SEPARATING THE FADS FROM THE FACTS: TRENDS IN MANUFACTURING ACTION PROGRAMMES AND COMPETITIVE PRIORITIES FROM 1986 TILL 1994

by

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ABSTRACT

Manufacturing Strategy is about the choice of priorities and the process and programmes through which these choices are implemented. Since 1986 we have carried out at INSEAD a bi-yearly survey of manufacturing strategy practices in Europe which focuses on these priorities and action programmes. Using the data of 5 consecutive surveys we have analysed the evolution of manufacturing action programmes and competitive priorities over the last decade. It appears that the consistently most emphasised action programmes are in the field of integrating information technology. Furthermore we observe that 'hard' standalone technology has been abandoned in favour of 'soft' action programmes e.g. strategic human resources management. This shift in action programmes can be explained by a shift in competitive priorities. Quality has increasingly become a qualifier for European manufacturing companies, while the ability to offer dependable deliveries and low pricing has gained considerably in importance from 1986 till 1994.

INTRODUCTION

Manufacturing Strategy is about the choices of the priorities one wants to pursue in manufacturing and the process through which these choices are implemented [1]. Since 1986 we have at INSEAD organised a bi-yearly survey of manufacturing practices in Europe, and this within the larger framework of the Global Manufacturing Futures Survey, which is currently conducted in more than 18 countries. The survey was conceived originally to validate empirically the model of

manufacturing strategy as proposed by Skinner [2,3] and refined by Hayes and Wheelwright [4], Hill [5] and others. Consequently this survey has focused to a large extent on the competitive priorities that senior manufacturing managers considered to be important for their business unit and the action programmes through which they intended to implement their strategic choices.

During the decade that we cover with the questionnaire results, manufacturing management has gone through a revolution and has also considerably matured. Since we rediscovered the role of manufacturing in the beginning of the eighties [6,7], and were taken by surprise by the achievements of Japanese manufacturing approaches, we have been able to put manufacturing action programmes on the top of senior managers' agenda in the second half of the eighties and the beginning of the nineties. Today we may actually observe a decline in interest in pure manufacturing to the advantage of the integration of manufacturing with product development and engineering management and the integration with the service component of our businesses.

During that same decade we have been inundated with conceptual frameworks e.g. post industrial manufacturing [8], frugal manufacturing [9], lean manufacturing [10], customer driven manufacturing [11] as well as 'winning' action programmes e.g. as JIT, TQM, Kaizen, reengineering, Design for Manufacture, Quality Function Deployment, Strategic HRM, etc. Apart from these classics it seems that almost any consulting firm had to develop its own version of a word class manufacturing programme. This attention paid to manufacturing and these abundance of programmes has undoubtedly stimulated the recovery of manufacturing in Europe and the United States. In order to understand this recovery and maturing of the

manufacturing function we wanted to understand whether some of these programmes have been fads or whether they have had lasting impact.

ANCHORING IN LITERATURE

The original Manufacturing Futures Survey was designed in the beginning of the eighties at a time that we started to explore the possibilities of the manufacturing strategy model as proposed originally by Wickham Skinner [2]. It was also the period that scholars in manufacturing management started to be aware of some of the superior manufacturing approaches developed by some outstanding Japanese companies. It is no wonder that the original questionnaire paid great attention to the extent that what is described as Japanese manufacturing methods (e.g. JIT, TQM, SQC and SPC) penetrated American and European manufacturing. The version of the questionnaire that we use in this paper was designed in 1986, but benefited largely from the experience with the first one, and kept the same philosophy. Consequently the questionnaire still reflects this original model of manufacturing strategy which argues that action programmes (as translations of the manufacturing policy decisions) are derived from the business strategy through the intermediary variables of manufacturing missions, qualifiers or competitive priorities, e.g. quality, flexibility, cost efficiency or dependability. As Hill [5] proposed, the translation from business strategy into manufacturing policies can happen by making the distinction between satisfying and order winning qualifiers. The questionnaire was further heavily influenced by the idea that strategy was both about formulation and the process of implementation [1]. The gradual discovery of new approaches to manufacturing and new types of action programmes led to inclusion of some of these programmes into the questionnaire. For example QFD [12] was included only in 1988 and the attention

