AN EXPLORATORY STUDY ON THE INTEGRATION OF INFORMATION SYSTEMS IN MANUFACTURING

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1. INTRODUCTION

The practices of manufacturing management have been changing rapidly over the last decade. Among the major changes one can see are:

a) the renewed attention to manufacturing as a competitive weapon; and,

b) a focus on using more fully the deployment of physical assets, raw materials and components rather than an emphasis on reducing direct labour costs.

The renewed attention to manufacturing as a competitive weapon stems from the work of Skinner (1969) and later of Hayes and Wheelwright (1984) and Buffa (1984) amongst others. All argued that technology in general and manufacturing technology in particular are not neutral elements in the definition and implementation of a company strategy. They stressed also that the mission of the manufacturing function is not to improve cost efficiency, but rather to fix objectives on quality, flexibility, dependability and cost efficiency.

Within this mission, flexibility has traditionally been associated with a job-shop-approach to manufacturing, relying on a limited use of general-purpose machines and a highly skilled and adaptable labour force. However, the technological developments of the last decade have spawned a range of programmable automation systems. Of these systems automated production, in particular, supports the combination of flexibility with efficiency. Flexibility is improved and hinges on the clever combination of automated systems which have been in use separately for some time, such as Computer Aided Design and Machining, Materials Handling Systems, Process Controls, Administrative Planning and Control Systems, etc.. A recent report by the US Office of Technology Assessment (1984) asserts that the most compelling aspect of automation in manufacturing is its convergence towards what is commonly described as Computer Integrated Manufacturing:

> The linking of design and manufacturing is the most established initiative in this area, with numerically-controlled machine tools permitting the designer to automatically generate tapes for machine control. Direct Numerical Control now permits the designer to download the program directly to the machine. The communication is not only one-way, either: criteria of producibility can be built into design data-bases alerting the designer to the constraints of the available manufacturing technologies before, rather than after, the design is sent to manufacturing. Links between design and administration permit the establishment of Bills of Materials and process plans directly from the design data base. Links between manufacturing and administration in Flexible Manufacturing Systems permit the direct control of inventory and materials flow integrated with tightly coupled machine systems.

A new challenge for manufacturing is to exploit the possibilities offered by these flexible automation systems. In practice this requires the integration of different systems. This integration must not only to be considered as a technical matter but also in planning a company's strategic direction. However, which systems are to be integrated and for what goals?

The second major area of change in manufacturing management has to do with a shift in the structure of manufacturing costs. The proportion of direct labour costs to total manufacturing costs has decreased in the last decade, compared with other elements of manufacturing cost, such as energy, raw materials, components and manufacturing overheads. In a recent study, (Ferdows et al. 1985) it was found that for a sample of large manufacturing companies in Japan, North America and Europe, the proportion of direct labour costs is on average less than 15% of the total manufacturing cost. As a consequence, cost savings in the direct labour force tend not to be realisable whereas more effective cost saving programmes often assert economic use of materials or a higher exploitation of capital equipment and management systems. Many programmes of recent manufacturing policies, such as Just-in-Time or Total Quality Control are evidence of this shift in focus.

Here again, reviews of literature (Axelsson, 1985) on the use of Computer Integrated Manufacturing systems (CIM) indicate that these systems can contribute to time saving in product development and production cycles, reduced consumption of raw materials, lower work-in-process and finished goods inventory, less scrap and rework, higher quality and, generally speaking, increased productivity. The challenge to management contained in the use of CIM systems is often less in the design of the system than in its implementation (Voss, 1985, Gerwin 1981). Tools and machines are in use or can be modified, but the real challenge is the implementation of an integrated system of centralised and decentralised databases and communication links which will enhance a company's attempts to protect and strengthen its competitive position.

The various information systems may be integrated in quite different ways. In some cases, complete turn-key installations will be introduced. Some vendors propose this type of total solution. In most cases the transition to integration is a step-by-step modular transition of gradual penetration. Several reasons support such a piecemeal approach. CIM systems need significant funding for capital equipment, generally raised by delayed returns from sales. CIM systems also demand considerable investment in the creation of automation know-how, and not without a lengthy "incubation" period. The implementation of CIM demands considerable management effort. A project of this type may require a gradual approach to keep it under control. Lastly, the technology evolves gradually; further updating of the system with a clever and fast application of supplementary characteristics of innovations fits only with a slow approach to integration and implementation of a CIM system.

If systems integration does not occur overnight, what path will large manufacturers take to reach CIM? Is it a hub and spoke approach whereby newly designed databases will be linking different systems? Is it a network whereby every system will be linked with every other system? Will central databases coexist with decentralised databases? In other words, what will be the architecture of the information network?

