

**EFFORTS TOWARDS ADAPTABILITY ENHANCEMENT:
- How Manufacturing and Service Industries can Learn from Each Other -**

Hiroshi Katayama ¹⁾ and David Bennett ²⁾

*¹⁾ Department of Industrial and Management Systems Engineering,
School of Science and Engineering, Waseda University, Tokyo, Japan.*

*²⁾ Technology and Innovation Research Centre, Aston Business School,
Aston University, Birmingham, United Kingdom.*

ABSTRACT

This paper discusses the recent emerging efforts for adaptability enhancement of Japanese industries to cope with a volatile demand environment.

It is based on an analysis of data obtained from respondent companies. The analysis is focused on both manufacturing and manufacturing-related service industries such as construction/maintenance, software supply, manufacturing consultation and logistics industries to highlight their current situation, the sense of crisis in Japanese companies and possible future directions in relation to the two industry sectors. The principal conclusion is that for most companies consideration of a revision or modification to its cost structure is an essential requirement for survival in the global competitive environment.

INTRODUCTION

In the emerging globalised economic environment, Japanese industry has increasingly needed to face challenges of a non-domestic nature due to local cultural issues, uncertain trading customs, restrictions on available technological functions and different operational resource characteristics. In addition, recent developments in the domestic economic environment have led to a difficult situation for Japanese companies in their own home markets. These developments include more volatile customer demand as well as drastic economic and environmental changes, for example the ending of the "bubble economy", industrial recession caused by shrinking domestic demand and strong price competition from cheaper foreign products. As a result, industries are being forced to examine their operations, to reconsider their organisational structures and reconstitute the cost structure of each business unit.

It is clearly evident that during the past thirty years or so the Japanese economy has become highly service oriented (MITI ed., 1996). The tertiary (service) sector which includes industries, such as transportation, communications, wholesaling, retailing and other miscellaneous service functions (rentals, hotels, hospitals, laundries, entertainment, education, consulting etc.) has grown rapidly, accounting for 60.3% of the workforce in 1995 compared with 38.2% in 1960. Despite this rise in the service sector, manufacturing has remained a major industrial category in Japan and relative to many other post industrialised economies it accounts for a higher percentage of the total labour force. Approximately 23.2% of employees work in manufacturing industries (according to the Japanese government census of 1995). This is higher than in the USA (16.4%) and France (18.8%) but somewhat lower than in Germany (26.7%). The level of employment in services in Japan has remained relatively stable during past the 30 years having declined only gradually during this period. A special feature of the

Japanese economy, therefore, is that service industries have become increasingly important, although not at the expense of manufacturing. Therefore when investigating the current situation and emerging problems of the tertiary (service) industries the links and relationships with secondary (manufacturing) industries are important issues to consider.

To illustrate the argument, this paper focuses on manufacturing- related service functions such as construction/maintenance, software supply, manufacturing consultation and logistics. It considers the strategic direction and action programmes needed to revise their cost structures in order to highlight their current situation, in particular their critical problem areas and possible future directions. The investigations have been carried out through questionnaire distribution to both manufacturing and service industries in Japan and the results are derived from a comparative analysis of the two industrial sectors. The underlying basis for these investigations has been the authors' previous work on the changing economic and competitive environment and its effect on the adaptability needs of manufacturing companies (Katayama and Bennett, 1996a). The principal conclusions are that the overall strategies of manufacturing and related service industries converge as the need for cost flexibility increases. Also the major action programmes to realise these strategies are largely derived from a company's information infrastructure such as CALS. It is considered that revision or modification of their cost structure is an essential requirement for survival in the global competitive environment.

THE CONCEPT OF ADAPTABLE PRODUCTION

Lean production systems have been a driving force over two decades in the manufacturing world (Womack *et al*, 1990), their relevant features are summarised as follows.

- fewer resource inputs: namely, less material, fewer parts, shorter production operations, less unproductive time needed for set- ups, *etc*.
- higher output performance, namely, better quality, higher technical specifications, greater product variety, *etc*.

This should result in greater customer satisfaction which in turn provides the opportunity for the lean company to gain a larger market share than that of its competitors. Therefore, it has been widely accepted that lean production is a relevant manufacturing strategy for a competitive growing market environment.