paid by manufacturing to the environment through recycling, remanufacturing or reverse logistics were included in 1992. At the same time the authors of the questionnaire have attempted to include some of the new evolution in strategy based on the resource based view of the firm [13,14]. Thus the questionnaire has been changing but always within the framework that was created in the beginning of the eighties. We are aware that there is currently some criticism on this model [15], but we are convinced that this does not have a great impact on our objective to describe the evolution of action programmes over the last decade.

OBJECTIVE AND METHODOLOGY OF THE PAPER

The framework we will use is simple. Senior manufacturing managers make choices with respect to the long term competitive priorities in their business. These choices will have impact on the action programmes they focus on. Changes in competitive priorities will lead to changes in the portfolio of action programmes. To understand these changes or shifts we will do four types of analysis :

1. For all the action programmes which were monitored throughout the decade we will identify the trend upward, downward or flat in importance and this through linear regression.
2. In order to avoid that we pay too much attention to the idiosyncratic evolution of a particular action programme we have regrouped through factor analysis these action programmes in a few generic categories.
3. Through linear regression we have identified the trends in the competitive priorities, again only for those which were monitored throughout the decade.

This group was quite stable. Indeed, competitive priorities are long term choices and do not change that fast throughout the decade.

4. Finally we have explored the relation between the evolution of competitive priorities and the generic categories of action programmes through correlation analysis.

DESCRIPTION OF THE DATABASE AND LIMITATIONS OF THE ANALYSIS

The data used in this analysis was obtained through the European Manufacturing Futures Survey (EMFS) 1986-1994. The questionnaires typically contained more than a hundred questions. For the majority of these questions the respondents answered on a seven point scale what their perception was. In some cases we asked for objective quantitative data. The respondents are typically senior manufacturing managers (plant manager and above).

The questionnaire has been adapted considerably over the years. However the questions we will use in this analysis have remained stable at least in their format. The two questions we used are :

1. Indicate for a list of priorities related to quality, cost efficiency, flexibility, delivery performance and service performance what the importance of each of these would be over the 5 years following the year of the questionnaire. The time horizon of 5 years was chosen in order to give the respondent a long term perspective.
2. Indicate for a list of about 35 action programmes and activities related to the production resources (human resources, technology, materials) and manufacturing activities (e.g. integration with partners, quality management,

etc.) the relative degree of emphasis the business unit would place on each programme in the two years following the year of the questionnaire. The time horizon of two years was chosen in order to render the answers as concrete and as close to reality as possible. The assumption was that two years is a reasonable time for implementation of large action programmes in manufacturing. Beyond that we may be confronted with dreams and wishful thinking rather than real implementation.

For both questions we asked the respondents to score their perception on a seven point scale going from least important or least emphasis (1) to most important or most emphasis (7).

For this particular analysis we had 1075 useful records. In table 1 we provide the number of respondents per year as they were included in the analysis. In some cases we had the same respondent answering for the same company over several years. But less than ten respondents have answered over the whole period. A longitudinal analysis based on such a group of loyal respondents would have been most interesting. But the size of this sample is too small to do any meaningful analysis.

Year	86	87	88	90	92	94	Total
Number of Respondents	174	221	187	224	108	161	1075
Number of Countries	14	14	14	15	17	17	
Number of Industries(i)	67	82	71	75	60	NA	

(i) measured by the number of different 3 digit SIC-codes in the sample

Table 1 : Number of Respondents

Consequently we have compared the samples from year to year, assuming that they are representative for the general attitude towards manufacturing in Europe in a particular year. This clearly limits the value of our analysis. It is difficult to judge

the influence of the change in the sample composition on the trends with respect to action programmes. But we feel confident that the size and the variety of the samples enables us to safely make the hypothesis that the data for a particular year reflects the attitude of leading companies in Europe. For a full discription of the samples and the specific results for each of the years, see de reports Ferdows and De Meyer [16,17,18] and De Meyer [19,20].

