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Construction Work and the Worker : Comparative Study of Craft & Mass Scale Technologies in Building Construction

Raufdeen Rameezdeen
Chaminda Pathirage

Abstract :

During the twentieth century the construction industry, it's products and technology have changed drastically. Studies carried out on the same or equivalent products of construction have showed clear differences in the nature of technology used in the production process. The construction industry is inherently labour intensive and many challenges arise through a need to maintain a skilled and competitive workforce. Two distinct forms of construction, the ancient craft-oriented form and modern mass scale form are commonly deployed within the construction industry. This comparative study, in respect of these two technologies, upon the nature of work and the worker, has revealed some differences in number of parameters such as skills, experience, supervision, rules and regulations, autonomy, deference and aggression. For these parameters there is a close relationship between the nature of work and the worker personality. Craft workers have more autonomy, which result in more skill, experience and responsibility in the work process. The dominating personality traits of deference and aggression in Mass Scale technology facilitate more management influence through supervision and rules and regulations.

1.0 Introduction

The construction industry is considered to be a sector of the economy, which lags behind all other industries in terms of technology and productivity. Nevertheless, during the twentieth century the construction industry, it's products and technology have changed drastically. Internationalization of the market has promoted the technical progress in an increasing number of subsectors, the most up-to-date technology is used and more of the buildings to be constructed are really high-tech products whose design requires modern scientific methods (Sebestyen, 1998). Studies on construction have revealed clear differences in the nature of the technology, whether machinery or technical organisation, used in the production of the same or equivalent products (Atkins, 1994; Cooke & Walker, 1994; Clarke & Wall, 1996). These clear differences have facilitated the development of two distinct forms of construction knowingly, the ancient Craft form and Mass Scale/Industry form. The changes in technology with several other factors together are contributing to the transformation of construction from an ancient Craft to a modern industry. Researches on these two distinct forms have revealed some sharp differences in the social organisation of production associated with a particular use of technology, range of skills, employment status, complexity of work processes and type of site management involved (Clarke & Wall, 2000).

Management is generally considered to have three major dimensions namely technical, conceptual and human. In the past most practicing managers either ignored the conceptual and human dimensions of their job or made some overly simplistic assumptions (Luthans, 1992). The construction industry is a sector of the economy, which in many ways different from all other sectors and faces many challenges. The industry is inherently labour intensive and many of the challenges arise through a need to maintain a skilled and competitive workforce. In this context more concentration needs to be placed on the conceptual and human dimensions of the workers. The attitudes, perceptions and motivation of individual construction worker towards the work they perform have a large impact on the ultimate output. A better understanding of the worker will facilitate managers to improve skills and competitiveness of the workforce. Hence a methodical study of worker and his personality in these two forms of construction is essential in order to improve the managerial effectiveness. This paper compares the nature of work performed and the worker characteristics in Craft and Mass Scale technologies.

2.0 Craft and Mass Scale Technologies

Braverman (1974) cited Craftsmanship as the ability to manipulate skillfully the tools and materials of a craft or trade. Craft knowledge has some unique characteristics,

most notably its inability to be communicated through any of the languages and its combination of inputs from all senses. Press and Cusworth (2000) argue Craft as containing its own thinking, its own knowledge, some of which are reducible to words, but most of which takes place through the physical act of making and is manifest in the 'crafted' object. A notion of intelligent making emerges from the literature that is a mixture of formal knowledge, tacit knowledge, physical and mental skill, contextual awareness, innovation and personal creative autonomy.

United Nations (1959) defined Mass Scale technology as "continuity of production implying a steady flow of demand; standardization; integration of the different stages of the whole production process; a high degree of organisation of work; mechanization to replace manual labour wherever possible; research and organised experimentation integrated with the process." As Warszawski (1999) cited Mass Scale form of construction means "the organisation of building industrially by applying the best methods and techniques to the integrated process of demand and design together with manufacture and construction."

