

TITLE: COMPARISON OF CULTURES IN THE CONSTRUCTION AND MANUFACTURING INDUSTRIES

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Abstract

This paper investigates and compares the culture found in the construction industry (as represented by the construction project site), with manufacturing. The results were obtained by use of questionnaires and intensive interviews with individual members of staff using a UK government sponsored questionnaire. A vertical section of each company was sampled such that equivalent organisational levels could be directly compared. The results from the manufacturing industries provide a bench mark for use by others. The main findings are that the culture existing in construction has significant differences to that found within the manufacturing industries. It will not be possible to transfer management tools from one industrial sector to the other without substantial redesign. The culture within a project, *project culture*, is different to the *company culture* found within individual companies.

KEYWORDS: construction industry, manufacturing industry, management, culture, performance, innovation, communications

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INTRODUCTION

There is a worldwide drive to improve efficiency and reduce construction costs. Table 1 shows performance improvement targets that have been set for the UK and the USA, many other countries have likewise set their own targets. These targets are in line with the general thrust of the Latham Report, chaired by Sir Michael Latham MP in 1994 and the following Egan Report, chaired by Sir John Egan, chairman of British Airports Authority; these were UK Government sponsored “big picture” investigations into the efficiency of the UK construction industry. The targets set were demanding but achievable as reported by Brown & Riley (1998). However the targets set will not be achieved by simply forcing contractors to reduce prices even lower than they are at present, with their existing tight profit margins. The only way to achieve targets of this magnitude is to achieve a step change in project delivery. By step change we mean that the whole process used to deliver a project to the client undergoes a complete and significant change. Such a step change will not be possible without a major change in culture within the companies involved in the project and as the Royal Academy of Engineering states, “It is clear that the challenge of changing the culture in the construction industryis daunting”.

It is important for all companies to create, nurture and manage a culture that is appropriate to their ambitions and business environment and construction companies have two aspects to consider. The first aspect is the culture exhibited within the company, as an independent organisation and referred to as *company* culture. The second aspect is the culture exhibited by the company acting in its role as part of the construction project and referred to as *project* culture. Management tools relying on company culture include business process re-engineering and total quality management. Management tools relying on project culture include supply chain management, interface management, just in time management and procurement strategies.

An important task for any construction project manager is to ensure that the optimum *project* culture is developed. However before this can be achieved a clear understanding of one's own company culture must be achieved

A difference in culture between the construction and manufacturing industries might be expected since there are significant differences in their business environment. These differences include the geographically distributed nature of construction, the dynamic nature of site management, the highly mobile and itinerant work force, a more difficult training scenario, lower levels of technology and the large number of companies and organisations that have to work together in the project. Perhaps the most significant difference is the time scale involved; a construction project has a fixed duration lasting, on average, two years whereas manufacturing provides a long term stable environment.

The traditional UK construction industry is also typified by conflict and an adversarial attitude between all the parties to the project and this is less common in manufacturing. These problems and proposed solutions are discussed in the author's "Working Together – Tools for an integrated construction supply chain".

LESSONS FROM THE MANUFACTURING INDUSTRY

In order to achieve the improvements targets set in Table 1 the construction industry is urged to use the good engineering management tools developed by the manufacturing industry. For example, the Royal Academy of Engineering states:

The Construction Industry would benefit significantly from the study and adoption of best practices from manufacturing and other industries. Elements are identified in this statement which could lead to early advantage: they include better supply chain management and considerable improvements in culture and organisation.

However, manufacturing practices can only be transferred to construction if there is no significant difference in culture between the two sectors. A large difference in culture is likely to make this transfer difficult. An understanding of any differences will allow the redesign of manufacturing practices before their transfer to construction. Any major differences might, indeed, prevent the transfer of such practices.

The key objective of this paper is to identify the culture that exists in both manufacturing and construction in order to assess the viability of transferring "best practice" engineering management tools from manufacturing to construction.

CULTURE - A BACKGROUND

Culture is used to describe the collection of "soft" management and behavioral variables that form the psyche of the business organisation. In order to manage and influence culture it is necessary to first define and then develop a conceptual model of what culture is; however it is typical of many soft issues that there does not exist a single accepted definition or model of culture. This is illustrated by the fact that Kroeber and Kluckhohn (1952) identified 164 definitions of culture and that, almost four decades later Ott (1989) still found that no clear definition had been developed, finding seventy three words or phrases used to define culture from fifty eight publications. With this difficulty of definition it is essential to know something of the history of culture in order to understand and manage it.

Bowers (1969) highlighted five variables that composed culture and highlighted communication as being the most significant. Harrison (1972) proposed a model consisting of four basic variables. Lundberg (1990) suggested six basic ingredients as representing culture. Maloney (1985, 1991) defined culture as "the set of assumptions shared by members of the organisation about the desired and appropriate behaviours, including how these assumptions are reinforced and how they are communicated to members, old and new" and suggested that the business environment has perhaps the largest influence on culture. This would mean that a company working in a high technology area should place greater importance on research, new product and process development and innovative problem solving.