Yet a comparison from year to year may entail additional biases. We have had the impression that the general economic conditions in the environment have an influence on how respondents answer the questionnaire. Favourable economic conditions may make some more buoyant about implementing action programmes or implementing a particular competitive priority, while a recession may make them more cautious. This bias can be real, i.e. it seems for example logical that in recession years cost efficiency will be more emphasised. But the bias may also be simply an indication of a general mood of optimism or pessimism. In order to avoid this second bias we have divided all scores representing the degree of emphasis on the action programmes or importance placed on a competitive priority in a particular year by the mean of all scores in that year for either the action programmes or competitive priorities. Thus a score higher than one indicates that an action programme was emphasised more than average in that year, while a score less than one indicates an emphasis less than average (see appendix 1 and 2).

There is in fact a second limitation to the analysis. The companies for which we received answers are typically better performing than the average European companies. From year to year we have compared objective data from the

questionnaire on capacity utilisation, age of capital equipment, inventory rotation with statistics available from international institutions. In most cases our sample performed better than the average European company.

RESULTS

Trends in manufacturing programmes

In table 2 and figure 1 we have summarised the results of the first analysis, i.e. a linear regression of the seventeen action programmes or activities which were offered to the respondents. Four of them, i.e. giving workers a broader range of tasks, the development of a manufacturing strategy to support the business strategy, closing and relocating plants and functional teamwork have significantly increased in importance. Three have significantly decreased in importance : the development of new processes for existing products, the introduction of robots and the investment in the improvement of production and inventory control systems. For the other programmes there was no significant trend.

Action Programme	BETA	p-level	Trend
Giving workers a broader range of tasks	0.2947	0.0000	Rising
Developing a manufacturing strategy to support business strategy	0.1591	0.0000	Rising
Closing and Relocating Plants	0.1159	0.0008	Rising
Functional Teamwork	0.1002	0.0039	Rising
Value Analysis	0.0610	0.0798	No conclusion
Integrating Information technology in the business unit	0.0398	0.2533	No conclusion
Statistical Process Control	-0.0067	0.8477	No conclusion
Supervisor Training	-0.0271	0.4356	No conclusion
CAD	-0.0245	0.4821	No conclusion
Integrating information technology in manufacturing	-0.0422	0.2253	No conclusion
Reconditioning Physical Plants	-0.0378	0.2772	No conclusion
Developing new processes for new products	-0.0454	0.1923	No conclusion
CAM	-0.0578	0.0969	No conclusion
Flexible Manufacturing Systems	-0.0591	0.0896	No conclusion
Developing new processes for old products	-0.0874	0.0119	Declining
Robots	-0.1547	0.0000	Declining
Production- and inventory systems	-0.2484	0.0000	Declining

