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Preliminary Communication

Information Technology in Small Medium Enterprise: Logistic and Production Processes

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Abstract

This paper presents and discuss a survey which describes how small-medium enterprises (SMEs) implement and use their information system with respect to their logistic and production processes.
The study first describes the rationale of the research, then it identifies the characteristics of the companies and detects their general attitude towards information technology (IT). In the following section the paper presents a set of detailed processes to verify the structure and workflow of companies and how IT supports their processes. In the last part we study the influence of some company characteristics to effective use of processes and to different technological approaches, to support defined logistic and production processes.
The novelty of the study and its interest, both in academic and institutional context as in the real world, resides in the opportunity to verify and understand the different attitudes of SMEs towards information technology in defining, organizing, planning and control their processes.
Keywords: small-medium enterprises, business information systems, production systems, logistic systems

1. Introduction

The present study is aimed to analyze, with special attention to the SME sector, the level of coverage that the information system provides with respect to logistic and production processes, examining how they are developed and implemented in company organization [2], [12], [15].

We believe that the novelty of the study and its interest, both in academic and institutional context as in the business world, resides in the opportunity to appreciate the attitude of SMEs towards information technology in defining, organizing planning and control their processes [7], [13], [14], [23].

The main function of IT was initially recognized in process automation; only later, other factors, such as knowledge representation and issues related to the activity planning, contributed to the evolution of enterprise Information Systems [27]. Clearly the evolutionary path taken by IT, from a mere support tool able to replace the human

operator, became a vehicle for change essentially in two directions: the integration between areas and the innovation of processes [10], [18], [24], [25].

The principal approach is with Enterprise Resource Planning (ERP) systems whose main prerogatives are control and optimal management of resource flows within the organization [8], [11]. They are composed of subsystems natively integrated in terms of computer architecture and logic design; the sharing of a common database allows a consistent representation of reality; they permit procedures to enable the interaction and cooperation of management dependencies [9], [29], [31].

Sometime, particular functions of ERP systems are substituted or integrated by Specialized software tools.

In many cases also other less structured approaches are followed, both with Office Automation tools, such as Excel or Project, both, to a lesser extent, with totally manual procedures.

2. The rationale of the study

The aim of the survey is to assess the approach of SMEs towards IT in organizing their logistic and production processes verifying the type of information system adopted [22], [26], [28], [30]. It is well known that the diffusion of information technologies and their extensive use is higher in large companies; thanks to their size, they can justify higher fixed costs, benefit from a higher attraction of skilled labor and enjoy easier access to financial capital. Equally obvious is also the diversity of the role and weight that innovation and investment in IT-intensive sectors, play in skilled labor and technology. In this sense, then, it is clear the interest and utility to monitor the reality of SMEs and their approach to IT [4],[5], [6], [16], [17].

The Friuli Venezia Giulia region (Nord-East Italy), especially in the last years, shows lively and active attention to the promotion and support of innovation, shared commitment across the board in universities, businesses and institutions.

The economic system of the Friuli Venezia Giulia is characterized by traditional industries: furniture, metallurgy and manufacture of metal products and machinery. However, the growing weight taken over the years by the field of electrical and electronic equipment and in part construction stands out positively. Mirror of Friuli Venezia Giulia is undoubtedly the Province of Udine, not only for the importance in terms of the number of local units (almost 47%) and employees (44%), but also for a production system very similar to that regional. These reasons justify the choice of these SMEs as a reference universe for our survey. Based on the information available at the Industrial Association of the Province of Udine, it was built a sample of all firms reporting a turnover between 5 and 50 million euro, eliminating previously non-homogeneous ones from the point of view of processes or as part of specific areas of the service sector. It was so granted the membership of the sample in the categories SMEs and at the same time, company size sufficient to allow investments in IT potentially significant.

The study is based on data collected through questionnaires. Each questionnaire was first sent to the interested companies and then compiled during an interview conducted at their seat, in order to ensure adequate support and a better control over the quality of the responses.

The questionnaire consists of several pages and is divided into three main sections. The first and the second identify the characteristics of the enterprise and detect their general attitude towards information technology. These data were usually compiled by administrative offices. The third part consists of a detailed list of production and logistic processes; it is exhaustive, but broad enough to reflect the structure and workflows of most companies [1], [3], [19], [20], [21]. For each process we required if it is present and, in the event, to indicate whether it is principally supported by electronic means or manually managed. If it supported by electronic means, it must be defined the information system principally adopted, according to three types: ERP, Office Automation, specific ad hoc developed system (Specialized Systems). For this technical analysis of the processes about half the interviews had as counterpart the company IT manager, in other cases the operational responsible for the processes.