It is generally agreed that lean production originated in Japan, especially the management technologies. Therefore, these technologies are very popular for Japanese manufacturers as a competitive weapon. The essential cause- and- effect relationship of successful company behaviour in the past growing competitive market, which suddenly disappeared in Japan along with the collapse of bubble economy in early '91, is explained by Katayama and Bennett (1996a). A brief explanation of this mechanism is that based on the existence of strong endogenous competitive pressure a rush to expand market share is the major driving force of companies' behaviour. Their principal means to compete with others is "price competition", which causes profit reduction. Therefore, a company has to compensate with further cost reduction and/or revenue increase. As typical methods of cost reduction KAIZEN activities are relevant means by which price competitiveness and share expansion could be realised. On the other hand, revenue increases require larger sales volumes and appropriate ways to achieve this purpose are the introduction of new products and/or products diversification. The expectation is that share expansion can be realised by such an approach. However, the latter procedure will likely require an increase of investment and indirect labour. This causes fixed costs to rise, increasing the break even point (BEP) and lead to profit reduction. This final problem, however, is not dangerous as long as there is a growing market so Japanese industries have been

able to maintain this cyclic activity continuously. However, in early '91, the chain of these events was broken along with the collapse of Japan's "bubble economy", which revealed the disadvantage of this mechanism that an increase in revenues through larger sales volumes is no longer a presumed step. In addition, the increasing value of the yen has reduced the opportunity for Japanese companies to rely on exports, which was an effective mean of compensating for lower domestic sales.

As a possible new behavioural mechanism many Japanese companies are trying to reconstruct or modify their own cost structure from their more macroscopic view point. A basic scheme of this consideration is offered by the "Adaptable Production" concept described by Katayama and Bennett (1996b). The essence of this idea is to change the company's or factory's cost structure from being relatively flat with a big fixed cost function to a small fixed cost function even though the variable cost element becomes steeper (See Figure 1.).

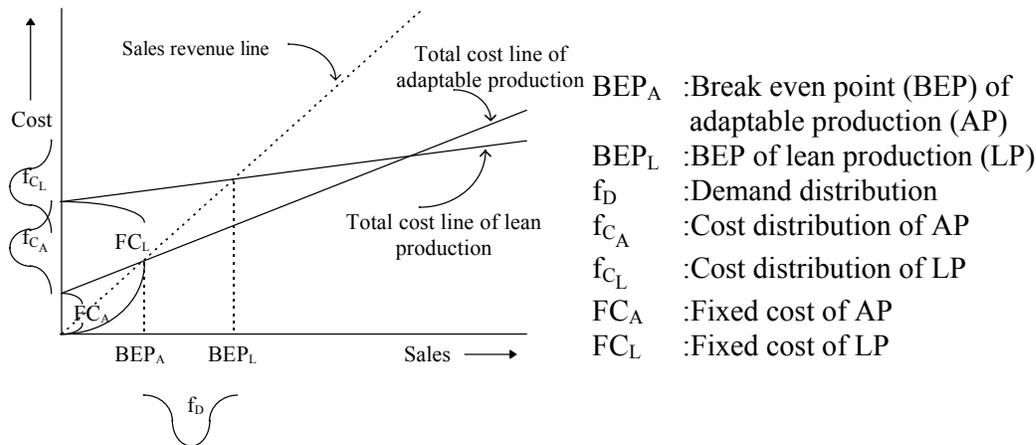


Figure 1. Cost structures of manufacturing

Summaries of cost structures of both schemes, *i.e.* lean and adaptable production, are summarised as follows.

<lean production>

This scheme potentially generates the greater profit at higher levels of demand, as it aims to realise efficient manufacturing operation as well as the development of new products constantly by investing in the facilities for the ultimate resource- efficiency. Therefore, it could be characterised as "offensive manufacturing". The variable cost of production systems is lower as a reduction of resource inputs and higher process performance is realised, however, fixed cost is sacrificed and consequently the cost of fixed assets, indirect labour and indirect overheads will all rise. The BEP becomes higher and cost sensitivity against demand fluctuations becomes reduced.