Table 2 : Regression table on manufacturing action programmes

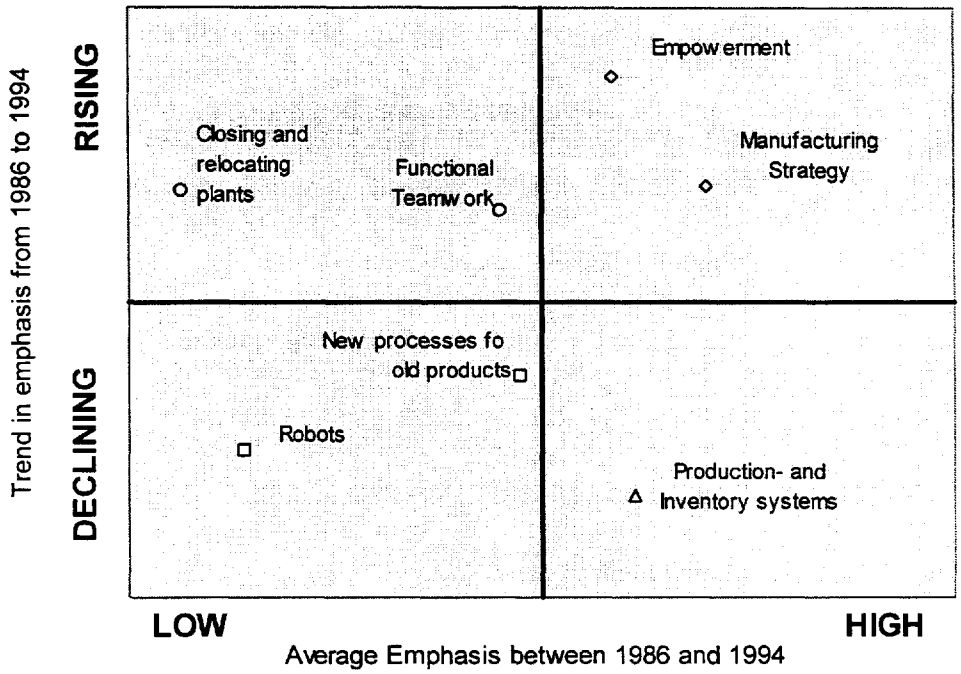

Figure 1 : Manufacturing action programmes from 1986 to 1994

Three out of the four 'risers' can be described as soft programmes, the closure or relocation of plants being the exception. The three 'losers' can be described as technological solutions of the past. Obviously this analysis does not indicate the real importance of these programmes. A highly emphasised programme that rise is different from a very lowly emphasised programme that is characterised by a small increase in emphasis. In order to get a better map of the real importance of these programmes we have put them in a matrix which relates the trend (as measured by the beta value) to the average emphasis on the particular programme across all years of the survey (figure 1). Such a mapping leads to four types of programmes :

1. High-High programmes such as the development of a manufacturing strategy or the broadening of tasks : these highly emphasised programmes which are in the lift, seem to be critical to manufacturing success and this over a decade.

2. High-Low programmes such the investment in production and inventory control systems : this is a set of action programmes which have been successful or which have been replaced by different approaches e.g. JIT. It may well be that the implementation of MRP I or II has reached its limits or has lost its relevance as a tool for obtaining competitive advantage.
3. Low-High programmes such as closure or functional teamwork : While closure may be an action related to specific economic circumstance, the continuous trend indicates that perhaps the relocation, like the functional teamwork, is a new trend which is rolled out over the last years.
4. Low-low programmes : these investment in robots or new processes for existing products remain unattractive to the average European manufacturer.

Identification of generic categories of action programmes

Observing the trends in individual programmes may entail a risk of paying attention to what may be an idiosyncratic evolution. Therefore we carried out a factor analysis (table 3) to determine which are the underlying factors in the implementation of a manufacturing policy as observed through the improvement programmes.

We can identify five factors which explain the variance in the data. These five factors are : the use of integrating hard and software, the implementation of hardware driven automation with an emphasis on new product development, the reconditioning of existing processes, the deployment of human resources programmes (this assumes that the new processes are more people oriented) and the closure/relocation of plants. -Like for any factor analysis this is a somewhat arbitrary labelling-

On the factor scores for these five factors we have carried out a regression analysis similar to the one in the previous analysis (table 4)