In the traditional Craft technology, the final output is produced in accordance with the customer's requirements and specifications by taking long manufacturing lead time and without any standardisation in the production process. These methods use local material; timber, clay, stones, often cut or moulded into small work pieces such as bricks, blocks and logs, which could conveniently be handled by several workers. The selection, adaptation, placement, jointing and finishing these resulted in whole walls, floors, stairs and other building segments. The efficiency and quality of this conventional process depended entirely on the skill of the individual craftsman and an enormous amount of human labour was required in the absence of machines. This gave rise to the development of several distinctive, specialised crafts such as bricklayers, masons, carpenters, tilers, plumbers, etc., who had to perform several activities in their respective fields of craft.

Mass scale production was characterised with the industrialization of the construction industry, most notably in the first half of the twentieth century. Mass Scale technology is commonly used as an alternative to 'prefabricated buildings', in which as much site work as possible becomes the assembly of factory-made components. Without limiting to prefabricated buildings, some identify this form of construction more narrowly with system buildings, although no system has yet eliminated Craft process entirely. Some identify it with dry construction whereas some regard the degree of mechanization on site and in the production process when describing the Mass Scale technology.

As in any other system, the Craft technology too contain some salient features, which are listed below.

1) *Clear division of labour:* The Craft system is based on preserving the exclusive privileges governing a particular trade, whether through traditional apprenticeship or maintaining a clear divide from the labourer and from other trades. The limits of the tasks a construction worker undertakes are defined by the 'tools of the trade', resulting in distinct social and technical interface in the work process (Marsden, 1999). "On the job training" is a distinct characteristics of this technique.

2) *High creativity:* As Finch (1998) pointed out, a salient feature of true artisans is their interest in the process of creating, rather than in how much money they are making. They focus on their product, the creative process and how much they enjoy it. Craft workers make objects that are not only practical but often very beautiful. They would therefore seem to possess high levels of design ability evolved by gradual development over a long period of time.

3) *Increased environmental concern:* Another emerging concept of Craft workers is their interest and attitude on the environment. They tend to reuse old material rather than make their products totally from new. Also they are more concerned about waste material resulting from their Craft unlike an assembly line worker.

Warszawski (1999) identified the following features in the Mass Scale technology.

1) *Centralization of production:* From this central location the product is transported to various consumer areas, which will thus use the economies of scale with respect to capital investment, management and auxiliary services.

2) *Mass production:* A salient feature of Mass Scale technology is the wider use of plant and machinery in the production process. The investment in plant and machinery associated with an industrialization process can be justified economically only with a large production volume.

3) *Standardization:* Production resources can be used in the most efficient way if the output is standardized. Then the production process, machinery, and workers training can best be adapted to the particular characteristics of the product. This has lead to the use of factory made components, which commonly termed as prefabrication. This has improved working conditions by transferring part of the process from open-air building sites to closed factories.

4) *Specialization*: Large volume and standardization allow a high degree of labour specialization within the production system. Workers continuously engaged in one activity results in performing at a high productivity level attained with specialization.

5) *Integration:* To ensure optimal results, a very high degree of co-ordination exists between design and production.

3.0 Research methodology

Though a number of research works can be found on construction work itself and the construction worker, none has combined the two. In addition, a comparative study on Craft and Mass Scale technologies in this respect has not been carried out. The current research has been carried out mainly concentrating the construction worker responses on the nature of work and their personality. Hundred and twenty construction workers from Sri Lankan construction industry representing a variety of trades from both Craft and Mass Scale technologies on equal basis were selected as the sample. A questionnaire survey was carried out among the sample workers during the working hours. They belong to eleven jobsites, six having Craft technology and five having Mass Scale technology. The profile of the questionnaire survey sample is given in the Table 1. The questionnaire was separated into two main sections that: (1) questioned the workers about their attitude towards the nature of the construction work they carry out; and (2) requested information regarding the personality of the individual worker. The former section was solely based on marks given by the workers on their personal assessment. For the personality test a maximum of 100 points were allowed to distribute among the three personality traits gaining highest point to the closest trait and lowest point to the least characterised trait.