<adaptable production>

This scheme potentially generates reasonable profit at lower levels of demand, as it aims to realise system robustness against the demand environment by properly relating manufacturing cost to the rate of added value according to the demand fluctuations. Therefore, it could be characterised as "defensive manufacturing". The fixed cost of production systems is lower as equipment will not need to be replaced as frequently and its investment cost is likely to be lower since it would be more general purpose in nature, however, the variable cost may be sacrificed and consequently, direct as well as indirect operation cost, indirect material cost are

increasing because of more manual work, greater inventories and less efficient use of facilities. The BEP becomes lower and cost sensitivity against demand fluctuations becomes higher.

STATUS OF ADAPTABILITY IN MANUFACTURING AND SERVICE INDUSTRIES

Outline of survey

Data from companies in both manufacturing and service sectors have been collected through questionnaire distribution. The total number of responding business units was 182. The number distributed was 1,300, so the return rate was just 14%. A relatively low rate for this sort of survey. The total number from the manufacturing sector was 157 within which those from the electronics/electrical equipment industry was 62 (34%), a relatively big number, followed by machinery and equipment with 21 (11.5%). Transport equipment was 16 (8.8%) and other manufacturing industries distributed more or less along with their power of influence in the economic society. The total number of companies categorised as construction/maintenance (48%), software supplier (24%), consulting (16%), logistics (8%) *etc.* are 25. Therefore, the ratio of service industries to manufacturing industries is about 1:6 probably due to the relative manufacturing focus of the questionnaires.

Some results on cost management issues

For the purpose of identifying adaptability enhancement efforts of manufacturing as well as service industries, trials to modify their own cost constitution toward the future are investigated.

Considerations investigated in this section consists of BEP analysis, gap analysis on cost variables and action programmes to cope with current difficulties.

1) BEP analysis

Figure 2 and 3 show BEP and current scale of operation of each category of industry, manufacturing and service.

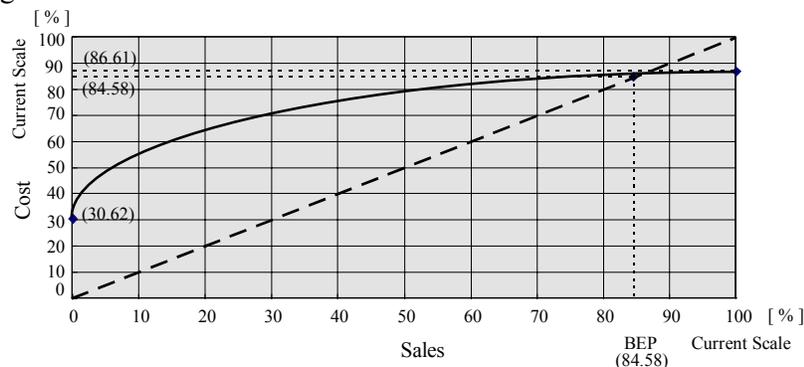


Figure 2. BEP analysis of respondent companies (manufacturing)

From the comparison of both industries, it is evident that service industries have bigger fixed cost, a linear variable cost function and bigger BEP whereas manufacturers have smaller fixed cost, non-linear variable cost function and smaller BEP. The major reason for big fixed costs in service industries is because of relatively infrastructure-based industries, and the reason for linear variable cost is because of weaker economy of scale benefits. These data indicate that service industries with such higher BEP are much more risky than manufacturing industries in a

demand shrinking environment. Therefore, on average, service industries in Japan are prone to further business difficulty.

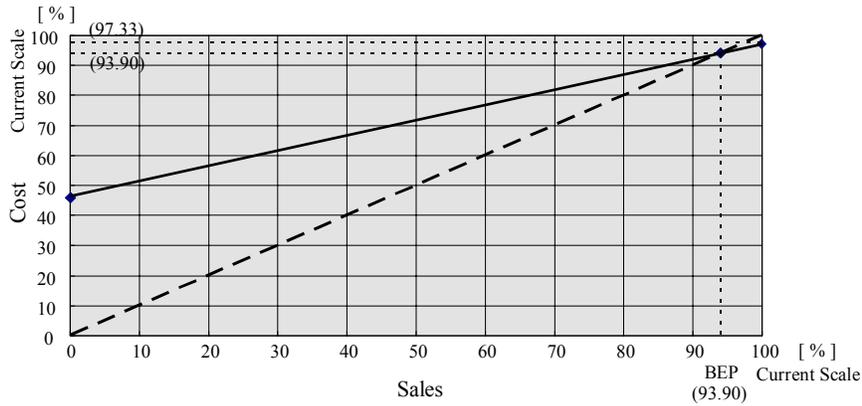


Figure 3. BEP analysis of respondent companies (service)

2) Gap analysis of cost issues

Companies were asked to respond by indicating one of 1 to 7 scores which represented the level of cost variables in their organisation over the last two years and next two years.