To answer these questions, different stances can be taken. One can take a modelling point of view and try to design an optimal system given the technical constraints and the strategic needs of the company. Or, one can try to discover how companies are actually building up and integrating systems. It is precisely this, the empirical approach (i.e. the description of the integration as it happens in the field) which will be developed in this paper.

2. METHODOLOGY AND SAMPLE DESCRIPTION

The empirical results, examined here, are based on the data of the European Manufacturing Futures Survey. Since 1983, INSEAD has administered a survey of large European manufacturers with the aim of providing a description of current thinking on manufacturing strategy in large manufacturing units in Europe.

The questionnaire-based survey covers four themes:

1. What is the character of the business unit in terms of profit, growth, market, product, etc.;
2. What are the immediate concerns for senior manufacturing management;
3. What are the competitive priorities and strategic directions the company or business unit is pursuing; and,
4. What are the action programmes and tools the respondents intend to implement over the next two years and with how much emphasis.

The questionnaire was sent in 1986 to about 1500 companies in Europe, of whom 172 replied. The respondents represent companies from all EEC countries, except Greece, Luxemburg and Portugal but complemented by Austria, Finland, Norway, Sweden and Switzerland. The sample represents a wide range of industries. Except for the production of electronic and electrical equipment, which accounts for about 20% of the sample, none of the industries (based on a two digit S.I. code) represent more than 13% of the sample. The sample is definitely not representative of European industry. The composition of the sample is such however that there is no bias towards a particular industry or European country.

Some of the questions in our last survey are basic to the topic of this paper. Since the first campaign, proposed plans for information systems have been a subset of questions under action programmes and tools the respondents intend to develop within two years. Further, we have extended this subset so as to broaden our enquiry on the nature of database integration itself. For a selected list of 12 computerised subsystems and databases, the respondents were asked:

a) To indicate on a five point scale to what extent these information systems are computerised (the scale ranged from not at all through to a fully computerised system);

b) To indicate on a 12 by 12 triangular matrix which pairs of computerised subsystems or databases they intended to integrate over the next two years.

The 12 computerised subsystems, which were submitted to the respondents are:

1. Sales Planning and Forecasting;
2. Inventory Status;
3. Materials Requirements Planning/Master Production Scheduling,
4. Shop Floor Control,
5. Design Engineering (incl. Computer Aided Design);
6. Manufacturing Engineering (incl. Computer Aided Manufacturing);
7. Process Controls;
8. Quality Reporting;
9. Accounting;
10. Order Entry;
11. Purchasing; and,
12. Distribution.

We hold no claim that the list is exhaustive. It is the result of a trade-off between a broad band of the computerised subsystems and databases in manufacturing, and a list which could be overlooked by the respondents.

3. RESULTS

The respondents' intentions on integrating information systems were measured on a five point scale (ranging from no emphasis to critical emphasis). In two questions they were asked how much stress they would place during the next two years on:

i. the integration of manufacturing information systems; and,

ii. the integration of information systems across functions.

These two questions were part of a set of 37 action programmes and tools of a general question on improving operations in the third part of the questionnaire. Other action programmes were related to capacity, materials management, quality management, labour relations, training, etc.. Comparing the average emphasis for each of these action programmes and tools, one can come up with a rank order of actions to be emphasised during the next two years by the average European company (Table 1). Integration of manufacturing information systems ranks fourth, and is within the top six action programmes, which are not significantly different from each other statistically. Amongst these one finds also direct labour motivation, production and inventory control systems, automation of jobs, supervisor training and manufacturing reorganisation. Integration of information systems is seventh and belongs to the second group. In the second group too are defining a manufacturing strategy, lead-time reduction in production and the improvement of vendor quality.

Table 1
The Ten Most Important
Action Programmes

GROUP 1	1	Direct labour motivation
	2	Production and inventory control systems
	3	Automating jobs
	4	Integrating manufacturing information systems
	5	Supervisor training
	6	Manufacturing reorganisation
GROUP 2	7	Integrating information systems across functions
	8	Defining a manufacturing strategy
	9	Lead time reduction
	10	Vendor quality

The integration of information systems in manufacturing and across functions is clearly an important one. This is no new fact. In previous surveys it is ranked in a similar position (Ferdows and De Meyer, 1985).

Before focusing on the nature of this integration of information subsystems, one has to address first the question: which subsystems or databases are already computerised? Indeed, this study provides a picture of the use of information systems and the intention to integrate at a particular moment, i.e. the beginning of 1986. All of our respondents have computers at their disposal, and all of them have computerised subsystems and databases.