Table 1 : Profile of the questionnaire sample

Project	Type	Cost in Rs. Millions	Number of skilled workers at the site	Number of interviewees
	Craft			
A	Four storied office & ware house at kirimandala Mawatha, Colombo 05	33	45	8
B	Twelve storied apartment complex with a car park at Ward Place	500	85	10
C	Thirteen storied apartment complex with basement at Ward Place, Colombo 07	250	160	10
D	Eleven storied apartment complex with a resturant, swimming pool & two car parks	750	350	12
E	Township project at Athurugiriya	2.5*	800	12
F	Six storied office building at Mattakkuliya	36	125	8
			Total	60
	Mass Scale			
G	Pre-fabricated factory building at Biyagama (Phacse I & II)	50	30	10
H	Pre-fabricated single-storied garment factory at Athurugiriya	14	25	12
I	Pre-fabricated factory building at Kaduwela	11	45	14
J	Workshop 'A' at Kaduwela	-	40	12
K	Workshop 'B' at Kaduwela	-	25	12
			Total	60

* The cost is for an average house only

Without limiting to questionnaire survey, some observations too have been made at the same sites, which proved valuable when commenting differences. Unstructured interviews were carried out with managerial level staff, whose thoughts and ideas too have been considered. Profile of the managerial level staff interviewed is given in Table 2 (within each category 2 to 3 interviews were conducted).

Table 2 : Profile of the managerial level staff iinterviewed

	Designation	Average Experience (Number of Years)
	Craft	
1	Manager Planning	23
2	Chief Quantity Surveyor	12
3	Site Manager	5
4	Site Quantity Surveyor	7
5	Human Resources Manager	7
	Mass Scale	
6	Chief Quantity Surveyor	13
7	Project Engineer	16
8	Human Resources Manager	9

4.0 Results

This study compared the Craft and Mass Scale technology from the worker perspective and focused mainly on two areas;

1. nature of work, and
2. characteristics of the worker.

The eleven projects selected as the sample provides some important comparisons on the two technologies (see Table 3).

4.1 Nature of work

Work is unseen and is gradually changing. Research done by labour economists have revealed three underlying concerns, which have given rise to the changing nature of work. First, work as an essential human activity and economic process. Second, work as a social process that shapes and is shaped by workers' actions and beliefs. Finally, a variety of institutional, technological, and political forces that changes the nature of work (Ackerman, 2000). In this context the first part of the study compared the nature of work with regard to Craft and Mass Scale technologies. Three aspects have been considered as given below;

1. Work Capacity
2. Work Management
3. Work Process

Work Capacity

Work capacity is described here as the ability or capability to perform or execute tasks within ones job. In that regard skills, experience and training are considered utmost important. *Skills* are known as the ability to do something well. Especially in construction, to perform a particular task it requires systematic recognized skills in that trade.

Table 3 : Comparison of Craft & Mass Scale projects in the sample Nature of work

	Craft Technology	***Mass Scale Technology***
Client involvement	High	Low
Procurement methods	Traditional methods such as lump sum and measure and pay	Design & build and turnkey
Average rate of production (m^2/ month)	250	375
Average cost of production (Rs./GFA)	14,500	11,500
Aesthetic appearance	High	Low
Diversity	Domestic and commercial; from single storey to multi-storey buildings	Industrial; single storey buildings
Method of construction	Concrete framed structures	Pre-fabricated, pre-engineered steel framed structures

Experience is known as the practical involvement in an activity from which one learns. Experience gained through performance plays a crucial role when carrying out a task correctly and precisely. *Training* implies teaching a particular skill to someone, aiming to grow in a particular direction or trade.