Question: How much will be spent on each cost component over the next two years, and how much was spent over the last two years ?

Based on these data, the management policy of cost variables, the investment level for each category of cost term (fixed and variable cost, BEP) between the past and future, are investigated through gap analysis as shown in Figure 4, which shows the force of inertia of each issue toward the future by calculating the difference between future and past/current scores.

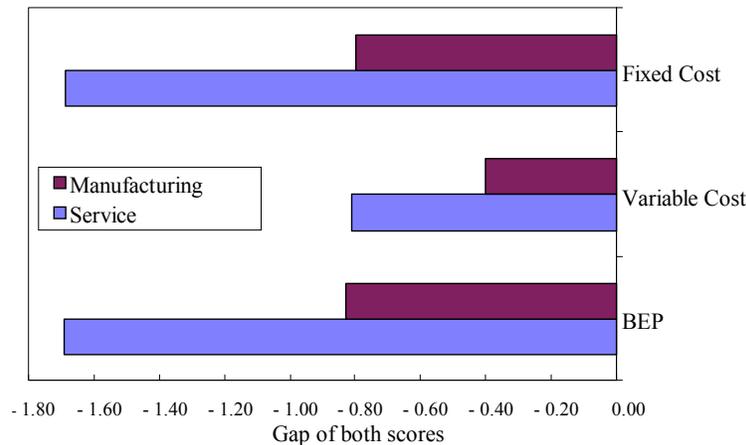


Figure 4. Gap analysis on actual cost level of respondent companies(manufacturing and service)

From this analysis, it is noted that service industries are interested in reducing all cost elements much more than manufacturers especially, having a much stronger desire to reduce both fixed cost and BEP. On the other hand, manufacturing industries have weaker interest in reducing all cost elements than services. As a more distinctive issue, both fixed costs and BEP are intended to be reduced more than variable costs in both industries, which is understood as the direction of adaptability enhancement.

3) Action programmes for cost adaptability

The next consideration is about action programmes for cost adaptability. Companies were asked to respond by indicating one of 1 to 7 scores for each action programme which represented the level of importance of each action programme over the next two years.

Question: How strong will be the emphasis of each cost management action programme over

the next two years ?

Based on these data, following Figure 5 is obtained.

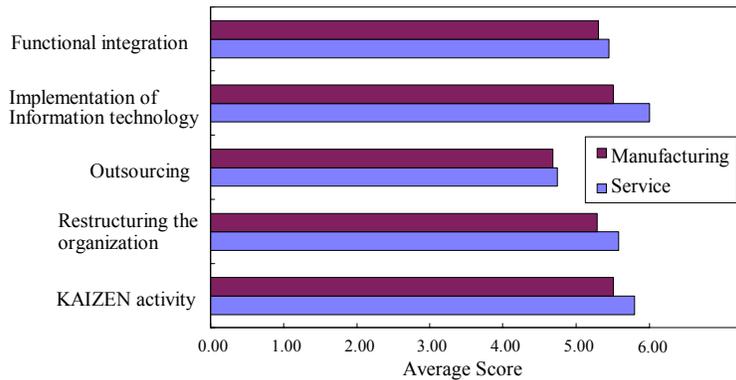


Figure 5. Comparison of cost management action programmes of respondent companies(manufacturing and service)

It is seen from this figure, that service industries have higher average scores on every action programme considered, which means they have a stronger sense of crisis than manufacturers. This tendency is especially apparent for “implementation of information technology”. “KAIZEN activity” is also the top ranked action programme for realising cost adaptability.

CONCLUDING REMARKS

In this paper, the concept of adaptable production has been described and a comparative analysis made between manufacturing and service industries based on survey data collected from various business units. The discussion focused on which strategies provide an effective direction in volatile markets and low growth economic environments. The results obtained from this study could be summarised as following.