To facilitate the exposure of the results, we grouped detailed production processes in five macro-areas

- Management of Structural data: Bill of materials, Operations definition, Factory layout, Production calendars.
- Definition and Analysis of Production Costs: Material and operation cost definition, Roll-up costing.
- Planning and scheduling: Master production Schedule (MPS), Material Requirement Planning (MRP), Capacity Resource Planning (CRP), Detailed production scheduling.
- Internal operations definition and control: Internal Production Orders, Operation definition and accounting.
- External operations definition and control: External production orders, Operations definition and accounting.

Alike we grouped detailed logistic processes in five macro-areas

- Management of structural data: Coding plane, Products data, Factory layout.
- Transactional data: Warehouse handling.
- Specialized requests: Batch management, Serial number management, Storage sectors, Automatic warehouse.
- Inventory: Warehouse costs, Rotation inventory.
- Analysis and control: Stock, Product availability, Handling control.

At last we did a statistical analysis of

- the characteristics of the sample;
- the motivations and the difficulties encountered in activating the Information System;

- the absent/present processes divided by macro-area;
- the type of technology used the present processes;
- the influence of the size of companies and their sectors of activity on the type of technology used.

The aggregate results of the analysis are presented and discussed in the following paragraphs.

3. The analyzed sample

The final sample is composed of 37 companies, half of which, approximately, has been active for more than 30 years (only 9.5% came from less than 10 years). 40% of companies have not important relationships with foreign countries (share of turnover of less than 20%); also 40% are involved in the exports with more than 60% of turnover. Almost all of the latter group is composed of metalworking and furniture firms, the sectors most represented in the sample [Table 1].

Activity	%
Metalworking	42.9
Furniture	28.5
Electrical/Electronic	20.0
Construction	8.6
Total	100.0

Table 1. Sample composition by Activity

Employees	%
<50	28.6
50-99	40.5
100-150	21.4
>150	9.5
Total	100.0

Table 2. Sample composition by Employees

Turnover	%
<10	26.8
10-19	41.5
20-39	24.4
>40	7.3
Total	100.0

Table 3. Sample composition by Turnover

Both in terms of staff employed [Table 2] and turnover [Table 3] the companies fall mainly into the category of SMEs (staff employed between 50 and 249 units, annual turnover between 11 and 50 million Euro) .

4. The attitude towards information technologies

About the question of the fundamental reasons of the decision to acquire information technology, the companies are in agreement especially on two factors: the performance improvement in their processes and the reduction of costs.

There is, however, who points out other causes, such as compliance with external legislative constraints (for instance detailed tracing of logistic movements, different models of inventory evaluation), alignment with corporate strategy and adjusting its position relative to competitors [Table 4].

Motivation	Points
Effectiveness	59
Efficiency	49
Law constraint	35
Competition	12
Strategy	11
Process advantage	7
Innovation	7
External production chain	4
Core business	0

Table 4. Motivation of IT investment

It is significant the "zero" assigned to the need for strengthening the core business, probable sign of a widespread difficulty in recognizing in the management of information systems as a source of competitive advantage.

Difficulties	Points
Target definition	33
Problems origin identification	25
Training	24
Internal resistance to change	20
Technical definition	17
Cost/Benefits	15
Internal competence	15
Software/Hardware	13
External competence	5

Table 5. Difficulties in IT adoption

This is consistent with the well-established tendency to concentrate the critical knowledge for the SMEs in the hands of a small group of people (if not the only entrepreneur). This approach inevitably limits the innovative potential of information technologies.

There is not the same convergence, however, to recognize the obstacles on the way of the adoption of information systems.

However, a few inconveniences prove more serious than others: the definition of the objectives and functional specifications, identification of problems and causes, staff training and internal resistance. Reading data from the opposite perspective, the only item on which there is a broad agreement is the easy availability of outside expertise [Table 5].

5. The technologies used in logistic and production processes

As already mentioned in the previous paragraphs, the main section of the questionnaire consists of a list of detailed processes, divided by macro-areas and, at an upper level, by functional area (logistics and production). For each of them, it was required to specify, if practiced, the type of information system that supports the process.

The variety of economic sectors and the particular areas in which each company competes require, first of all, a verification of the presence at all of the mentioned processes. With our sample the companies declares in the average the 67.5% presence of the proposed process. The absence of processes respectively 32.6% (logistic) and 32.5% (production), often is referred to specialized requests, as rotation inventory or detailed production schedule. The global data is satisfactory and ensures comparability between both companies established both the representativeness of results.