When comparing the degree of skills and Experience possessed by the workers of these two distinct technologies it revealed a clear difference as shown in Figure 1. Craft workers possessed high degree of skills and experience over the Mass Scale workers. In Craft technology the worker performs the whole job whereas in the Mass Scale technology majority of the work is performed through machines. This in turn requires less degree of skill and experience from a Mass Scale worker. Contrast to skills and experience, the degree of training obtained by the Craft and Mass scale workers does not differ significantly. It appeared that on the job training is an important feature of Craft technology and workers highlighted the necessity. Mass Scale workers do not consider training to be an essential ingredient for the better execution of work.

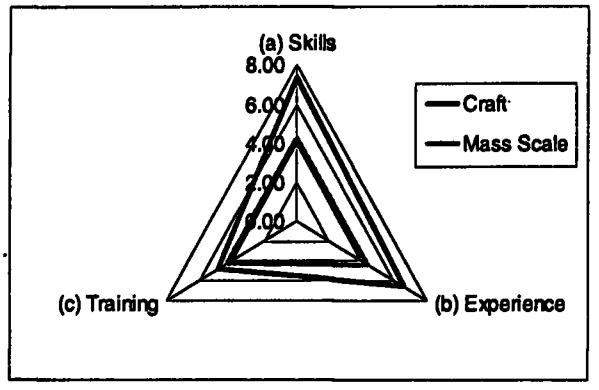


Figure 1 : Comparison of work capacity

Work Management

Work management is the way of controlling the work to get a desirable outcome from the workers. Under work management three aspects are considered namely, supervision, rules and regulations and management influence. *Supervision* involves directing and inspecting workers as a means of exerting managerial control. Different levels of managerial control through supervision might expect to be found ranging from high level of supervision to more autonomy to the individual worker. *Rules and Regulations* are statements or principles governing behaviour or describing a regular occurrence in nature. The degree to which a worker has to confirm or adhere to rules, procedures, policies and practices may vary from job to job. *Management Influence* is the power to produce an effect on actions according to the desirability of the management.

An apparent distinction as shown in Figure 2 has been found between Craft and Mass scale technologies in

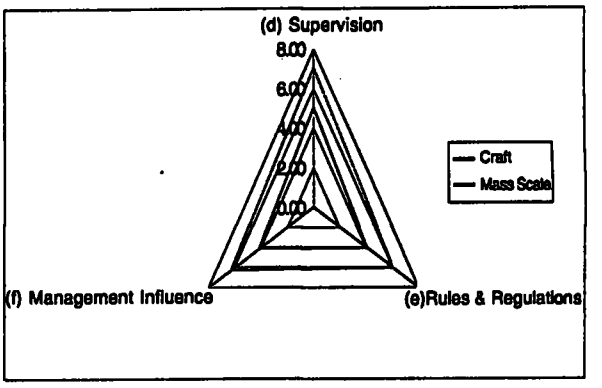


Figure 2 : Comparison of work management

all three aspects of work management. Mass Scale workers were subjected to high level of managerial control than Craft workers. This may be due to the fact that most of the workers involved in the Mass Scale production are less skilled and inexperienced. In contrast the Craft workers were given more autonomy, especially for highly skilled workers, to get a desired level of output.

Work Process

Work process refers to the way in which work is organised and carried out by the workers. There are three components in work process namely job enlargement, job rotation and responsibility. Job Enlargement is concerned with expanding the number of operations performed by a worker i.e., adding more tasks to the job for variety, making the job less specialized. Job Rotation reduces boredom by switching people around to various jobs, i.e., doing different jobs. Responsibility is a duty resulting from one's job or position, deserving blame or credit for the work carried out. The degree to which a worker is given personal responsibility in achieving their part of the goals are of great importance from the workers point if view.