- ① Average cost structures of manufacturing and service industries have been summarised through BEP analysis, and it is clear that service industries are in a much more severe situation than manufacturing industries.
- ② Adaptability enhancement is the aim of both industrial sectors with service companies are much more concerned about moving in this direction than manufacturers.
- ③ It is also evident from the data that efforts to realise adaptability enhancement have been made in various way both by manufacturers and service industries.

As the final remark, it should be emphasised that adaptable production will sustain its robustness in an era of globalised and uncertain markets by being applied together with the KAIZEN which still retains its effectiveness as the traditional tool for giving Japanese manufacturers their competitive advantage.

ACKNOWLEDGEMENT

This research has been accomplished with the support of Waseda University Grants for Special Research Projects '96 - '97. We, the authors, sincerely appreciate the kind support by the fund.

REFERENCES

- Katayama H. and Bennett D. J., Lean Production in a Changing Competitive World: a Japanese Perspective, *IJOPM*, Vol. 16, No. 2, pp.8- 23, 1996.
- Katayama H. and Bennett D. J., “Adaptable Production and Its Realisation: Some Cases of Japanese Manufacturers”, *Proc. of the 3rd ICOMA*, pp.357- 362, 1996.
- MITI ed., *MITI White Paper*, Printing Centre, Ministry of Finance, 1996.

Womack, J. P., Jones, D. T. and Roos, D., *The Machine that Changed the World*, New York, Rawson Associates, 1990

ANNEX

Table 1. Distribution of respondent industries of Japanese domestic companies

Manufacturing Industries		Service Industries	
Category	Number of BUs	Category	Number of BUs
Food, beverage and tobacco	8	Construction	12
Textiles, clothing and footwear	3		
Pharmaceuticals	3	Software	6
Wood and Wood products, furniture	1		
Paper and paper products, printing	6	Consulting	4
Chemicals and petroleum products	14		
Non- metallic minerals	6	Logistics	2
Basic Metal products	7		
Fabricated metal products	10		
Transport equipment	16	Others	1
Electronics and electrical equipment	62		
Other machinery and equipment	21		
Total	157	Total	25

Strategic issues and their levels

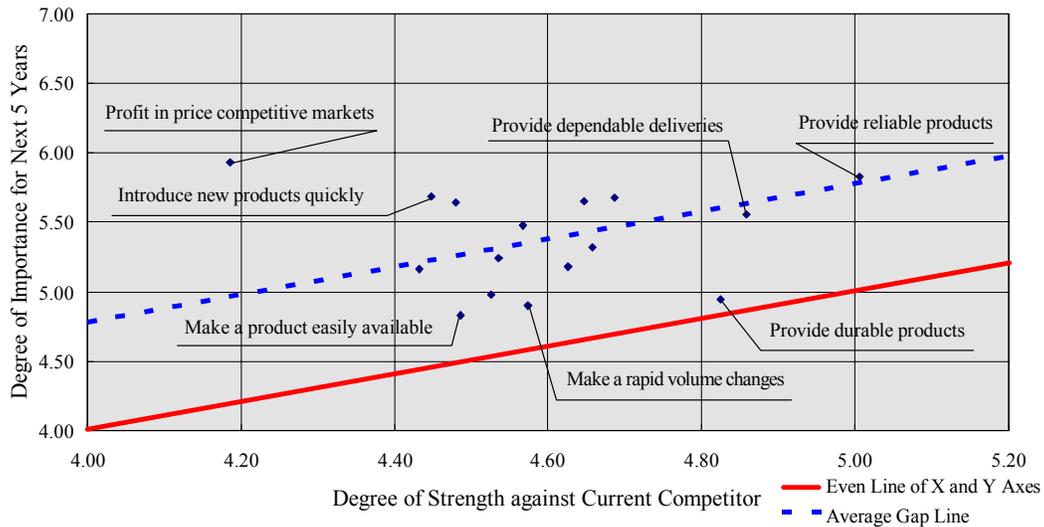


Figure 4- 1. Gap analysis between current strength and future importance of competitive priority score (manufacturing)