Drennan (1992) defined culture as meaning "how things are done around here" but again this simple phrase hides the fact that culture is built up from many factors and is influenced by a range of variables that change over time. Culture develops through the normal and traditional methods by which things are done. The acceptable standards are established and become the norm. It is rooted in history, collectively held and sufficiently complex to resist attempts at direct manipulation. Drennan suggests that it is the

company's internal environment that has the most influence on employee attitude and not the external environment such as rising unemployment or global competition.

It is important to understand that there is no ideal organisational culture that is able to guarantee success for the company because every company is unique (Gorman, 1989). The appropriate culture for an organisation depends on many factors, including the age of the organisation, market, geographical location, history and even the preferences of the chief executive and top management. The temptation for any particular company to simply implement management approaches from other successful companies in order to change attitudes to culture but this is naive and dangerous and quite likely to create negative results (Brown and Riley 1999).

An overall view of culture is provided by National Economic Development Office (NEDO) who defined culture as the amalgam of aspirations, attitudes and values shared by the employees. Although there is no single best culture for use by all companies, NEDO found that regardless of company size and although all the cultures were different, they all shared a similar philosophy and similar characteristics. The cultures of all successful companies were found to have the following characteristics (NEDO):

- It is strong and identifiable.
- Is embodied in a clear mission statement which encourages commitment and co-operation across functions.
- Encourages the acceptance of change and new ideas - especially from outside and hence avoids the problem of "not invented here".
- Engenders continuous striving for improvement and positively discourages complacency.
- Dictates that customer considerations pervade all activities.
- Ensures that targets are set through consultation with those responsible for their achievement.
- Links rewards to company performance and personal achievement.
- Generates enthusiasm and dedication.

The NEDO model of culture has been used to enable the different cultures within each of the three companies to be compared. The NEDO model of culture has also been used as the basis for a detailed questionnaire to help companies assess their own culture and this questionnaire, described later, has been used for this research.

RESEARCH METHOD

1. Two manufacturing companies were selected to represent the manufacturing industry. Their results are used as benchmarks for similar observations of the culture within a construction company. One manufacturing company was an automobile manufacturer and the second was the producer of a brand name beverage. The construction company selected was a civil engineering contractor since the “manufacturing” phase of a construction project is carried out on site it was felt that observing a construction site would be more appropriate.
2. The culture within each of these three companies was investigated using an industry standard questionnaire.
3. Interviews were also conducted following the return of the questionnaires in order to carry out a quality control check on the their accuracy.
4. Each company was defined by observing employees within the same equivalent *vertical section* of the companies organisational structure. This included the appropriate director, middle management and the operators and unskilled workers.
5. The perceptions of culture observed in each of the three companies’ vertical sections were compared.
6. The results across the three companies are determined, analysed and discussed.

DESCRIPTION OF THE THREE COMPANIES

The Construction Company

The construction company is the civil engineering contracting arm of a UK international construction group, established over sixty years ago and having a turnover in excess of £700million. It is responsible for more than half of the group’s turnover which has in excess of 8000 employees. Other companies within the group are responsible for house building and mining operations.

The company has a management philosophy which aims to maintain and reinforce the company's culture and to guide and support the behaviour of all employees. Their culture emphasises the company's belief that the primary concern is customer satisfaction and the importance of employee development and training to ensure high levels of quality and safety in all aspects of their work;.

The research was based on a major road contract in Southern England. The contract value was over £25 million and involved the construction of approximately 5 kilometres of new road plus side roads and structures. The contract was let under the traditional strategy using the Institution of Civil Engineers Conditions of Contract, 5th Edition and with a contract period of 140 weeks. The traditional strategy involves design by consulting engineers, selected list of contractors bidding on the fully detailed design drawings and documents, lowest bid accepted and payment by re-measured bill of quantities. There were 30 full time staff controlling over 60 sub-contractors. The highest manager working full time on the contract was the site agent who reported to a contracts manager/regional director whose role was to co-ordinate several sites and report to the managing director of the company. The site agent had successful record of managing similar highway projects.

The Production Manufacturing Company

The production manufacturing company selected was an automobile manufacturing plant that is part of a global group. The group has been responsible for original and fundamental work in improving production manufacturing methods.

The plant manufactures a single vehicle type. The group has another manufacturing plant in Europe producing the same vehicle type. Thus, the plant observed had direct competition from both within the group and from other manufacturers world-wide. Components were sourced from both inside and outside of the UK. The UK division employs some 50,000 people and a turnover in excess of £600million.