Table 2 lists the degree of computerisation of the databases and subsystems. The subsystems or databases are rearranged in descending order of computerisation. They are divided into five groups. The rank orders of the items within the groups are not significantly different from each other (on a 1% significance level (2-tailed)) based on a Wilcoxon matched-pairs signed-ranks test. The difference between the groups is significant on the basis of this non-parametric test.

Accounting is the most computerised subsystem. Almost half the respondents indicate that it is fully computerised and 84% note that it is computerised fully or significantly. Inventory Status and Order Entry rank second. Three-quarters of the respondents consider them to be significantly or fully computerised. Master Production Scheduling & MRP, Purchasing and Distribution form a third group in the order of importance. About half of the respondents show it to be at least significantly computerised. Sales Planning, Shop Floor Control, Process Controls and Quality Reporting are at the same level of computerisation and fourth in rank. The bottom group consists of CAD and CAM. They are, in half of the cases, not or only slightly computerised.

Table 2
The Degree of Computerisation Distribution as a Percentage of the Number of Respondents

Database or Subsystem (*)	Not at all	Some-what	Moder-ately	Signi-ficant	Fully	Mean Rank	No. of answers
	Degree of Computerisation as a Percentage of the Number of Answers						
1 Accounting	0.6	2.4	9.6	39.8	47.6	9.4	166
2 Inventory Status	2.4	5.4	16.3	34.3	41.6	8.7	166
Order Entry	4.3	6.1	17.1	32.9	39.6	8.4	164
3 MRP/MPS	6.7	13.9	20.6	35.8	23.0	7.3	165
Purchasing	7.8	16.9	21.1	30.7	23.5	7.1	166
Distribution	7.0	17.7	24.7	31.6	19.0	6.6	158
4 Sales Planning	13.7	26.7	16.8	31.7	11.2	5.7	166
Shop Floor Control	13.0	20.4	29.6	26.5	10.5	5.7	161
Process Controls	14.1	30.7	23.3	24.5	7.4	5.5	163
Quality Reporting	14.4	32.3	22.2	22.8	8.4	5.3	167
5 CAM	21.5	35.0	24.5	17.2	1.8	4.2	163
CAD	28.8	28.1	20.0	21.3	1.9	4.1	160

(*) Numbers indicate groups which are significantly different in rank order based on a Wilcoxon matched-paired signed-rank test (2-tailed 1% significance level)

The groups themselves have face validity. Inventory Status and Order Entry are logically linked. Order acceptance is indeed often dependent on the Inventory Status of either finished goods or raw materials and Work-In-Process. Purchasing, MPS and Distribution belong to the same group of production planning programmes. Shop Floor Control, Process Controls and Quality Reporting on the one hand, Sales Planning and Forecasting on the other, are the more technical and operational aspects of production and sales. CAM and CAD are more technologically orientated systems and have become only in the last decade, available to a broader range of manufacturers. One could argue that the extent of computerisation reflects the history of the introduction of computer supported information and decision support systems in the industrial world.

Having said this, what are the future plans of the large European Manufacturers, concerning the integration of these databases and subsystems? To this aim, the respondents were presented with an upper triangular matrix in which the twelve systems or databases were combined with each other. This leads to 66 possibilities of integration. The respondents were asked to indicate those pairs they intend uniting more fully over the next two years. The advantage of using this time frame is that the respondents can state what may be achieved rather than declare an ideal configuration which might be to integrate all subsystems: they have to focus on the major integration plans for the immediate future.

In Table 3, the number of respondents (out of 150, that answered this question) who ticked the boxes are shown. In Table 4, the ten most often ticked pairs are given in order of frequency. Tabulated in Table 5 is the number of times a database or subsystem is paired with another.

Table 3
The Frequency with which Respondents Matched Pairs of Computerised Subsystems for Integration over a Two-Year Period (N = 150)

	Inventory Status	MPS/MRP	Shop Floor Control	Design Engineering (+ CAD)	MFG Engineering (+CAM)	Process Controls	Quality Reporting	Accounting	Order Entry	Purchasing	Distribution
Sales Planning	43	68	11	10	11	4	7	22	34	26	28
Inventory Status		48	21	3	5	4	9	29	18	40	15
MPS/MRP			43	8	17	17	12	19	38	36	20
Shop Floor Control				5	23	27	33	19	7	10	6
Design Engineering (+ CAD)					44	10	14	3	4	4	5
MFG Engineering (+ CAM)						40	23	7	3	5	4
Process Controls							56	10	6	9	4
Quality Reporting								14	8	19	4
Accounting									30	30	16
Order Entry										26	29
Purchasing											12

Firstly, the tables highlight the importance of Master Production Scheduling/MRP in the effort towards integration. It is quoted five times in this list. This is confirmed by the number of times an individual item is indicated. Indeed, Master Production Scheduling/MRP is, in combination with other items, quoted 326 times, (or 2.17 times per respondent). The second table, and on the top of pairs together with MPS/MRP is sales planning and forecasting.