Table 6 analyzes in detail the absence of processes in the logistic macro areas. Definition and management of structural data and Warehouse handling are the areas more covered and managed; Inventory and other Warehouse analysis follows with a coverage of about 70%. Only Specialized requests, like rotation inventory, are very poorly treated used only in particular conditions.

Logistic	**%**
Structural data	19.0
Handling	14.3
Inventory	28.6
Analysis/Control	31.0
Specialized requests	70.0

Table 6. Logistic: percentage of absence of defined processes by Macro areas

Table 7 analyzes in detail the absence of processes in the production macro areas. Definition and management of Structural data and Costing are the areas more covered and managed; Planning and management of Internal operation follows with a coverage of about 65%. The External operation are the lesser managed, probably used only in particular conditions.

Production	**%**
Structural data	26.2
Costing	25.4
Planning	36.7
Internal operation	34.5
External operation	39.7

Table 7. Production: Percentage absence of defined processes by Macro areas

SMEs show a high level of computerization: personal utility tools are used, in fact, from 95.2% of them, confirming it as the basic support that organizations use. However, more sophisticated technologies have a large diffusion: Specialized Systems (83.3%) and ERP (78.6%). It is possible to appreciate the average degree of coverage that each kind of technology provides to the company's logistic and production processes [Table 8].

Immediately visible is the positive data represented by the remaining part of the processes (3.7%) performed without the aid of computer. The ERP is the system that provides larger support (62.6%) among SMEs.

Technology	**%**
ERP	62.6
Specialized Systems	17.8
Office Automation	15.9
No System	3.7

Table 8. Percentage of coverage of Logistic and Production processes by Technology

Reasoning on the value of ERP coverage, despite being the highest, it is remarkable that about than 37.4% of the processes, on average, do not use a management system that by its nature is intended to provide a complete and integrated support to the operation. It has already been pointed out to the flexibility that allows partial implementation in independent functional modules, but it does not seem to be the only explanation that justifies the data set out above.

The result appears more clear when considering only organizations with ERP; the share of SMEs in which this information system supports more than half of the process is 66.7%; of these, however, only 36.4% have coverage by more than 70% of

the process, in a quite articulate and extended mode to be consistent with the fundamental characteristics an integrated information system. In Table 9 and 10 we analyze in detail the different logistic and production macro-areas.

In logistics undoubtedly ERP systems are the most used and offer greater levels of coverage, with a peak, as indeed predictable given the volumes involved, in the procedures for Handling and especially in Inventory.

The Office automation is relatively widely used in the management of the structural data, for its simplicity in associating to individual items sheets and/or design and/or images. It is little used in the procedures that treats large data sets as the Handling and Inventories.

Symmetrically Specialized Systems are less used in procedures with greater sets of data and more in the processes of Analysis and Control.

Logistic	% ERP	% Specialized Systems	% Office Automation	% No System
Structural data	67.0	12.7	16.4	3.9
Handling	76.8	14.4	6.0	2.8
Inventory	80.6	14.7	4.7	0.0
Analysis/Control	68.5	17.6	10.5	3.4
Specialized Requests	58.5	19.8	18.5	3.2

Table 9. Percentage of coverage of Logistic processes by Technology and by Macro-areas

Production	% ERP	% Specialized Systems	% Office Automation	% No System
Structural data	69.4	16.8	10.6	3.2
Costing	55.4	15.5	24.9	4.3
Planning	40.6	16.0	32.7	10.8
Internal operation	42.7	31.7	22.1	3.6
External operation	66.9	19.0	12.9	1.3

Table 10. Percentage of coverage of Production processes by Technology and by Macro-areas

The Specialized requests, that are relatively not very present, have the least use of ERP systems (often just they are not present in ERP systems) and are divided between the Specialized Systems and Office Automation.

The manual operation is very low everywhere, with a “zero” in the Inventory procedures.

In the area of production systems, ERP systems are still the most common, but certainly to a lesser extent than in other areas. They are widely used in the definition and management of the Structural data such as bill of material (BOM), and Costing (that are related to structural definition). But there is a relatively low use in the procedures of Planning and management of Internal operations. Regarding the

Planning area, analyzing the raw data it is observed the MRP is widespread while other planning procedures, such as CRP or MPS, are lesser used.

The high percentage in External operations should be evaluated considering that they are relatively rarely used and, when present, require a strong link with purchases and logistics and therefore the use of an ERP system is very useful.