Management has been devolved to plant level but subject to the wider group decisions. The group has a long established practice of developing its management by moving staff to different plants throughout Europe and the world.

The Process Manufacturing Company

The parent group of the process manufacturing company was established over 200 years ago and produces, in over 40 countries worldwide, a range of specialised beverages for human pleasure/delectation which are sold in over 130 countries. It has built up a strong portfolio of brand names. The company observed is a speciality UK division responsible for a particular brand of beverage. The UK division had a turnover in excess of £300million and employs some 1500 people mainly on two sites.

The group has a stated commitment to become a world leader through a company environment based upon:

- an innovative approach to business and intelligent risk taking
- a distinctive competitive edge on quality and customer service in all areas of the business
- empowering employees to contribute fully to, and benefit from, the continuing success of the company
- a determination to set the standards for the industry

The company operates three eight hour shifts with each shift supported by shift fitters and shift electricians provided from a different division within the company.

QUESTIONNAIRE DESIGN

To make direct comparisons one questionnaire was used by all three companies.

An existing industry standard questionnaire was used to ensure that results could be compared over time and across different industries. This questionnaire was the "Innovation Management Tool Kit Questionnaires" prepared by the UK government sponsored National Economic Development Office (NEDO). The NEDO questionnaire asks employees at all levels their views on culture and these are assessed against the NEDO

responses to that question. The NEDO response is based on their research into the culture associated with successful companies. The scores for all the questions are used to build up a picture of culture within the company. This approach is somewhat prescriptive but has the advantage of being reproducible. The full NEDO questionnaire is extensive and limited space precludes their inclusion here but copies of the questionnaire can be obtained from NEDO and a copy appears in Riley (1998) which is available at the web address attached to the references.

The NEDO questionnaire investigates ten key areas that were identified as defining the culture of a business and are:

1. Company values: measures the attitudes, aspirations and values of the company as shared by employees; measures the understanding for what the core business is and the uniqueness of the company's business from the employees point of view.
2. Employees: measures the selection, motivation, training and performance/rewards aspects.
3. Internal communications: measures the effectiveness and style of company internal communications
4. Structure: measures levels of responsibility, areas of activity and their inter-dependencies within the organisational structure of the company.
5. Customers: measures customer relations and how, and at what level, this is monitored.
6. Finance: measures the responsibility and control that employees have over both internal and external financial aspects and the relationship with investors.
7. Suppliers: measures the input of new ideas and management processes from suppliers and the supply chain.
8. Competitors: measure the understanding that each level in the organisation has regarding competitors since it is essential that they are known and managed.
9. Technology: measures employees understanding of technology support and management.
10. New Products and processes: measures the generation of new ideas and products and how employees contribute.

The score for each of these areas is expressed as a percentage of the actual score against the NEDO score and this is used as the measure of that aspect of culture.

DESIGN OF VERTICAL SECTION THROUGH THE ORGANISATIONAL STRUCTURE

The design of the “vertical section” through the company organisational structure is critical if a true comparison in the variation of culture between the companies is to be achieved. It is important to compare the culture between equivalent occupational levels. The occupational levels are defined from Level I (director level) to Level VII (unskilled labourer level) with the various supervisory and management levels located within this scale by using the following five measures, based on a work profiling approach:

1. The number of reporting steps to the head of the UK organisation; defined as a number 0, 1, 2, 3 etc.
2. The financial impact of their performance are defined and scored as 1 (extreme), 2 (very substantial), 3 (substantial), 4 (large), 5 (moderate), 6 (small), 7 (none).
3. Their responsibility for resources are defined and scored as 1 (overall), 2 (very substantial), 3 (substantial), 4 (large), 5 (moderate), 5 (small), 6 (none).
4. Their responsibility for personnel are defined and scored as 1 (overall), 2 (very substantial), 3 (substantial), 4 (large), 5 (moderate), 6 (small), 7 (none).
5. The time span for job errors to take effect are defined and scored as 1 (annually), 2 (monthly), 3 (weekly), 4 (daily), 5 (immediate).

A senior member within each company was asked to assess the criteria of their employees within the vertical slice. By building up the score for each employee they can be placed within the appropriate level and the company's cross section defined and directly compared regardless of industrial sector. The results of this profiling are shown in Table 2.

The number of questionnaire respondents related to the occupational levels is as follows.

Construction Company: all site staff and at least three staff from each of the sixty sub-contractors responded. At level one, one response; at level two, one response, at level three, three responses; at level

four, nine responses; at level five 25 responses; at level six and seven, over 120 responses from sub-contractors.

Production Manufacturing Company: all staff from one shift responded. At level one, one response; at level two, one response, at level three, three responses; at level four, no staff at this level; at level five seven responses; at level six and seven, over 100 responses.