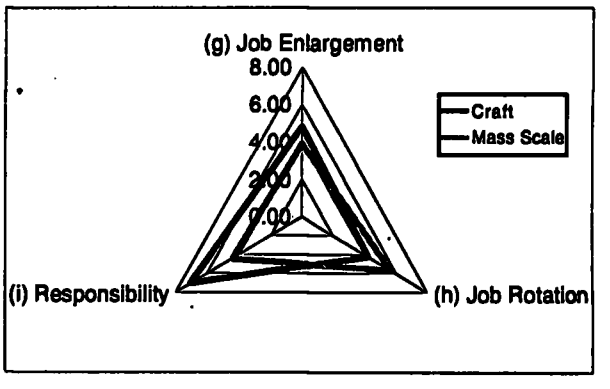


Figure 3 : Comparison of work process

Job enlargement was not practiced widely in construction. As a result, both Craft and Mass Scale technologies show low scores as shown in Figure 3. However, job enlargement is more prevalent in Craft technology than in Mass Scale technology.

Job rotation on the other hand is more common in Mass Scale technology. Craft workers bear more responsibility than the Mass Scale workers in almost all trades.

4.2 Characteristics of the worker

A leading assumption of industrial or organisational psychology is that individuals in an organisation, who are effective in their job make a positive contribution to the betterment of the organisation as a whole. The underlying fact of this assumption is that there is a growing need to understand the behaviour of people in work settings. This understanding requires, at minimum, the description and measurement of the behaviours and the variables that affect these behaviours. In this study, personality of the construction workers was compared between the two technologies.

Psychologists use the term personality to describe those persistent and endeavouring behavioural patterns of an individual that tends to be expressed in wide variety of situations (Dubrin, 1985). As Luthans (1992) noted, events in the external environment, including work, strongly influence the way people behave at any particular point of time, yet people always bring something of themselves to the situation. We often refer to this something, which represents the unique qualities of an individual, as *personality*. A comprehensive list of personality traits within the job has been identified by Wellin (1984) based on human needs, which can be categorized into three groups namely, Group A, B and C which represents three different domains of personality traits.

Group A

Under the first group of personality traits achievement, affiliation and aggression are considered. *Achievement* is accomplishment of a difficult task or to win over others. It can be seen as a measure of person's commitment in achieving his goals. *Affiliation* is a way of seeking out close relationships with others, basically to be a loyal friend. *Aggression* is an intention to attack, injure or punish others, even the fellow workers, to overcome people.

It is found that most of the Craft workers are achievement oriented than Mass Scale workers as shown in Figure 4. Since the nature of work carried out by the highly skilled workers of Craft technology has a target to be met they are achievement oriented. Craft workers seemed to possess a higher degree of affiliation than the Mass Scale workers due to the teamwork required in the Craft process. A clear-cut difference is seen in aggression in which Mass Scale workers possessed a high value compared to Craft workers.

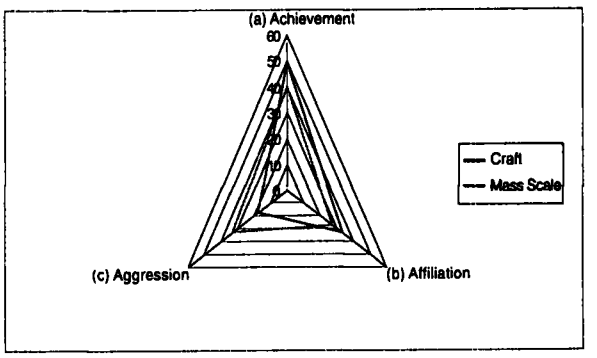


Figure 4 : Comparison of group A elements

Group B

Under the second group of personality traits autonomy, deference and dominance are considered. *Autonomy* is freedom that a worker gets to act independently and to be free of constrains. Rules and regulations are considered as a factor that hinders innovativeness. *Deference* is to admire and support a superior or other person in authority, thereby conforming to the custom. *Dominance* is to influence others toward your way of thinking, often by forceful methods.

Out of these three personality traits autonomy has gained a high significance among the Craft workers and deference among the Mass Scale workers (See Figure 5). The trait of dominance has scored a low value compared to autonomy and deference despite the fact it is equal in both Craft and Mass Scale technologies due to the reason that Sri Lankan's by their nature are not willing to confess themselves as dominating characters.