Again we find three groups. The risers are the closure/relocation of plants and the emphasis on the deployment of human resources. The losers are the investment in hardware driven automation, and the reconditioning of the existing plant.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Dimension
Eigenvalue	4.46	1.51	1.27	1.16	1.02	
% of total variance explained	26.26	8.87	7.45	6.82	5.98	
Integrating information technology in manufacturing	**0.840**	0.189	0.081	0.122	-0.021	**Integrative technology**
Integrating information technology across the business unit	**0.836**	0.145	-0.012	0.137	0.070	
Investing in improved production and inventory systems	**0.491**	0.256	0.343	0.125	-0.232	
Developing a manufacturing strategy to support business strategy	**0.488**	0.104	-0.038	0.371	0.293	
CAD	0.098	**0.792**	-0.226	0.048	0.066	**Hardware driven automation**
CAM	0.200	**0.727**	-0.029	0.066	-0.032	
Robots	0.050	**0.718**	0.250	0.029	0.006	
Flexible manufacturing systems	0.172	**0.642**	0.133	0.217	0.144	
Value analysis	0.089	**0.551**	0.088	0.273	0.024	
Developing new processes for old products	0.006	0.010	**0.767**	0.105	0.087	**Recondi -tioning**
Reconditioning plants	0.182	0.105	**0.478**	0.063	0.465	
Functional teamwork	-0.049	0.230	0.140	**0.690**	-0.102	
Empowerment	0.082	0.021	-0.280	**0.670**	0.264	**Human resources programmes**
Statistical process control	0.236	0.127	0.209	**0.568**	-0.058	
Supervisor training	0.252	0.091	0.109	**0.541**	-0.014	
Developing new processes for new products	0.173	0.356	0.313	**0.359**	0.090	
Closing and relocating plants	-0.035	0.072	0.085	-0.012	**0.824**	**Closing and relocating**

Table 3 : Summary of factor analysis

	Beta	p-level	Trend
Factor 5 : Closing and relocating plants	0.2457	0.0000	Rising
Factor 4 : Human resources programmes	0.2231	0.0000	Rising
Factor 1 : Integrative technology	-0.0543	0.1575	No conclusion
Factor 2 : Hardware-driven automation	-0.1386	0.0003	Declining
Factor 3 : Reconditioning	-0.2935	0.0000	Declining

Table 4 : Regression table on factor scores

Trends in competitive priorities

In table 5 and figure 2 we present a similar analysis to the one we carried out for the action programmes. Two competitive priorities are on the rise : the emphasis on cost efficiency (which is captured in the ability to compete on price) and the ability to provide dependable deliveries. Two of them are losing in importance and both are related to quality as a qualifier : the ability to offer consistent quality with low defects and the ability to offer high performance products. Yet we should be careful. As is shown in figure 2, the ability to deliver consistent quality remains the most important competitive priority if we take a time horizon of a decade. But its importance as a order winning priority is decreasing. Its role is partially taken over by the ability to compete on price and to deliver dependably.

Competitive priority	BETA	p-level	Trend
The ability to profit in price competitive markets (Price)	0.1071	0.0006	Rising
Dependable deliveries	0.0888	0.0042	Rising
The ability to introduce new products quikly.	0.0495	0.1114	No conclusion
The ability to make rapid volume changes	0.0441	0.1562	No conclusion
The ability to provide fast deliveries	0.0277	0.3725	No conclusion
The ability to offer a broad product line.	-0.0235	0.4508	No conclusion
The ability to offer a consistent quality with low defects	-0.1405	0.0000	Declining
The ability to offer high performance products	-0.1808	0.0000	Declining

Table 5 : regression table on competitive priorities :