Process Manufacturing Company: all staff from all the shifts responded. At each shift there is at level one, one response; at level two, one response, at level three, one responses; at level four, one response; at level five three responses; at level six and seven, over 30 responses.

RESULTS OF THE SURVEY

Table 3 presents the overall results of the NEDO questionnaire for each occupational level within each of the companies and for each of the ten NEDO culture areas. The combined results of the process and production manufacturing companies are used as bench marks for the generic manufacturing industries and referred to in this paper as *manufacturing*.

Table 4 shows the analysis of the variance of the scores of Table 3 with companies analysed in pairs and the F and P values calculated. Areas of significant differences between companies are highlighted in the table with a star adjacent its P value. The F test calculates the variance ratio, F , that allows a judgement to be made as to whether the sample variances of two sets of data belong to the same sample; in other words it helps to assess whether the different companies responses to the NEDO questionnaire are the same or different and hence whether they have the same culture or not. The P value or p level of the test indicates the significant level at which the F test hypothesis would have to be rejected.

Figures 1, 2, and 3 show the mean score for each culture area related to the occupational Levels I to VII for each company.

DISCUSSION OF RESULTS

Cultural Profile for the Construction Company

The construction company scores are shown in Table 3 and Figure 1. There appears to be a greater variability in the quality of perceptions of culture than those for the manufacturing companies. The scores for each occupational level shown in Figure 1 illustrate that the scores crossing over and do not have a common trend; this demonstrates poor shared perceptions between occupational levels. The view that trade workers should not be expected to understand or worry about these business aspects is clearly no longer relevant. This view is based on the lack of communication on business aspects between different levels that should be known across all employees. It is particularly important that all levels understand the importance of customers. The increased use of sub-contractors makes the situation more difficult for construction since the higher levels are likely to be employees of the main or prime contractor whereas the lower levels are likely to be employees of sub-contractors rather than the main contractors. This makes the project manager's role of managing the culture of the whole project very difficult, but it is important to be aware of the differences in culture, aspirations and objectives of the sub-contractors.

Cultural Profile for the Production Manufacturing Company

The production manufacturing company scores are shown in Table 3 and Figure 2. The culture scores of each occupational level tend to move together. Few of the lines representing the different occupational levels cross demonstrating shared perceptions between occupational levels. The higher levels of management have a greater awareness of competitors, suppliers and, to a lesser degree, finance.

Cultural Profile for the Process Manufacturing Company

The process manufacturing company scores are shown in Table 3 and Figure 3. The culture scores of each occupational level tend to move together. Few occupational level lines cross showing shared perceptions between occupational levels. The higher levels of management have a greater awareness of competitors, suppliers, competitors and, to a lesser, degree finance. Generally, most employees understood that they were part of a worldwide business with strong interdependencies but were proud of and loyal to their own company.

Comparison Between Industries

The comparison of the culture scores is shown in Table 4 and supported by Figures 1, 2 and 3. The following points arise from their inspection.

1. A comparison of the production manufacturing company and the process manufacturing company results show no statistically significant difference in their results, and justifies the amalgamation of the two sets of results into one combined set representing the whole manufacturing sector and referred to as manufacturing. This shows that management tools developed for the manufacturing industries can rely on the culture being similar across the sector.

2. A comparison between the construction company and the process manufacturing company found four of the ten NEDO areas to be significantly different:

- Culture: The culture was more clearly defined in the process company and contained more innovative values
- Communications: The construction company had significantly better communications than the manufacturing companies
- Technology: The process company was more technically innovative than the construction company
- New Products and Processes: The process company showed greater awareness of the possibilities and potentials.

3. A comparison between the construction company and the production manufacturing company found five of the ten NEDO areas to be significantly different. These were the four found in the above section together with the structural area.

Comparison between Occupational Levels

The scores of each occupational level, from Figures 1, 2, and 3 can be compared based on the NEDO areas.

- Culture: The culture of both manufacturing companies was significantly more clearly defined than construction. All their staff were conscious of their company's strategies and felt strong team spirit in spite of the difficult economic situation. However many of the personnel on the construction site knew nothing of the companies management philosophy; this might be anticipated since some 60% of personnel on site were sub-contract staff. However, senior engineering staff on site did state that they tried to use the same sub-contractors on all jobs if possible and if this is the case the score achieved is disappointing.
- Employees: The construction company scored lower than both manufacturing companies although the variances significant showed no statistical difference. However, individual responses did show significant differences in some key areas, particularly in the way that employees regarded the reward system. As an example, the question "I receive a bonus based on the companies performance" received a positive response from 3% of production engineering, 15% of construction and 91% of the process manufacturer.
- Internal Communications: Many of the hourly paid staff at the production manufacturing company felt that they did not have sufficient opportunity to state their opinion and this led to a feeling that many of their concerns were not being addressed and created an unsatisfactory situation. The situation in construction is significantly better.
- Structure: Both manufacturing companies had a flatter organisational structure than that existing in construction and the structure on a major construction site is not obvious, particularly to sub-contractors new to the site. This is an area to note for construction companies.
- Customers: All three companies scored similar profiles. The construction company had an erratic set of results probably due to the large number of sub-contractors. Some sub-contractors often have no clear idea of who the real client is and even less knowledge of the client's attitudes and aims for the project.