Secondly, the data show accounting (which is the most computerised database or subsystem) to be nowhere on the list of top targets for integration. It is listed eighth in the order of times an item is mentioned. It is either already integrated to a satisfactory level or our respondents do not have an immediate need to integrate it.

Table 4
The Ten Most Frequent Matched Pairs
of Databases for Further Integration

(68)	1	Sales Planning (incl. forecasting) with Master Production Scheduling
(56)	2	Process Controls with Quality Reporting
(48)	3	Inventory Status with Master Production Scheduling
(44)	4	Design Engineering (incl. CAD) with Manufacturing Engineering (incl. CAM)
(43)	5	Sales Planning (incl. forecasting) with Inventory Status
(43)	6	Master Production Scheduling/MRP with Shop Floor Control
(40)	7	Inventory Status with Purchasing
(40)	8	Manufacturing Engineering (incl. CAM) with Process Controls
(38)	9	Master Production Scheduling/MRP with Order Entry
(36)	10	Master Production Scheduling/MRP with Purchasing

Bracketed numbers show the frequency of each matched pair

Thirdly, of relative importance is, what one could call, the "techno-cluster" in the list of databases or subsystems. Process controls combined with quality reporting, CAD with CAM, CAM with Process controls are respectively second, fourth and eighth (Table 5). The total number of times each of these elements is mentioned in connection with another is quite low. This suggests that if you consider them as a group, they are mentioned often, but only in relation to one of the other subsystems and databases of this same group. They form, as it were, an isolated group of systems to be integrated with each other. This group can be called the "techno-cluster" since each of the systems involved is technically orientated.

Table 5
The Number of Times Computerised Subsystems or
Databases were Paired for Improved Integration

Number of respondents = 150	Order of Frequency	Number of times per respondent–
Master Production Scheduling/MPS	326	2.17
Sales Planning (including forecasting)	264	1.76
Inventory Status	235	1.57
Purchasing	217	1.45
Shop Floor Control	205	1.37
Order Entry	203	1.35
Quality Reporting	199	1.33
Accounting	199	1.33
Process Controls	187	1.25
Manufacturing Engineering (CAM)	182	1.21
Distribution	143	.95
Design Engineering	110	.73
Totals	2470	16.46

Fourthly, another aspect which attracts our interest, is the low ranking of Design Engineering (incl. CAD). It is mentioned only 110 times, of which 44 times in relation to Manufacturing Engineering (CAM). If it were not for this seemingly popular CAD-CAM link, Design Engineering would remain a very isolated computerised subsystem. The integration between CAD and the rest of the subsystem requires a matching which goes further than the integration of operations. Indeed, it requires engineering or development to be integrated with production and sales. Are the organisational problems which may arise in these circumstances too important to push for an integration effort in this area within the next two years?

Table 6
The Average Number of Times Information Systems Will be Integrated with other Systems as a Function of the Existing Degree of Computerisation

	The Extent of Computerisation				
Information Systems	not at all	to some extent	modera-tely	signifi cantly	fully
Sales Planning & Forecasting	1.05	1.52	2.00	1.73	1.56
Inventory & Status	1.75	1.22	1.41	1.84	1.04
Master Production Scheduling & MRP	2.00	1.61	2.74	2.39	0.97
Shop Floor Control	0.33	1.48	1.73	1.19	0.88
CAD	0.46	0.76	0.81	0.82	0.33
CAM	1.09	1.09	1.20	1.21	0.33
Process Controls	0.87	1.22	1.55	0.88	0.67
Quality Reporting	0.71	1.13	1.78	1.11	0.57
Accounting	1.00	2.50	1.81	1.29	0.91
Order Entry	0.71	1.00	1.64	1.46	0.94
Purchasing	1.54	1.04	1.51	1.53	0.95
Distribution	0.18	0.89	1.08	0.86	1.03

Is the effort to integrate more fully the computerised subsystems and databases determined by a previous form of computerisation? In other words, will the degree of computerisation of a particular database have an effect on the efforts to extend integration of other database systems? A priori, one can develop arguments in both ways. On the one hand, it can be argued that those companies who still have to computerise partly or fully a particular subsystem or database, will attempt to learn from others' experience or from the possibilities offered by software vendors and will immediately implement an integrated system. On the other hand, the more an information subsystem is computerised, the more obvious it becomes to take the next step towards integration.