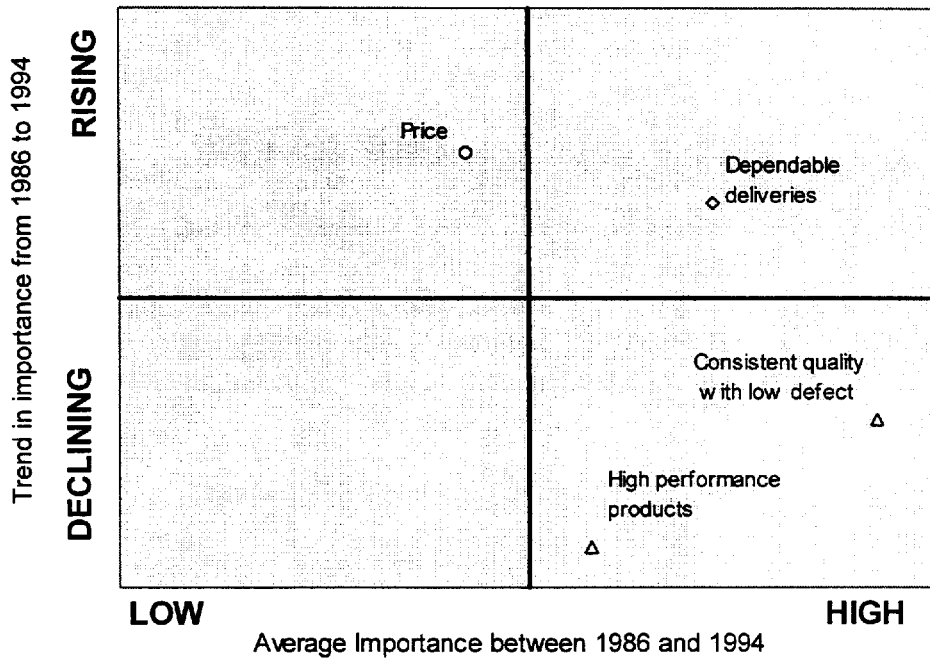

Figure 2 : Competitive priorities from 1986 to 1994 :

Summarising the results of this figure we can distinguish three categories :

1. High-High priorities e.g. dependable deliveries : this is the order winning priority of today
2. High-Low priorities e.g. consistent quality and high performance products : the order winners of yesterday and the qualifiers of tomorrow
3. Low-High priorities such as the ability to compete on price : this may well indicate the rediscovery of price competition as the order winner of tomorrow.

Linking competitive priorities to action programmes

In table 6 we provide the correlation coefficients (with their significance) between eight competitive priorities and the five generic factors. We found eight correlations out of forty possibilities to be significant on a 5% level and only two on 1% level.

	FACTOR1: Integrative technology	FACTOR2: Hardware-driven automation	FACTOR3: Reconditioning	FACTOR4: Human resources programmes	FACTOR5 Closing and relocating plants
The ability to profit in price competitive markets	-.0468 (p=.234)	.0485 (p=.217)	.0317 (p=.420)	**.0835 (p=.034)**	**.0923 (p=.019)**
The ability to introduce new products quickly	-.0133 (p=.735)	.0410 (p=.297)	-.0272 (p=.489)	**.1262 (p=.001)**	-.0293 (p=.457)
The ability to make rapid volume changes	**.0833 (p=.034)**	-.0101 (p=.798)	.0061 (p=.876)	.0145 (p=.712)	-.0025 (p=.949)
The ability to offer a broad product line	.0113 (p=.774)	.0647 (p=.100)	.0240 (p=.542)	.0445 (p=.258)	-.0088 (p=.823)
The ability to offer a high quality with low defects	.0011 (p=.978)	**.0788 (p=.045)**	**.0828 (p=.035)**	.0024 (p=.952)	**-.1465 (p=.000)**
The ability to offer high performance products	**.0813 (p=.038)**	**.1568 (p=.000)**	-.0164 (p=.677)	-.0032 (p=.935)	-.0524 (p=.183)
The ability to provide fast deliveries	.0206 (p=.600)	.0642 (p=.102)	.0669 (p=.089)	.0745 (p=.058)	.0696 (p=.076)
The ability to offer dependable deliveries	.0571 (p=.146)	-.0433 (p=.271)	.0044 (p=.912)	.0621 (p=.114)	-.0055 (p=.888)

Table 6 : Correlation between competitive priorities and manufacturing action programmes

Summarising one can argue on the basis of these results that:

- a priority in cost efficiency is positively related to relocation and closure of plants, as well as an investment in the human resources (incl. the development of new processes for new products); this seems to suggest that the increasing trend of relocation is in search for low cost environments; it also suggests that in the remaining plants one looks for savings not through automation but through people;
- fast product introduction is positively related to investment in human resources (incl. developing new processes for new products); faster product development will not necessarily come through an investment in CAD or other technologies related to innovation, but through innovative ways of organising people such as multidisciplinary teams, empowerment, etc.
- rapid volume changes are positively related to integrating soft and hardware (which probably allow for fast changes in production schedules)

- consistency in quality is positively related to improving the existing plant and the investment in hardware driven automation (including value analysis). On the other hand, there is a negative relation between consistency in quality and the closing and relocation of plants.
- high performance products as a priority is positively related to integrating hard and software as well as the investment in hardware driven automation (emphasising product development)

DISCUSSION

Correlations do not prove causality. Yet on the basis of previous analysis we like to venture some explanations which may be taken as hypothesis for research using other methodologies.

1. Over the last decade we have seen a shift in the average portfolio of competitive priorities of European manufacturers. In the second half of the eighties consistency in quality proved to be a pervasive priority for almost every European company. Though quality is still important, the emphasis on consistent quality is decreasing and quality loses its role as an order winning qualifier in the international business scene. The same evolution exists for the ability to produce high performance products, an area in which Europe traditionally had an advantage. The current competitive priority (high in importance and still on the rise) is the ability to deliver in a dependable way. The new priority (still low but on the rise) is the ability to compete on price. These results should not surprise us in the increasingly international markets where even smaller and medium sized companies are confronted with international competition and where the cost

reduction programmes of for example GM, Ford or Volkswagen have put enormous price constraints on European subcontractors and suppliers.

2. This shift in competitive priorities can partially explain the trends in the implementation of the action programmes and activities. The ability to have consistent quality is correlated to reconditioning the existing plants. The quality movement is to a large extent identified with continuous improvement of the existing processes. It was in the eighties also correlated with investments in hardware driven automation. Not surprisingly these two generic categories of action programmes are less emphasised. At the same time we see that the two generic categories of programmes which are correlated with the ability to compete on price are on the rise. This seems to suggest that there is a clear consistency between the strategy which is chosen by the manufacturers and the policies they implement.

3. Though we observe consistency, we may be surprised by some of the correlations which are lacking. Neither price competition nor fast product introduction seem to rely on automation. It is the human factor (training, teamwork and empowerment) that is replacing the trend towards automation that most of us have observed in the eighties. The current examples in the automobile industry of Toyota, Volkswagen or Fiat are indications of the fact that companies have come back somewhat on their expectations with respect to automation.

4. The most important factor in the factor analysis, which explains more than one quarter in the variance in the data is what we have labelled as integrating hard and software. This represents the group of programmes around which there is the least

unanimity, and the highest differentiation. It appears that this is the area where companies have not been following a few examples, but have developed or are developing proprietary strategies. It is by the way also the area where we had the least to learn from the outstanding Japanese producers.

5. Independent from the trends in action programmes and activities which are driven by the change in competitive priorities, we observe also a general trend towards 'soft' programmes as opposed to 'hard' programmes. Many of us have participated in programmes which were leading towards total automation and very sophisticated flexible manufacturing systems. It appears that companies today have a more mature view of the possibilities of automation and the limits imposed by increasing system complexity on what is achievable with automation. This perhaps explains the increased emphasis on human resources and the decrease in importance of standalone technology.

6. The present analysis shows a remarkable stability over the years in the competitive priorities. By using a linear regression we obviously have not captured those cases where the importance would have increased and subsequently decreased in a symmetrical way. Plotting some of the programmes and priorities over the years enables us to see that some of this exists. There are indeed 'fads'. But it concerned marginal activities, and it was difficult to describe these fads in a statistical significant way. The overwhelming conclusion was rather one of gradual but steady change in the importance and emphasis.