- Finance: There were no significant differences between companies with all scores being low.
- Suppliers: There were no significant differences between companies with all scores being low. The slightly higher scores for construction probably reflect the situation on site with greater interaction with suppliers. They also expected greater support from their suppliers in terms of new product information and quality control.
- Competitors: The attitude of all three companies is highly competitive. It is interesting to note the heightened understanding and attitude at the lower levels in construction. This is probably the response from sub-contractors who are usually appointed on a lowest cost basis.
- Technology: There are similar results for manufacturing and lower results for construction.
- New products and processes: There are similar results for manufacturing and lower results for construction.

SUMMARY AND CONCLUSIONS

Each of the companies chosen were considered as "blue chip" representatives of their respective industries. Each has its established management system to support continuous improvement; none had recently carried out any significant change program. As such it is felt that they could be considered good representatives of their respective industries and therefore the results are believed to be typical and acceptable.

There were significant differences between the construction and manufacturing companies in 4, perhaps 5, cultural characteristics (40%-50%) in the cultural profile. This infers that the transfer of management ideas and methods directly from manufacturing to construction is not likely to be successful unless considerable effort is taken to modify these management tools or the culture in the construction industry. Modification of existing manufacturing management tools will require a change in vocabulary and context.

The organisational structure on a construction site includes a large percentage of subcontract staff. For this reason the main contractor will have to rely on a larger and deeper company hierarchy to reinforce company culture, corporate memory and management.

A typical construction company appears to have two cultural situations; the corporate or “head office” based culture and a distinctive, separate, project culture associated with each unique construction project. Each sub-contractor on site will have it’s own unique culture which will be different to the prime contractors culture. These cultures have to be brought together to create a single unifying project culture to improve working relationships. Management tools have to be developed to achieve this; for example one way of achieving this is by implementing an “induction” process to help the integration of new sub-contractors into the project’s culture when they arrive on site.

In comparison, the manufacturing industry appears to have only a corporate or company based culture.

The majority of respondents were very interested in the research programme and were appreciative of the interest being shown in their views about their company. This highlights the importance of communication between all levels. Communication helps employees feel they contribute and are empowered. This will lead to increased efficiency and reduced costs.

Although there were differences, the culture profiles of the two manufacturing companies did, essentially, agree with each other. This gives confidence that these culture profiles are reasonably typical of the manufacturing industry as a whole and can be used as a bench mark for other companies and industries.

The results from the construction company profile indicate that the shared values are quite different compared with the manufacturing companies.

In construction the soft issues and the beneficial effect of managing the soft issues are less understood.

Many of the hourly paid staff at the production manufacturing company felt that they did not have sufficient opportunity to state their opinion and this led to a feeling that many of their concerns were not being addressed, this was not felt by management to reflect reality. Management stated that staff are the most important asset and has set up systems such as a “suggestions box” (with reward system) and company newspapers etc to ensure good communication. It appears that company newspapers are viewed as one way from management and that suggestions boxes are not seen as an effective communication to management. It is likely that the hourly paid employees are referring to daily, work related communication rather than management’s more strategically based “big picture” communication when they talk about communication.

The results show the construction industry being less innovative than the manufacturing industry. This may not be a true reflection of reality since the nature of a construction site is one of continually producing new solutions to a unique site production situations. This sort of innovative thinking may be taken for granted by site staff and not thought of as being anything special and hence not scored as such. The role of innovation needs further research.

From the scores it appears that the culture or the cultural profile of an organisation evolves in part (if not mostly) as a consequence of productivity improvements accomplished rather than changed to accept productivity improvements. This may imply that management strategies are possible that may facilitate more rapid productivity improvements by consciously attempting to simultaneously “shape” the cultural profile.

This research has highlighted some of the areas of dissatisfaction and also areas of potential benefit by managing culture. A greater understanding and appreciation of cultural issues should be encouraged in the construction industry to achieve increased benefit and value for the client.

There is a problem on construction sites of developing an integrated project culture due to the use of large numbers of sub-contractors. Fortunately the increased communication that takes place, as of necessity, with sub-contractors helps to co-ordinate cultural interactions. This increased communication follows from the

use of contractual documents and the formal planning and management required to control sub-contractors in this relationship.

The need to manage the rather random nature of sub-contractor culture has been sub consciously known by project management staff in that the same sub-contractors are used on several projects if at all possible. The improved relationships that are being created naturally leads to the increased use of supply chain management and an increased use of partnering ways of working.