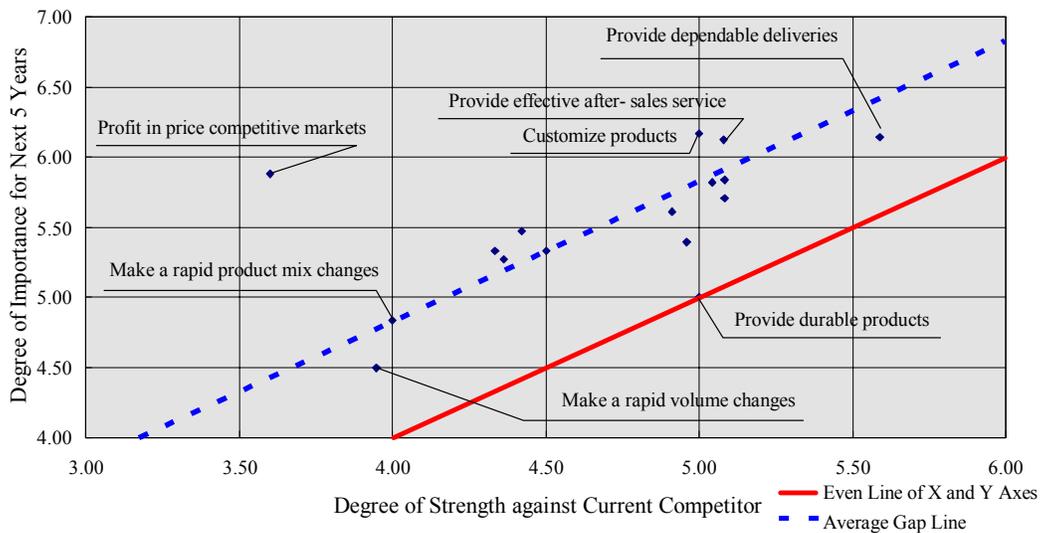


Figure 4- 2. Gap analysis between current strength and future importance of competitive priority score (service)

Action programmes and their levels

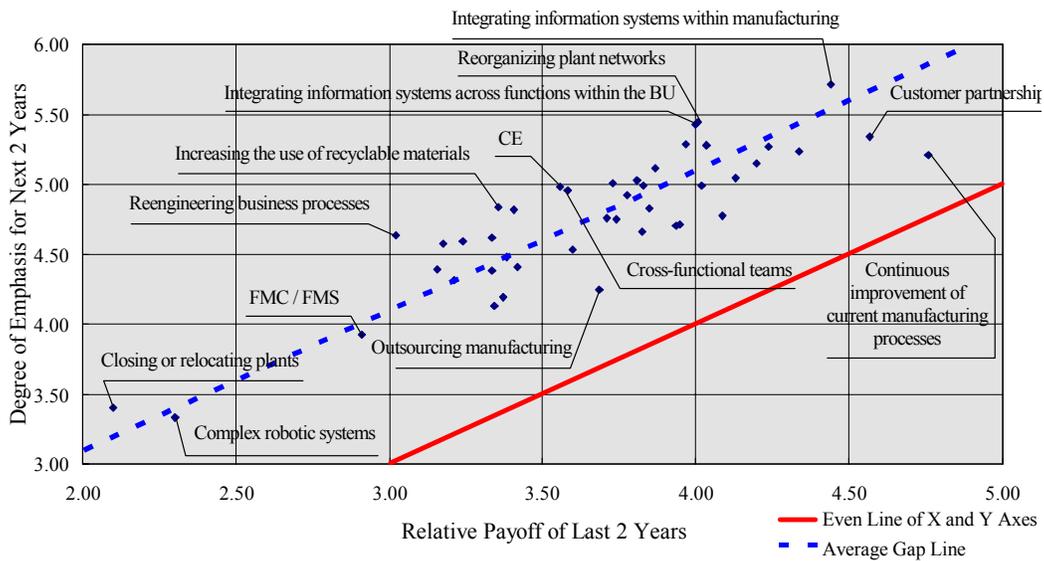


Figure 5- 1. Gap analysis between last 2 years scores and future 2 years scores of action programs (manufacturing)