7. Contrary to our initial expectations there was, as we indicated, no real fad syndrome. On the contrary the action programmes fell easily in five coherent

categories with good face validity. We may hypothesise from this that European senior manufacturing managers have a comprehensive systems view of the programmes they implement. They are less the victim of fashionable action programmes than the popular literature may suggest, and anchor their action programmes in a set of programmes around broader themes e.g. technology or human resources deployment.

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

The analysis of competitive priorities and action programmes over the period 1986-1994 shows consistency between priorities and action programmes, a steady but gradual change in the average strategy and an evolution in the choice of preferred action programmes, probably based on the experience and learning with some of the other programmes. It also shows that the area of integrating hard and software is the one where there is a divergence of opinion and where surprising strategic moves can be expected.

The managerial conclusions of this analysis are probably best summarised by raising questions around the same three ideas : consistency, dynamic choice of priorities and action programmes, and analysis of the area where strategic surprises can be expected. What is the type of consistency you have created between your strategic priorities and the set of action programmes, how do you make the choices for both evolve, and where is the highest strategic uncertainty in your industry. Drawing the maps we have provided in figure 1 and 2 may be helpful in this respect and the

current analysis can serve as a benchmark in carrying out that exercise. Linked to this we also suggest to re-evaluate the set of programmes you may have against the categories of action programmes we have derived and you may want to analyse their internal consistency.

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APPENDICES

Appendix 1 : List of manufacturing action programmes and their relative degree of emphasis

	1986	1987	1988	1990	1992	1994	Average
Developing a manufacturing strategy to support business strategy	1.10	1.10	1.12	1.21	1.24	1.22	1.16
Supervisor training	1.16	1.18	1.16	1.15	1.13	1.16	1.16
Integrating information systems in manufacturing	1.17	1.14	1.18	1.15	1.14	1.12	1.15
Integrating information systems across the business unit	1.12	1.11	1.18	1.12	1.17	1.15	1.14
Investing in improved production and inventory systems	1.18	1.19	1.13	1.02	1.03	0.95	1.09
Developing new processes for new products	1.08	1.15	1.01	1.08	1.10	1.04	1.08
Giving workers a broader range of tasks	0.99	1.01	0.96	1.06	1.18	1.28	1.07
Statistical process control	1.07	1.13	1.00	1.07	1.11	1.07	1.07
Developing new processes for old products	0.96	1.03	1.02	0.95	0.94	0.91	0.98
Computer aided manufacturing	0.97	0.96	1.03	1.00	0.93	0.90	0.97
Functional teamwork	0.96	0.93	0.90	0.93	0.86	1.11	0.96
Flexible manufacturing systems	1.02	0.91	1.04	0.97	0.90	0.91	0.96
Computer aided design	0.96	0.92	1.02	0.97	0.87	0.94	0.95
Value analysis	0.95	0.94	0.93	0.93	0.91	1.04	0.95
Reconditioning physical plants	0.87	0.95	0.79	0.96	0.90	0.83	0.89
Robots	0.80	0.75	0.77	0.68	0.65	0.60	0.71
Closing and relocating plants	0.59	0.61	0.64	0.62	0.74	0.74	0.65

Appendix 2 : List of competitive priorities and their degree of importance

Competitive priority	1986	1987	1988	1990	1992	1994	Average
Ability to offer consistent quality with low defects	1.20	1.21	1.17	1.14	1.16	1.15	1.17
Ability to provide dependable deliveries	1.06	1.07	1.10	1.11	1.10	1.12	1.09
Ability to provide high-performance products	1.08	1.07	1.03	1.02	0.97	0.94	1.03
Ability to provide fast deliveries	0.99	1.02	1.06	1.01	1.01	1.04	1.02
Ability to profit in price competitive markets	0.99	0.93	0.91	0.99	1.00	1.02	0.97
Ability to introduce new products quickly	0.94	0.95	0.96	0.95	0.98	0.98	0.96
Ability to make rapid volume changes	0.85	0.85	0.89	0.89	0.88	0.89	0.88
Ability to offer a broad product line	0.89	0.88	0.87	0.90	0.89	0.85	0.88