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Performance Metric	USA Government		UK Government /EPSRC
	Target	Rank	
Total Project Delivery Time	Reduce by 50%	First	Reduce by 25%
Lifetime Cost (Operation Maintenance Energy)	Reduce by 50%	Second	
Productivity and Comfort Levels of Occupants	Increase by 50%	Fifth =	Improve by 20%
Occupant Health and Safety Costs	Reduce by 50	Sixth	
Waste and Pollution Costs	Reduce by 50%	Fifth =	
Durability and Flexibility in Use Over Lifetime	Increase by 50%	Third	
Construction Worker Health and Safety Costs	Reduce by 50%	Fourth	
Costs			Reduce by 30%
Construction Quality			Zero Defects

Table 1. Construction Sector Performance Improvement Targets for the USA and UK

Blank spaces indicate no target for that metric

USA source: Wright Rosenfield Fowell, UK source: Engineering and Physical Science Research Council's Innovative Manufacturing Initiative Program

Occupational Class	I	II	III	IV	V	VI	VII
Title in:							
Production Comp	Plant Manager	Production Manager	Superintendent	Not used	Supervisor	Group Leader	Operative
Process Comp	Production Director	Head Brewer	Production Manager	Ass Prod Manager	Supervisor	Tradesman	Operative
Construction Comp	Contracts Manager	Site Agent	Sub Agent & Works Manager	Senior Engineer & Section Foremen	Site Engineer/ Foremen	Tradesman	Labourer/ Operatives
Number of steps to report to head of UK organisation	1 1 1	2 2 2	3 3 3	4 4 4	4 5 5	5 6 6	6 6 6
Financial impact of performance	Extreme = 1 Extreme = 1 Extreme = 1	V. Substantial = 2 Substantial = 3 V. substantial = 2	Substantial = 3 Substantial = 3 Substantial = 3	Large = 4 Large = 4	Large = 4 Moderate = 5 Moderate = 5	Small = 6 Large = 4 Large = 4	Small = 6 Small = 6 Small = 6
Responsibility for resources	V. Substantial = 2 V. Substantial = 2 V. Substantial = 2	Substantial = 3 Large = 4 Substantial = 3	Large = 4 Large = 4 Large = 4	Moderate = 5 Moderate = 5	Moderate = 5 Moderate = 5 Moderate = 5	Small = 6 Small = 6 Small = 6	Small = 6 Small = 6 Small = 6
Responsibility for personnel	Overall = 1 Overall = 1 Overall = 1	V. Substantial = 2 Substantial = 3 V. substantial = 2	Substantial = 3 Substantial = 3 Substantial = 3	Large = 4 Substantial = 3	Large = 4 Large = 4 Moderate = 5	Small = 6 Small = 6 Small = 6	Small = 6 Small = 6 Small = 6
Time span for job errors to take effect	Annually = 1 Annually = 1 Annually = 1	Monthly = 2 Annually = 1 Monthly = 2	Monthly = 2 Monthly = 2 Monthly = 2	Monthly = 2 Weekly = 3	Daily = 4 Weekly = 3 Weekly = 3	Immediate = 5 Daily = 4 Daily = 4	Immediate = 5 Daily = 4 Daily = 4
TOTAL SCORE	6 6 6	11 13 11	15 15 15	19 19	21 22 23	28 26 26	29 28 28

Table 2 Showing Definition of Occupational Level: the Scores and Criteria

	CULTURE	EMPLOYEES	INTERNAL COMMUNICATIONS	STRUCTURE	CUSTOMERS	FINANCE	SUPPLIERS	COMPETITORS	TECHNOLOGY	NEW PRODUCTS AND PROCESSES
CONSTRUCTION										
Mean	53.33	52.33	61.89	57.41	64.64	51.57	59.86	64.57	46.64	40.86
Standard Deviation	12.01	14.97	13.62	16.42	18.24	15.32	10.05	11.59	18.15	10.65
PRODUCTION MAN										
Mean	60.79	57.76	47.85	68.15	64.76	45.36	52.67	73.85	65.76	67.21
Standard Deviation	14.04	15.23	19.02	18.33	22.10	29.99	19.83	18.22	18.78	17.22
PROCESS MAN										
Mean	62.32	62.41	48.82	60.71	61.14	41.09	54.50	72.86	62.27	61.50
Standard Deviation	17.05	17.57	19.78	20.36	18.98	29.89	18.39	17.40	17.37	22.00
MANUFACTURING INDUSTRY										
Mean	61.40	59.62	48.24	65.20	63.31	43.65	53.40	73.45	64.36	64.93
Standard Deviation	15.18	13.21	19.15	19.33	20.80	29.75	19.12	17.74	18.14	19.28