In Table 6, one finds the average number of times a particular database or subsystem was mentioned with respect to improved integration with others as a function of its degree of computerisation. For example in those companies where shop floor control was not computerised it was mentioned on average .33 in relation to another subsystem. Based on an ANOVA with the effort to integrate as the dependent variable, and the degree of computerisation as the independent variable, one has to reject the hypothesis that an extension of computerisation leads to an increased tendency to integrate. The table suggests superficially that in those companies where the computerisation is either non-existent or fully implemented, the intended efforts for better integration are lower than for those companies where the extent of computerisation is moderate. Again, however, such a hypothesis has to be rejected on the basis of the analysis of variance.

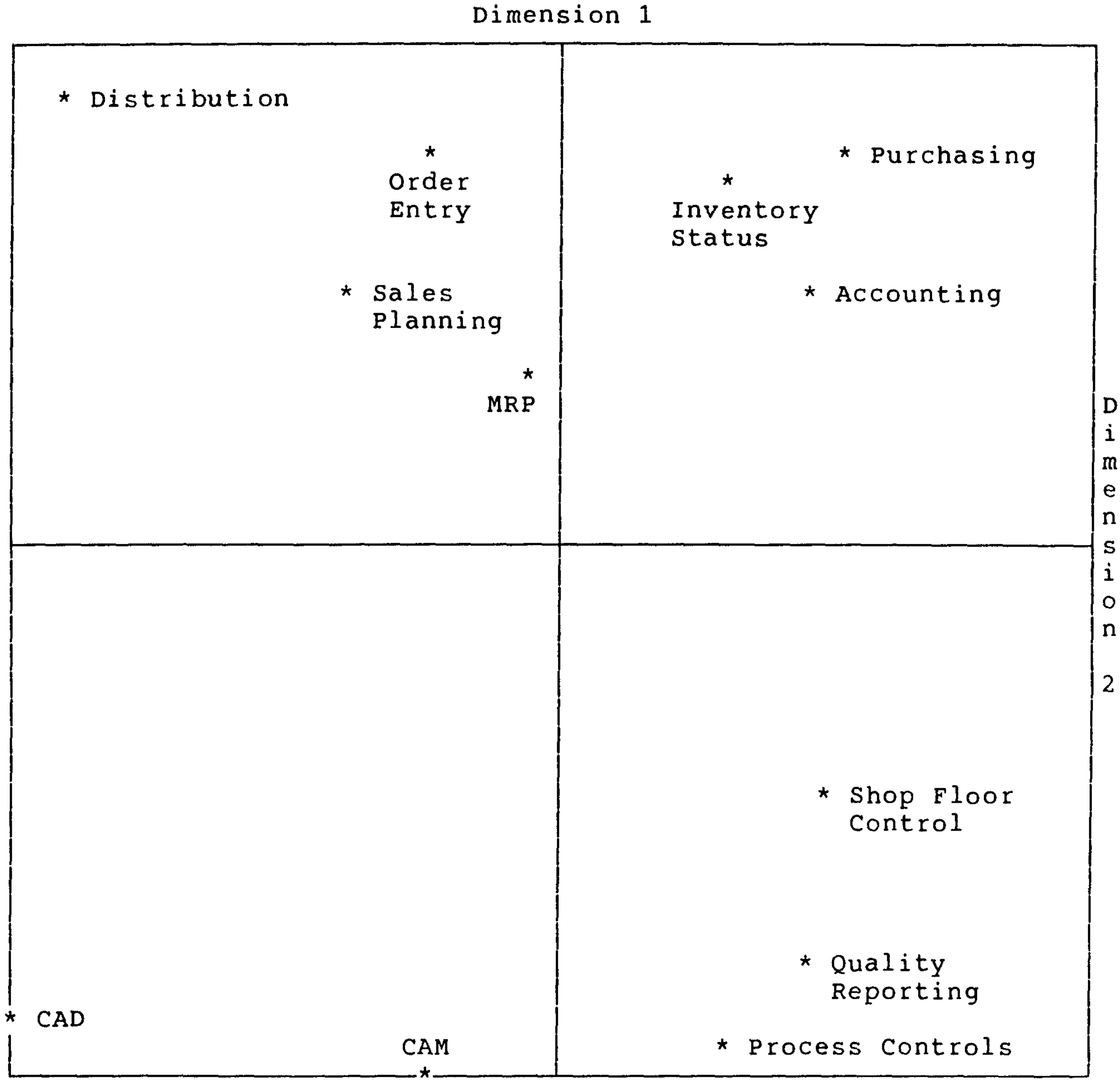
The whole question remains, in our opinion, unresolved. Indeed, our results could be corrupted by the two contradictory influences mentioned above, or by some other factors we have not measured. The satisfaction respondents feel about the performance of fully computerised systems can, for example, influence the intention to integrate the system. The difference between the intention to integrate MRP/MPS systems and accounting can illustrate this. Both are significantly to fully computerised in most of the cases. However, the pattern of integration is different. MRP/MPS will be integrated strongly, and this in companies with a low degree of computerisation of this subsystem as well as in the companies with a high degree of computerisation. For accounting the pattern seems to be different. The higher the degree of computerisation, the less the respondents intend to integrate it.