Office automation is used in support of Costing and Planning operation, while Specialized System are more used in Internal and External operation.

Manual operation is almost absent, with the exception of planning that is, in low percentage, always done without information support.

Analysis of data shows some fragmentation of the information system for SMEs where we find the parallel use of different technologies in support of the same functional area. The most likely causes, and not necessarily alternative, seem to be two: widespread provision of basic management packages (less restrictive in how to use and less invasive in terms of organization than sophisticated ERP), or implementation and use of the management system often inadequate.

6. The influence of Enterprise characteristics on technological solutions

We have deepened our analysis trying to assess how certain characteristics of companies influence the technological solution adopted. The results here reached must be mainly considered as indicative trend, because the evaluations, given the relative small size of the sample in the single sets, may be influenced by the individual business situations.

Although we collected many companies' parameters, we focused on three characteristics, already presented here in section n. 3. In particular we analyzed the influence of different business activities and of two dimensional parameters, namely the turnover and number of employees; in these last parameters we merged the two higher classes to avoid working with too small sets of analysis.

6.1. Enterprise size

We analyzed the influence of Enterprise size, considering both the Turnover and the Employees. First of all, we analyzed the process coverage, verifying the absent processes. The results for parameters of turnover and number of employees are visible in Tables 11 and 12.

Turnover	Production	Logistic
<10	48.5%	35.2%
10-19	36.0%	34.2%
>20	14.3%	28.3%

Table 11. Percentage of absence of defined processes by Turnover and by Production/Logistic

Employees	Production	Logistic
<50	52.4%	36.4%
50-99	27.3%	31.3%
>100	20.8%	30.7%

Table 12. Percentage of absence of defined processes by Employees and by Production/Logistic

With the analysis of the data we can say

- both in terms of turnover and number of employees, with increasing size, grows the number of processes that are actually defined in the company (decreases the rate of absent processes);
- in both cases, the phenomenon is more accentuated in the production process and less in logistics processes.

We continued detailing the analysis, considering only defined processes and verifying the type of used coverage. With regard to logistics processes the results are reported in Tables 13 and 14.

We see that the growth of turnover from first to the two upper classes, implies an increase both in the use of ERP and Specialized Systems. Note that both underlie a vision of "structured" computerized approach, desirable at the growth of the economic volume handled by the company. Similarly, respect to smaller companies, there is a significant decrease of Office Automation tools that represent an unstructured approach. The manual approach is negligible in all subsets.

Turnover	% ERP	% Specialized Systems	% Office Automation	% No System
<10	65.6%	11.9%	20.5%	2.0%
10-19	72.1%	18.2%	6.1%	3.6%
>20	71.8%	16.0%	10.2%	2.0%

Table 13. Percentage of coverage of Logistic processes by Technology and by Turnover

Employees	% ERP	% Specialized Systems	% Office Automation	% No System
<50	77.1%	0.0%	19.8%	3.1%
50-99	58.2%	32.2%	7.7%	1.9%
>100	80.2%	8.4%	8.1%	3.3%

Table 14. Percentage of coverage of Logistic processes by Technology and by Employees

Regarding the table related to employees, we note that the smaller industries (first subset) do not use Specialized Systems and their work relies in a significant part (about 20%) of unstructured tools of Office Automation. Conversely, the greater companies (second and third subsets) use structured tools (ERP and Specialized Systems) with an overall percentage of around 90%. It is interesting, however, to observe an important use of Specialized tools in mid-range group (not visible in the table of Turnover), probably related to a specific group of companies, as we will check also with subsequent analysis. Also in this table the manual approach is negligible in all subsets.

With regard to production processes the results are reported in Tables 15 and 16

Turnover	% ERP	% Specialized Systems	% Office Automation	% No System
<10	41.3%	20.5%	28.5%	9.7%
10-19	58.6%	20.2%	19.1%	2.1%
>40	60.6%	18.8%	16.6%	4.0%

Table 15. Percentage of coverage of Production processes by Technology and by Turnover

Employees	% ERP	% Specialized Systems	% Office Automation	% No System
<50	55.1%	7.4%	24.8%	12.7%
50-99	42.2%	33.3%	22.5%	2.0%
>100	70.8%	12.9%	14.9%	1.4%

Table 16. Percentage of coverage of Production processes by Technology and by Employees

In these tables, the situation seems better outlined and in particular we notice

- a significant increase in the use of structured tools, ERP or Specialized Systems, to grow the size;
- a significant decrease of Office Automation tools as size increases;
- a still low use of manual methods in the medium and high classes, but significant in lowest group; it is explained by the objective difficulty for smaller companies to use computer tools even if not structured to solve production problems;
- the presence in the intermediate group of a sensible use of Specialized Systems also in the production area, as already seen in the logistics area, probably related to a particular group of companies, as before explained;
- the use of structured technologies (ERP and Specialized System) lower here than in logistic area.