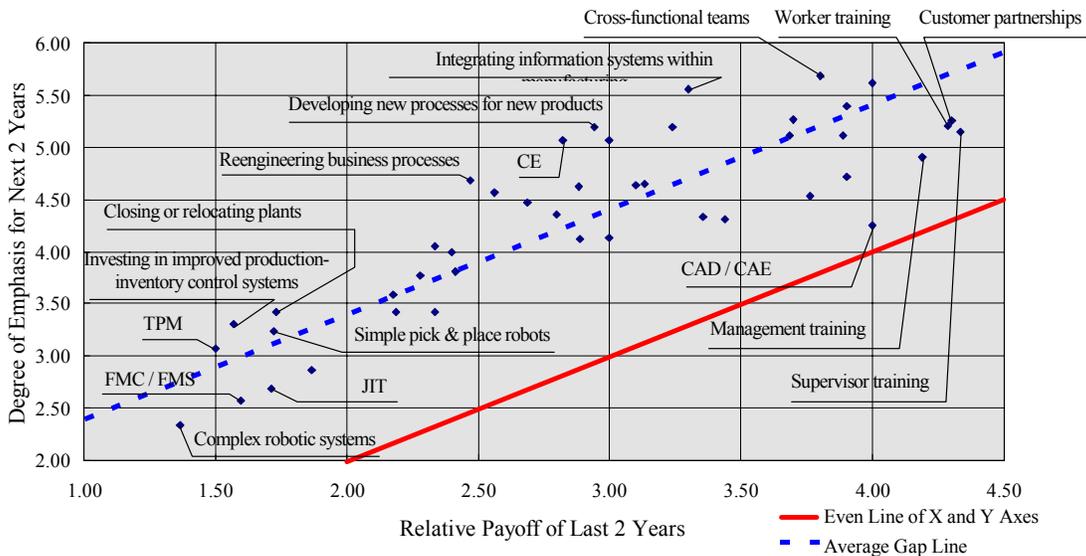


Figure 5- 2. Gap analysis between last 2 years scores and future 2 years scores of action programs (service)

Performance

Table 2- 1. Comparison table of average performance indicators of two categories of industries (physical manufacturing process)

Physical Manufacturing Process	Manufacturing	Service
Average defect rates at the end of manufacturing	112.59	103.91
Average unit production costs for typical product	117.66	118.91
Work- in- process inventory turnover	105.77	106.86
Equipment changeover time	110.57	103.29
Manufacturing cycle time	114.17	109.00
Variety of products producible by manufacturing	114.77	191.91
Productivity of direct production workers	118.04	142.33

Table 2- 2. Comparison table of average performance indicators of two categories of industries (supply process)

Supply Process	Manufacturing	Service
Procured materials inventory turnover	104.66	125.44
Procurement lead time	108.35	119.30
Average defect rates of the procured materials	107.25	98.80

Table 2- 3. Comparison table of average performance indicators of two categories of industries (order fulfilment process)

Order Fulfilment Process	Manufacturing	Service
Overall quality as perceived by customers	106.48	104.71
Average defect rates in customer's hands	109.14	97.73
Finished goods inventory turnover	108.22	109.29
On- time delivery to customers	105.29	118.00
Delivery lead time	110.52	100.42

Table 2- 4. Comparison table of average performance indicators of two categories of industries (overall business unit performance)

Overall Business Unit Performance	Japan	
	1996	
	Manufacturing	Service
Market share	102.92	133.20
Profitability	112.59	90.69

Cost management issues

Table 3. Gap analysis on actual cost level of Japanese domestic industries (manufacturing and service)

Japanese Domestic Manufacturing	Fixed Cost	Variable Cost	BEP
Manufacturing	- 0.80	- 0.40	- 0.83
Service	- 1.69	- 0.81	- 1.69