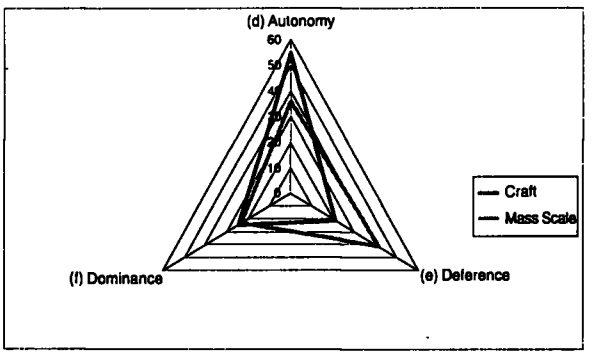


Figure 5 : Comparison of group B elements

Group C

Under the third group of personality traits nurturance, order and power are considered. *Nurturance* is the act of helping, supporting and taking care of weak and needy fellow workers. *Order* is to put things in order, to achieve arrangement, balance, neatness and precision in their day to day working. It is considered as the systematic performance of the work. *Power* is a strong need to control other people, the co-workers and resources, for fame and recognition.

There is no significant difference between Craft and Mass Scale workers in all three personality traits as given in

Figure 6. Nurturance has a slightly higher value among the Craft workers due to the help and support given by highly skilled workers of Craft technology to their subordinates. The trait of Order too has a slightly higher value among the Mass Scale workers who have the habit of keeping the surrounding environment neat and clean.

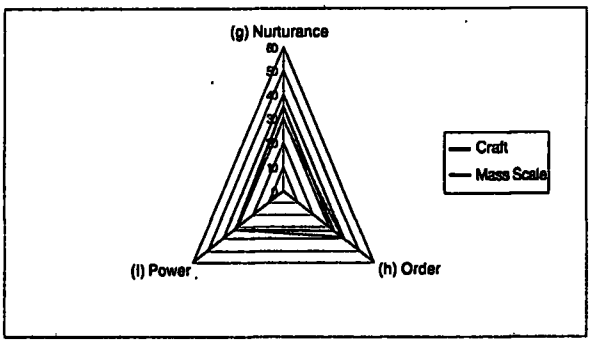


Figure 6 : Comparison of group C elements

5.0 Discussion

The prime intention of this research work is to compare and identify the differences in the nature of work and the worker personality between Craft and Mass Scale technologies. Not all parameters considered under the nature of work and worker personality showed differences. Some parameters showed a significant difference while some showed not so significant but considerable difference between the two technologies. In order to distinguish this, three categories have been defined based on the scores obtained from the research. The difference has been calculated by using the following formula.

$$\text{Difference (D)} = \frac{\text{(Higher Value - Lowr Value)}}{\text{Lower Value}} \times 100$$

Three categories identified based on the percentage difference obtained from the above formula are as follows

Significant - Where D > 50%
Considerable - Where 50% ≥ D ≥ 25%
Marginal - Where D < 25%

Parameters, which showed a significant difference in their respective technologies, are given in Figures 7 and 8. In these parameters, there is a close relationship between the nature of work and the worker personality. The personality trait of autonomy is high among Craft workers compared to Mass Scale workers facilitating them to take more responsibility and gain more skills and experience (see Figure 7).

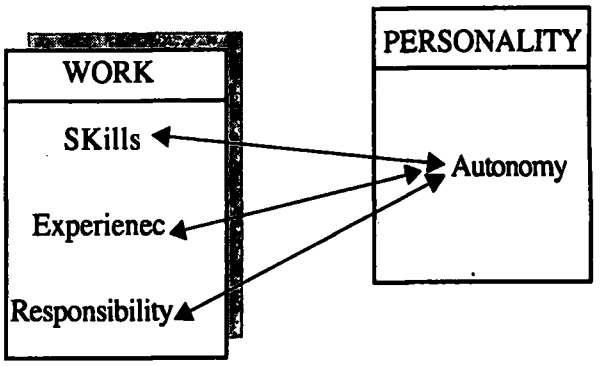


Figure 7 : Dominating characteristics of Craft workers

As given in Figure 8, Mass Scale workers showed the personality traits of deference and aggression due to the high level of supervision and management influence found in the work process. They seemed to be admiring and supporting the superior in authority. Also they worked in a systematic, balance, neat and a precise way confirming to the rules and regulations in the work process.