6.2. Enterprise activity

At the end we considered for the two main areas the influence of enterprise business activity.

Also here, as a first step we analyzed the coverage of processes, checking the absent ones. The results are visible in Table 17.

Activity	Production	Logistic
Metalworking	28.8%	32.2%
Furniture	30.3%	30.0%
Electrical/Electronic	36.0%	28.6%
Construction	50.5%	52.4%

Table 17. Percentage of absence of defined processes by Production/Logistic and by Activity

We can say that in Metalworking, Furniture and Electric/Electronic industries the process's coverage is fairly homogeneous both for production and for logistics, fluctuating between about 64% and 71%. The Construction sector appears the one that has less activated processes (just under 50%). This is certainly understandable given the special nature of its work and we will discuss this in the following, analyzing the coverage by Technology

We concluded detailing the analysis only for defined processes, verifying the type of used coverage.

With regard to logistics processes the results are reported in Table 18

Activity	% ERP	% Specialized Systems	% Office Automation	% No System
Metalworking	66.9%	20.7%	9.5%	2.9%
Furniture	90.0%	6.1%	3.9%	0.0%
Electrical/Electronic	51.3%	18.5%	23.1%	7.1%
Construction	63.3%	18.9%	17.8%	0.0%

Table 18. Percentage of coverage of Logistic processes by Technology and by Activity

The sector with the greatest impact on the use of ERP tools is undoubtedly that of furniture manufacturers; this is probably due to the fact that it is a "consolidated" field with a considerable amount of materials handled, whose single value is relatively low; often the presence of technical configurators probably plays an important role because they lead to an explosion of combinatorial coded articles, hardly approachable without ERP systems.

The other activities are supported by a percentage of around 20% by Specialized tools, it is assumed due to objective complexity of logistics processes, often with large amount of components used (especially the Metalworking and Electrical/Electronic); with significant percentages both Constructions and Electrical/Electronic sectors also avail themselves of Office Automation tools: both choices seem related to the difficulty of finding in market the structured products (ERP or Specialized Systems) able to solve some specific material processing issues.

With regard to production processes the results are reported in the Table 19

Activity	% ERP	% Specialized Systems	% Office Automation	% No System
Metalworking	53.0%	25.8%	15.8%	5.4%
Furniture	70.2%	6.1%	18.4%	5.3%
Electrical/Electronic	48.7%	27.6%	20.7%	3.0%
Construction	23.7%	18.8%	55.3%	2.2%

Table 19. Percentage of coverage of Production processes by Technology and by Activity

Even in the manufacturing sector the greatest impact of the use of ERP tools is in the Furniture factories, albeit with significantly lower percentages respect logistic; usually the production processes in this activity have not high complexity and thus can also be managed with standard ERP tools.

Both the Metalworking sector that the Electrical/Electronic one, have a massive use of Specialized tools, this probably tied to a complexity of manufacturing processes that rises significantly in these two areas and therefore implies the use of specialized software.

Discourse in itself deserves the Construction industry, which notoriously has very specific production problems, linked to the concept of "order/plant" (type ETO, Engineering To Order); these issues are very different from those managed with highly structured procedures, and in fact over 55% of the processes is approached through Office Automation tools.

7. Conclusions

The sample of SMEs surveyed showed a good level of computerization in logistic and production systems, guaranteed, in particular, from the ERP. However, there are important differences of the used technology at the growth of company size and also in different business sectors.

The analysis by functional macro-area has also emphasized that the use of computer technology is often inadequate, resulting in a messy support to enterprise management, in several situation with a large use of unstructured “Office Automation” tools and sometimes also with manual activities.

A partial coverage of the processes especially in the smaller companies and, not least, the difficulties encountered in completing the questionnaire help to reveal, therefore, a mentality unwilling to look beyond the purely technical aspects of the application of IT and difficult to recognize in them an opportunity growth and innovation.

Undoubtedly, the challenge for the future goes through a better and more coherent use of information systems, in particular ERP systems that are aimed at integrating the various business functions.

Not least it is the need to consider the information system not a simple tool, often replaced by spreadsheets or similar unstructured applications, but the heart of the organization and control of business processes

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