Possible explanations can be that either accounting is already integrated or, as Kaplan (1985) suggests, that present management accounting systems are unable to cope with the control demands of modern manufacturing. In the latter case, the extent to which the respondents do not want to integrate accounting systems is perhaps influenced by their disenchantment with existing management accounting practices. Consequently still open is the question on intentions to integrate information systems: how are plans for this influenced by the extent of computerisation? Further research on the topic is needed.

4. A DIFFERENT TYPE OF ANALYSIS

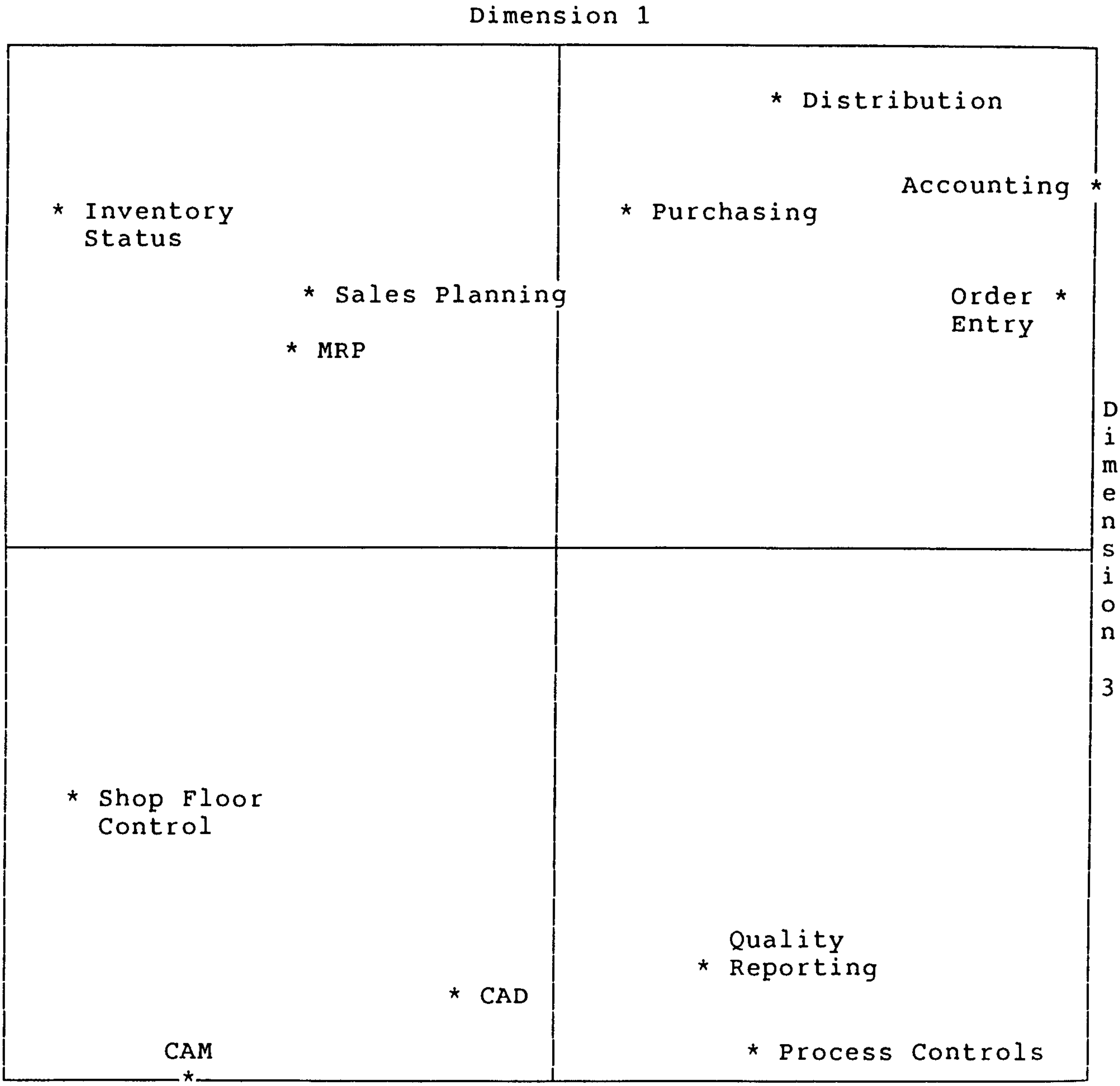
The upper triangular matrix in Table 3 is a precise representation of the results of the survey, but it may be difficult to explain. To improve our understanding of the implicit models and relations from which the respondents derive their perception, we decided to use a non-metric multidimensional scaling method to interpret the data. The matrix indicates what respondents propose in attempting to bring pairs of databases or subsystems together. One can see this as a measure of closeness or similarity of the databases. On the basis of this assumption a similarity analysis (Kruskal, 1964), was used to map the data.