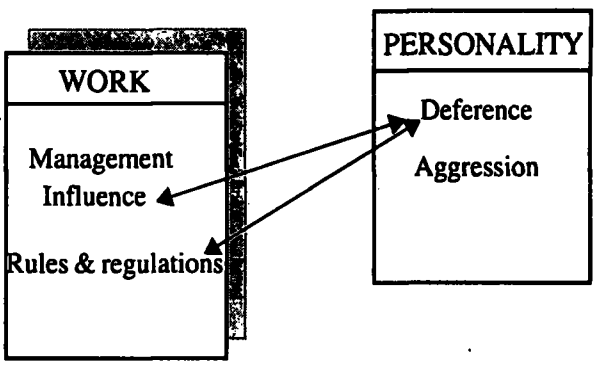


Figure 8 : Dominating characteristics of Mass Scale workers

Under the category of considerable difference, Job enlargement, achievement, affiliation and nurturance are identified in Craft technology while supervision and job rotation in the Mass Scale technology.

Parameters, which showed a marginal difference, are given in Table 4. These can be considered to be equal in both technologies.

Table 4 : Parameters which showed a marginal difference

Nature of Work	*Worker Personality*
Training	Dominance
Job Enlargement	Order
	Power

6.0 Conclusions

As in any other system, the Craft and Mass Scale technologies used in construction too contain some inherent characteristics, which have been considered in detail in this study. In this context the definitions dictated and the characteristics that have been explained gain an utmost importance for the better understanding of each technology or method of production.

The first half of the comparative study deals with the nature of work in those two distinct technologies. The study revealed some significant differences in number of areas, which also added some new dimensions to the character of each methodology. In the traditional Craft technology, one can observe the artisans building products to a customer's specifications, taking long manufacturing lead times, without any standardisation, either in the products or in the manufacturing process. One can identify a model of intelligent making within the Craft technology that is reflective, integrative and interactive. The efficiency and quality of this Craft process depends entirely on the skill of the individual craftsman that have given rise to the development of several distinctive, specialised Crafts. Skill, experience and responsibility are found to be the distinct characteristics in the Craft technology. In contrast, Mass Scale technology can be considered as a continuity of production implying a steady flow of demand; standardizations; integration of the different stages of the whole production process; a high degree of organisation of work; mechanisation to replace manual labour wherever possible; research and organised experimentation integrated with the process. Pre-fabricated buildings are commonly characterized with this technology, in which as much site work as possible becomes the assembly of factory-made components. Supervision, rules and regulations and management influence are the most significant characteristics of Mass Scale technology.

The human subsystem of any organization is a critical factor, which has a great impact over the success or failure of an organization. This is considered to be the most important and a promising area of organizational achievement (Luthans, 1992). The labour intensive nature of the construction invariably increases the necessity for better understanding and management of workforce in either methodology. As such, the second half of the comparative study is devoted to the study of personality among the workers of the two technologies. Result revealed some significant differences between the two types of workers. Among Craft orientated workers, autonomy is the dominating personality trait, which gained the highest mean percentage value. Among Mass Scale workers deference and aggression are the leading personality traits with the trait of deference achieving the highest mean percentage value. Parameters where significant differences are shown there is a close relationship between the nature of work and the worker personality. Craft workers have more autonomy, which result in more skill, experience and responsibility in the work process. The dominating personality traits of deference and aggression in Mass Scale technology facilitate more management influence through supervision and rules and regulations.

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