Table 3 NEDO Questionnaire Results: Mean and Standard Deviation for each Company and generic Manufacturing Industry

	CULTURE	EMPLOYEES	INTERNAL COMMUNICATIONS	STRUCTURE	CUSTOMERS	FINANCE	SUPPLIERS	COMPETITORS	TECHNOLOGY	NEW PRODUCTS AND PROCESSES
PRODUCTION v CONSTRUCTION F value P value	4.76 0.033 *	1.60 0.211	10.36 0.002 *	5.60 0.021 *	0 0.986	0.54 0.458	1.65 0.206	3.08 0.086	10.36 0.002 *	28.04 0 *
PROCESS MAN v CONSTRUCTION F value P value	4.67 0.036 *	3.89 0.055	7.47 0.009 *	0.41 0.525	0.30 0.587	1.47 0.234	0.99 0.326	2.47 0.125	6.69 0.014 *	10.65 0.003 *
MANUFACTURING SECTOR v CONSTRUCTION F value P value	5.82 0.018 *	3.40 0.069	10.97 0.001 *	3.24 0.074 *	0.05 0.827	0.92 0.34	1.48 0.228	3.15 0.081	10.64 0.002 *	20.10 0 *
PRODUCTION v PROCESS MAN F value P value	0.13 0.713	1.09 0.301	0.03 0.856	1.96 0.168	0.40 0.532	0.27 0.606	0.12 0.731	0.04 0.842	0.48 0.49	1.16 0.286