Figure 1a
A Three Dimensional Representation of
Integration for Subsystems Based
on a Similarity Analysis (dimensions 1 and 2)



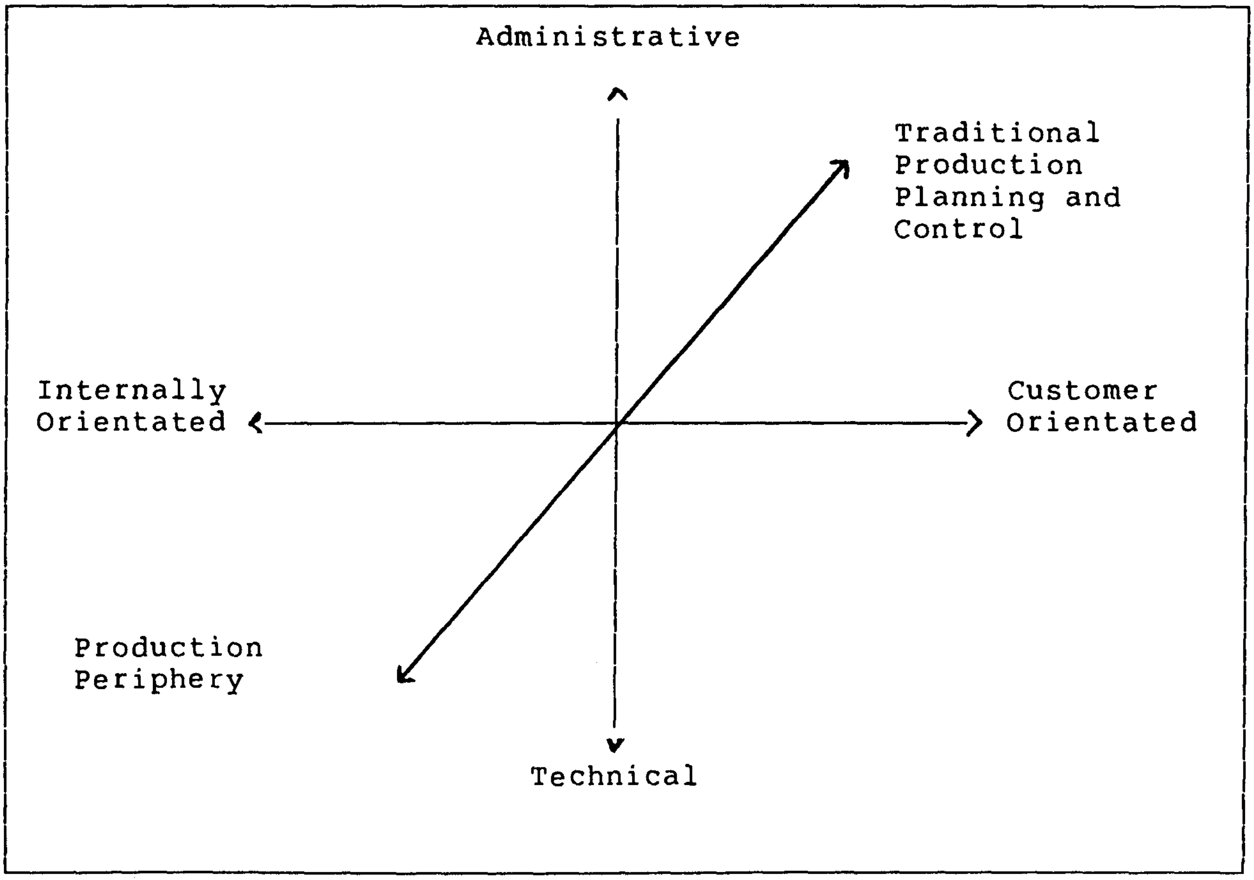
The data can be represented in a two-dimensional space, leaving a stress of 11.2% and in a three-dimensional space (Figures 1a and 1b), leaving a stress of 6.2%. According to Kruskal (1964) these stress values can be considered as respectively "fair" and "good". The first two dimensions of the three dimensional map are to a large extent the same as the ones in the two dimensional map.

