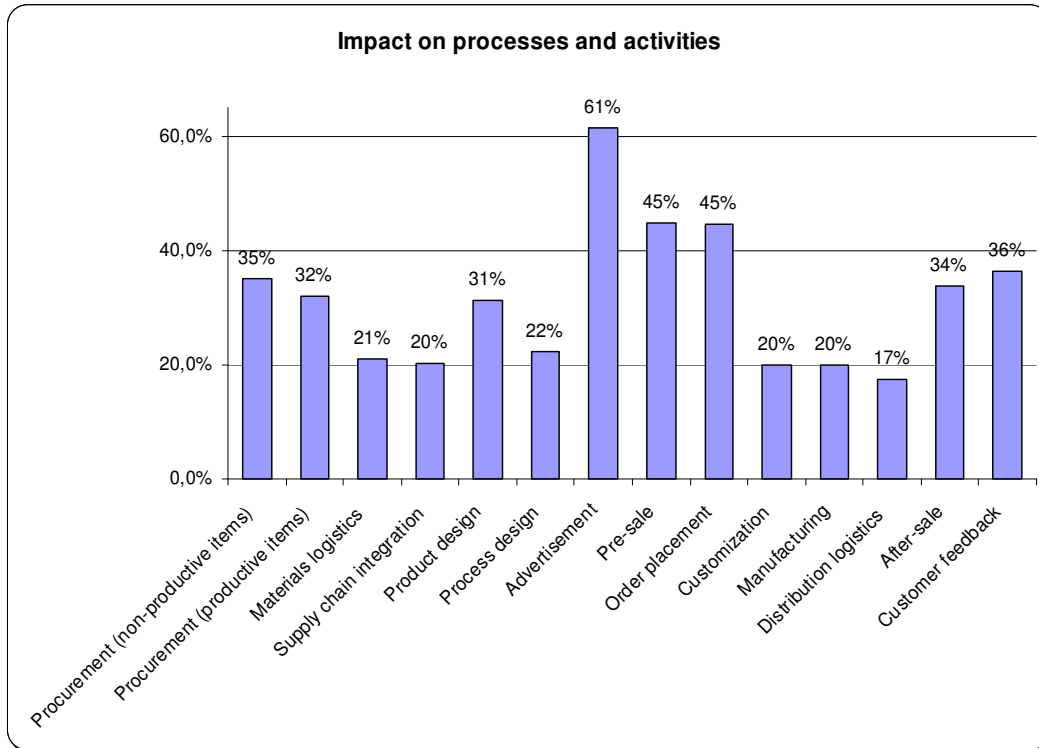


Figure 7

At last, companies were asked to point out technologies, methods or techniques that they were using, or intended to start using over the next 3 years. The list of methods and techniques that was submitted to the surveyed companies (see Figure 8, below) includes items that may not seem, at a glance, to directly relate to the use of the Internet by the organizations. It is not convenient to spend time justifying the inclusion of such items, here. The authors of this paper have strong reasons to believe that each and all of these methods and techniques can either be empowered by the Internet or increase the benefits of its adoption (or both).

Respondents were presented with the following options from which to choose, for each of the methods/techniques: “no intention to use (next 3 years)”, “is going to use (within 3 years)”,

“very little current use”, “little current use”, “moderate use”, “used a lot” or “essential to the business”. Figure 8 shows two bars for each surveyed item. The first bar indicates the percentage of companies that currently use the method/technique, at least moderately. The second bar shows the percentage of respondents who believe their companies will be using that method/technique within the next 3 years (that includes the companies that already use it, to a moderate or higher extent).