Table 4 Results of the Analysis of Variance of Industries Compared

Figure 1 Construction Company Project Site Team Mean Scores

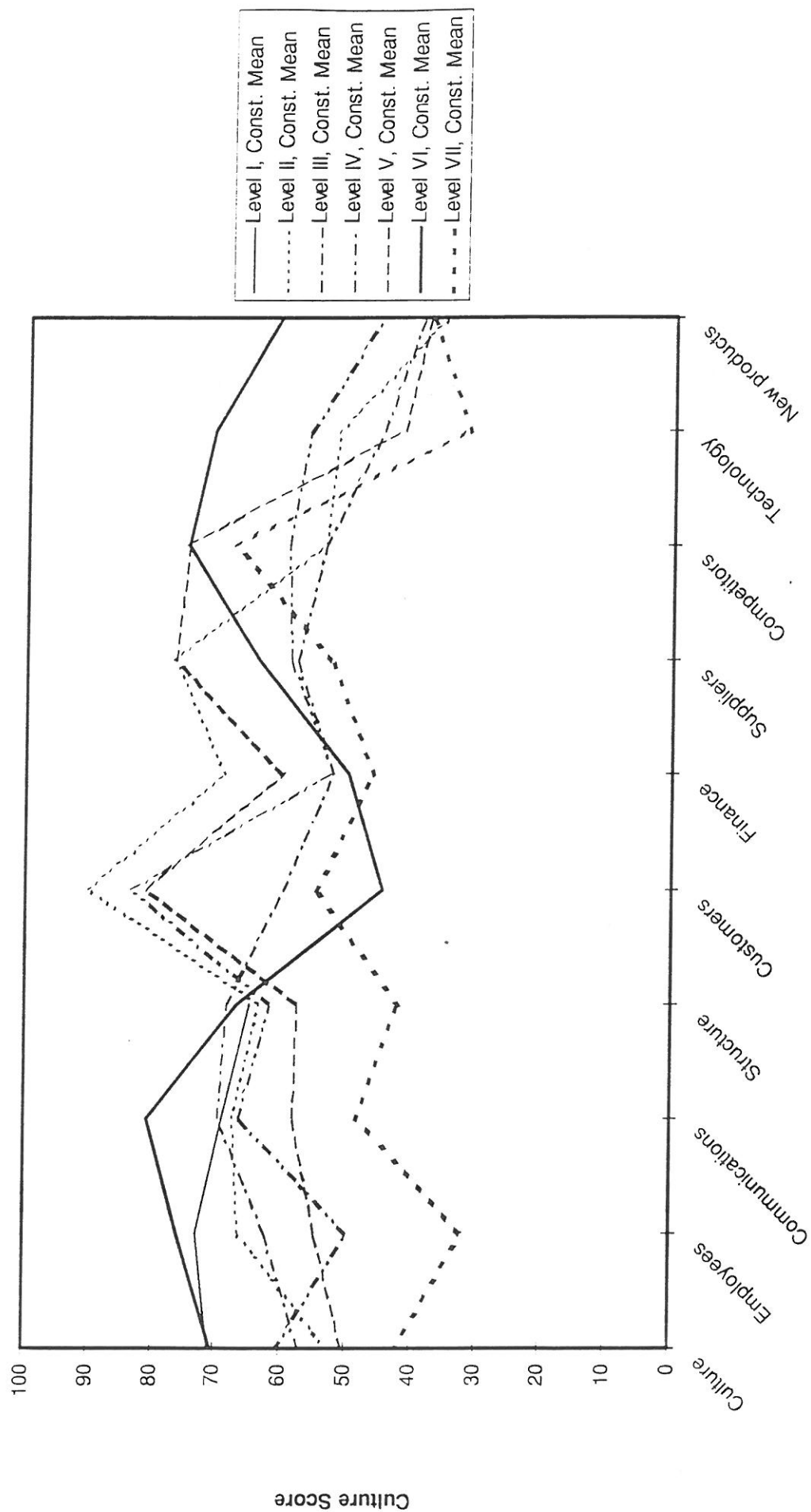


Figure 2 Production Manufacturing Company Mean Culture Scores

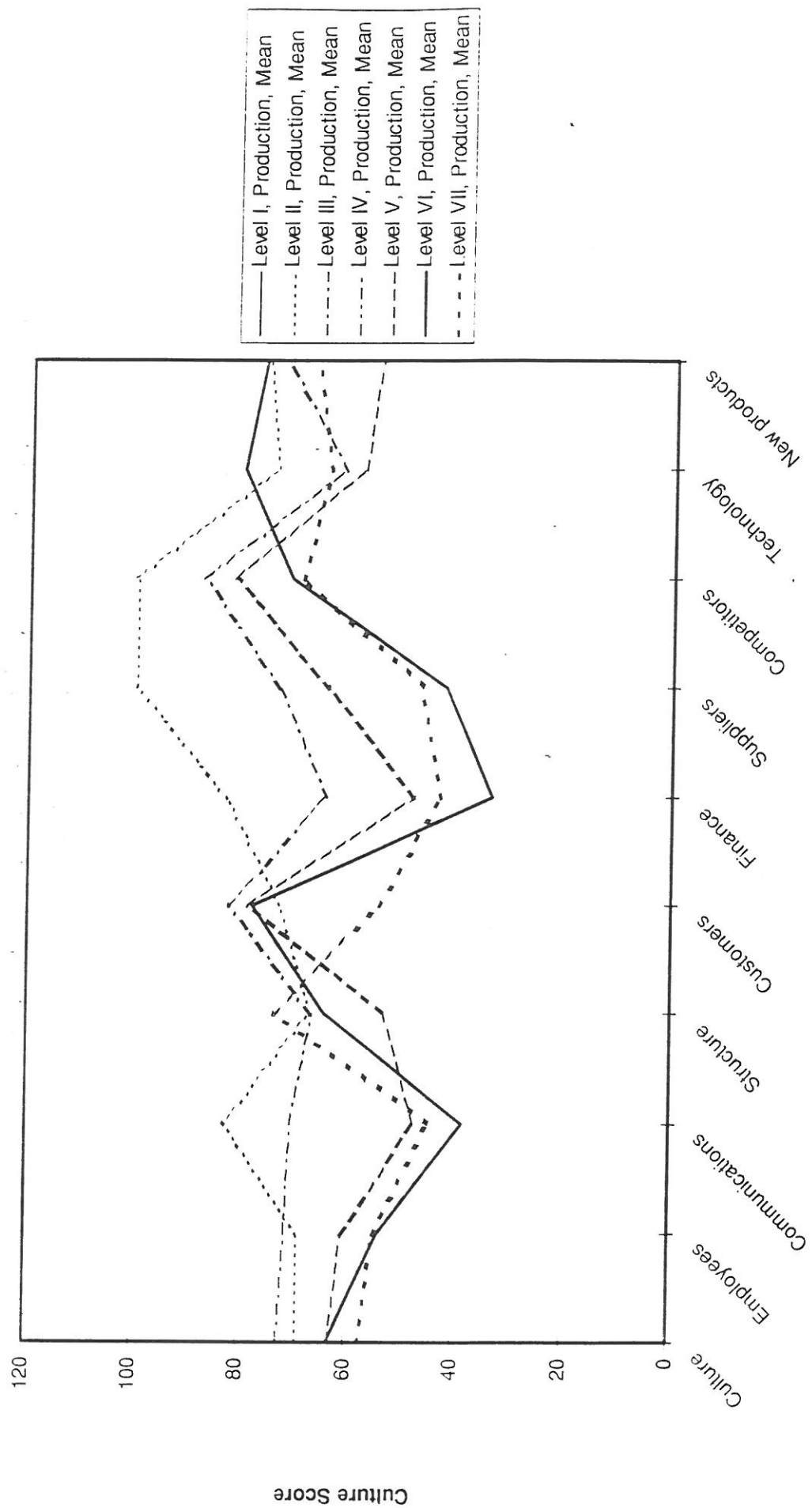


Figure 3 Process Manufacturing Company Mean Culture Scores