Figure 1b
A Three Dimensional Representation of
Integration for Subsystems Based
on a Similarity Analysis (dimensions 1,2 and 3)



The first dimension contrasts the group of technical databases and subsystems, such as CAD, CAM, quality reporting process controls and shop floor control with more administrative orientated systems such as purchasing, distribution, accounting, inventory status and MPS. This is a contrast which is hinted at above. The second dimension contrasts internally orientated information systems such as shop floor control, inventory status, purchasing, quality reporting and process controls with systems that are orientated to groups external to manufacturing (i.e. distribution, sales planning, CAD and order entry). The third dimension distinguishes order entry, accounting, distribution, quality reporting and process controls from shop floor control, inventory systems and computer aided design and manufacturing. In the dimension's centre, is CAD and purchasing. This dimension opposes the traditional production planning techniques ranging from sales planning to shop floor control versus information systems which are more on the edge of production such as distribution, purchasing, etc.. In Figure 2 the three axes are illustrated:

Figure 2
Three Integration Dimensions



Limiting oneself to the two first dimensions, one can set the results in four clusters for intended integration:

a) the internally orientated administrative systems, e.g. Inventory Status, Accounting and Purchasing;

b) the market orientated administrative systems, e.g. Distribution, Order Entry, Sales Planning and forecasting;

c) the internally orientated technical control systems, e.g. Process Control, Quality Reporting and Shop Floor Control; and,

d) the technical systems, which link manufacturing to external groups such as design, engineering and eventually the customer, i.e. CAD and CAM.

These four clusters have face validity and can be said broadly speaking to represent different functions within the enterprise. The first of these can in a limited sense be identified with the materials planning function, the second with the sales administration, the third with the production planning function and the fourth reflects the engineering function. Each of these signify existing functions but more importantly extend beyond their exact functions and to a lesser or greater extent integrate the other functions.

These "islands of integration" seem to be linked with each other through the pivotal database which is the Master Production Scheduling/MRP.

This again has face validity. The use of the MPS as a linking pin is what vendors of MRP II packages often use while describing the advantages of their system.

The third dimension puts these four islands in perspective with respect to the closeness of the information systems to the core production tasks.

5. DISCUSSION AND CONCLUSION

On the basis of the empirical data, we would hypothesise that European manufacturers have opted for the creation of a number of integration islands, in their evolution towards a completely integrated manufacturing information system. The interpretation of these islands is, of course, a judgmental issue. The most obvious candidate for making a pivotal and effective link between the islands could very well be Master Requirements Planning/Master Production Scheduling. One can only speculate about the reason for this central role of MRP/MPS, which was noted last year (Ferdows and De Meyer, 1985). One of the reasons could be that some of the major computer suppliers have used MRP packages as a "Trojan horse" to gain access to the manufacturing companies. Another reason could be that the claims made for more recent MRP II packages are attempts to provide at least part of an integrated information system. Finally, one can argue that MPS is determined by a definition of integrating efforts between production and sales, and consequently a natural focus for integration.

It is not however that the MRP/MPS function is already heavily computerised which makes it pivotal. If that were so, accounting would be found in the same position. No, we have to lead ourselves to the conclusion that MRP/MPS have a kind of pre-existing and a somewhat "organic" role to fulfil in integrating different functions.

It is not our intention to make a normative statement about whether this approach to integration is a good one. We can only conclude that in practice large manufacturers apply an incremental approach, and do not implement complete turn-key systems. This implies a clear message to those who supply hard and/or software. If the pivotal role of MRP proves to be correct, these vendors who have built up a strong position with a flexible MRP package, seem to be at an advantage. Indeed, they will be able to force, at least partially, their standards onto suppliers of the more peripheral elements of the computer integrated manufacturing system. Here our concern is not about standards, such as MAP from General Motors or TOP from Boeing, which define technical communication standards. The standards consided here are about data definition and database structure and are related to the seventh layer of the TOP/MAP standards. Those vendors who start from a strong position in robotics, process control or accounting, and who have considered MRP to be a marginal product to their business, might discover that they have positioned themselves less favourably in the market for integrated manufacturing systems. This becomes even more true if our findings show that there is no relation between the present degree of computerisation and integration policy. Lastly, this market, given our results on the importance of integration in the immediate action plans of large manufacturers, can be expected to grow rapidly.

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LIST OF INSEAD RESEARCH WORKING PAPERS

80/01 **"Identifying cognitive style determinants of retail patronage**, by Christian PINSON, Arun K. JAÏN and Naresh K. MALHOTRA, January 1980.

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