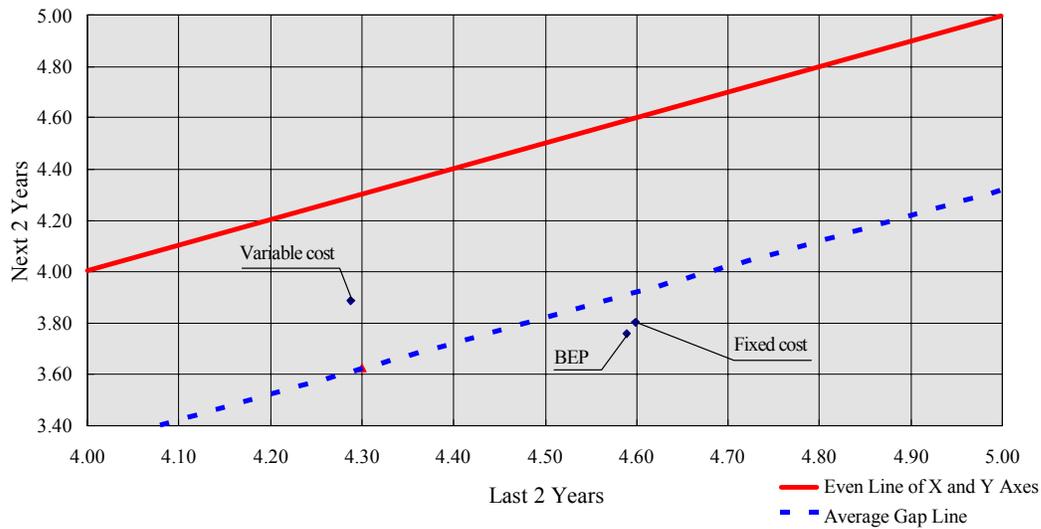


Figure 6- 1. Gap analysis on actual cost level between last 2 years and next 2 years (manufacturing)

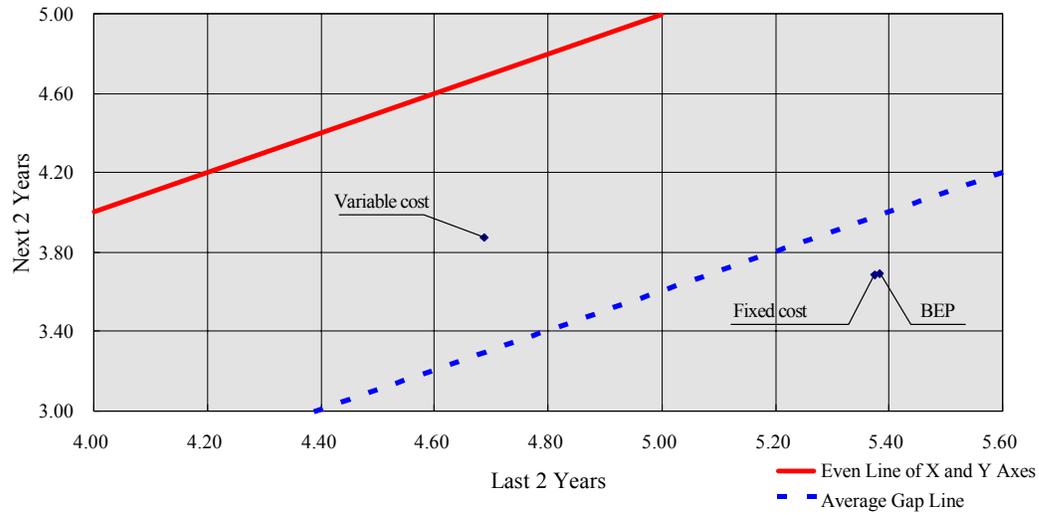


Figure 6- 2. Gap analysis on actual cost level between last 2 years and next 2 years (service)

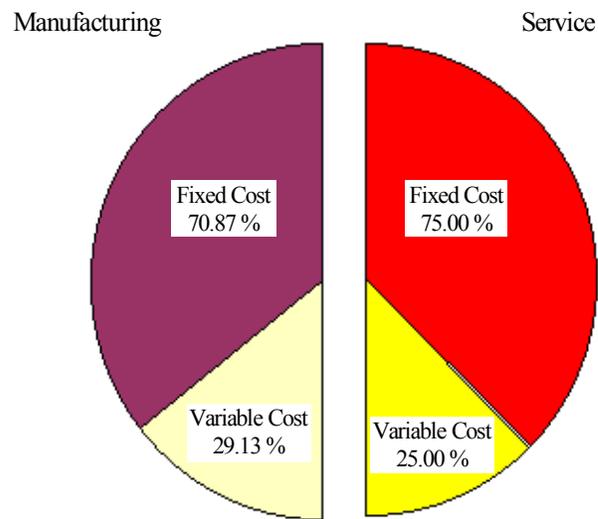


Figure 7. Emphasising cost issues of Japanese domestic industries (manufacturing and service)