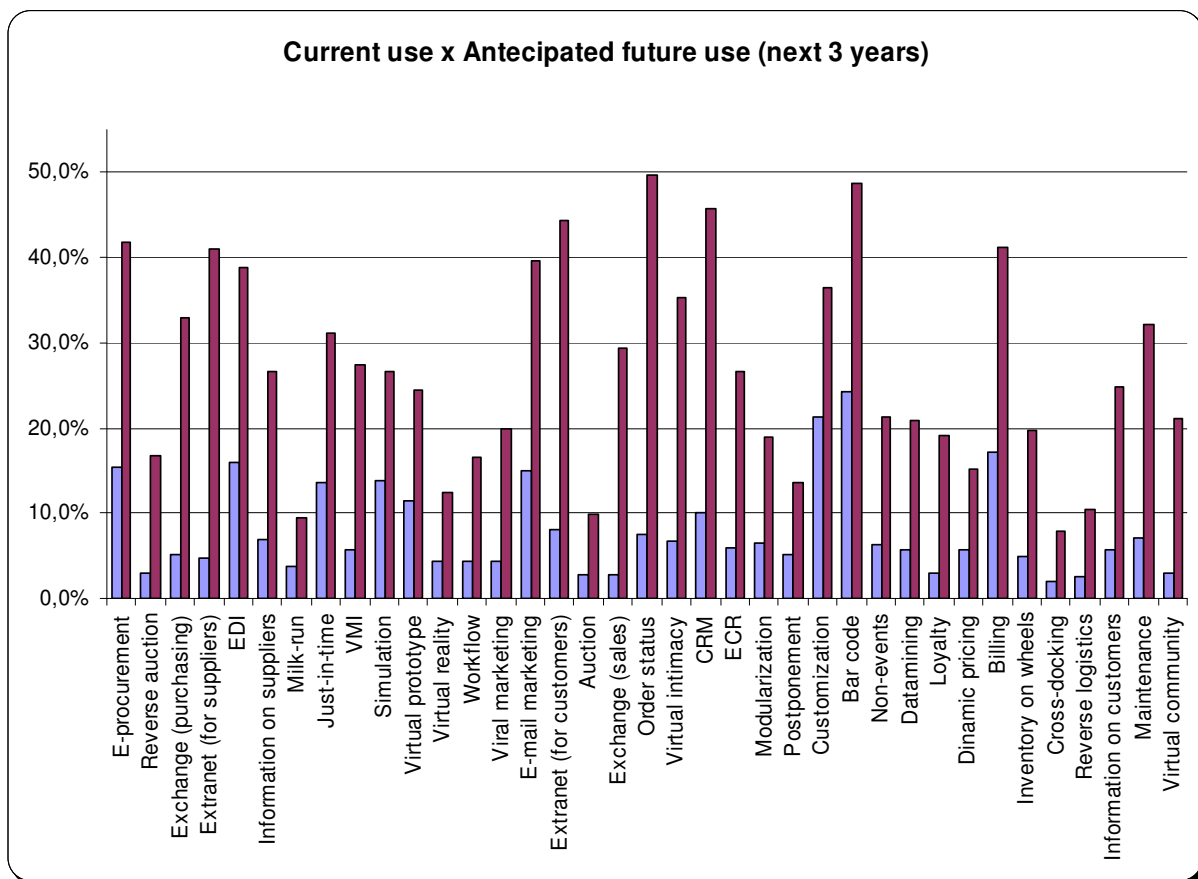


Figure 8

Several methods/techniques will expand at a fast rate, if the respondents' expectations are confirmed. Almost 50% of the companies, for example, intend to provide means for their customers to follow-up the status of their orders through the Internet (49.8%). E-procurement (41.8%), extranets for suppliers (41.1%) and for customers (44.4%), CRM (45.8%) and billing (41.2%) are other areas where great changes are expected. The trend for bar code automation will go on: 24.2% of the surveyed companies believe they currently make at least moderate use of that technology, but 48.8% expect to be using it within 3 years from now.

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

As it could be noticed, manufacturing companies are still far from being able to explore the Internet's full potential. Methods and techniques, which will support a more effective use of the web for business purposes, and which will also be supported by the Internet to become, themselves, more useful tools to provide a competitive edge, are being introduced at a fast rate. One should not consider the Internet as the only factor responsible for the changes described in the previous sections, however. Other IT advances precede or happen along with the introduction of the Internet in the corporate environment, contributing to another "wave of e-evolution".

The fact that digital prototypes are not "physical" as their traditional counterparts, for example, provides them with those "magical qualities" that, according to GEOFFRION AND KRISHNAN (2001), make them perfect for the Internet. The Internet would be much less

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useful to that specific design activity if other technologies had not been made available, such as CAD, high-quality computer monitors etc.

Physical constraints that made collective, shared and simultaneous work so difficult in the past are not a problem anymore. Design activities can become much more dynamic and inclusive, in the sense more people can contribute to them. Not only different design teams can work together on the same project from remote locations, but the customers, themselves, can interfere with the development and production of items they want, fine-tuning the product to specific requirements and starting the manufacturing process.

Although this research project concentrated on manufacturing companies, there is a vast field of research ahead of those who wish to study the impacts of the Internet on other areas, such as service companies, government, agriculture, education and health organizations. Part of the questionnaire applied in this study, could also be used in surveys addressing those other fields, although questions on manufacturing techniques and methods would, of course, need adaptation or elimination.

About 500 hours have already been spent on this project, in the activities of formulating the questionnaire, pre-testing and applying it, communicating with respondents, handling the data and developing the preliminary analysis that was presented in this paper. Next steps involve analyzing the huge amount of data that was generated by the 655 respondents using more sophisticated statistics. The authors are particularly interested in working with factor analysis and clustering. They believe that interesting results may arise from the use of multivariate

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techniques, concerning patterns of adoption depending on the size, or the specific business a company is involved with, for example.

One thing has already become clear, the Internet-driven transformation of the organizations, though radical in its promised effects, does not necessarily happen at as fast a pace as one might expect. It is not just a technology shift. Processes have to be redesigned to take advantage of the new technology available and its infrastructure. In many cases, whole businesses need to change. Such deep restructuring involves and affects the organizations and their people in profound ways. That kind of transformation will not happen to the extent it could (and should), if managers do not concentrate in handling arising issues that may prevent the desired changes to occur. MORTON (1988) wisely alerts to the fact that changes in technology or business processes have to be well-balanced and aligned with relevant changes in the company's strategy, its organizational structure and people's roles. Otherwise, the desired positive effects will not be achieved and the change initiative will only waste time and generate frustration.

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