STUDYING THE EFFECT OF SYSTEMATISATION ON DESIGN ACTIVITY

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It is considered that systemisation, the use of standard systems of components and design solutions, has an effect on the activities of the designer. This paper draws on many areas of knowledge; design movements, economic theory, quality evaluation and organisation theory to substantiate the view that systemisation will reduce the designer's discretion at the point of design. A methodology to test this hypothesis is described which will be of use to other researchers studying the social processes of construction organisations.

Keywords: Autonomy, case studies, design activity, design systemisation, work processes.

INTRODUCTION

The historic background and economic rationale for the application of systemisation to the construction industry are used to set the backdrop for the soft systems study of the systemisation of design. The aim of the research is to investigate the impact of systemisation on the work of the designer, through the investigation of the extent of autonomy and discretion given to designers in the construction process.

Systemisation, for the purposes of this paper, is the use of standard systems of components or design solutions within the design process or completed building product. This definition avoids any discussion and uncertainty whether a building or design activity is systematised or not; all buildings are systematised, it is the extent to which the product and process are systematised and any effect on the design activity which is the key issue.

BACKGROUND

Modern movement, mass-production ideals

The observation is made that much construction research focuses on productivity and efficiency and gives little attention to the implications on the design or its longer term impact on society. Productivity and efficiency improvements were part of the Modern Movement ideology (Le Corbusier 1927) which included; industrialisation, standardisation of components and the use of mass-production techniques. Mass-produced components and elements of buildings have two significant benefits, the unit price of production is reduced because of economies of scale and the quality of a product will be more consistent as a prototype will be developed before it goes into production and checks throughout the production process will regulate the quality of the product. This approach has also been applied to the design process. The Modern Movement, and later the systems building movement of the 1960s and 1970s,

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recognised that the re-use and standardisation of the design of building elements carried the benefits of economies of scale. At the time, the observation was made that this approach has economic advantages but there was an acknowledgement that there was a reduction in the designer's freedom (Gosling 1962).

Social and cultural responsibility

Both of these movements had social components as well as economic benefits driving their implementation. Gropius (1965) considered that the existence of common societal values was justification for the standardisation of components, a literal metaphor which in retrospect may be considered idealistic and autocratic (Mitchell 1993). A driver for the CLASP system school building programme was a central government recognition of a societal need. The present use of industrialised approaches to construction is driven by economics alone. But this neglects the social responsibility of design, and that the remit of designers extends beyond the merely functional requirement of meeting a client's needs. Indeed, the task of a building designer is to take account not merely of what the client states but also of what is permissible and advisable with regard to the social and cultural context of a project.

Application to the construction industry of new manufacturing approaches

Approaches to both manufacturing and economics have evolved since the 1960s. Flexible manufacturing allows small-batch production to be profitable and acknowledges that economies of scope, where the use of joint production processes to produce more than one product, are as pertinent as economies of scale (Chandler 1990). This shift in thinking and production methods were partly due to the need to offer greater consumer choice by providing a range of alternatives when selecting a product. In practice the choice is limited, the customer is offered a pre-defined range of options, colours and optional extras, which make one product different from the next but the function and design of the product remains fundamentally unchanged. This is familiar practice in the automotive industry which has also been applied to construction; the factory production of Toyota housing in Japan (Gann 1996) and the prefabrication of McDonald's restaurants (CIRIA 1997). These are examples of the application of manufacturing techniques which have been applied to the construction industry (Koskela 1992). This approach is embraced internationally by the broader concept of business process re-engineering (BPR), which is influencing change in many areas of business through the review of processes and the introduction of IT (Davenport 1992).

The application of IT to the design process

There are many research projects using IT to review and improve the construction process. The effect of these technological developments can be grouped into three generic categories depending on how they effect design; those concerned with the medium of exchange of information, those concerned with storing data needed by designers and those which use artificial intelligence to rationalise the design process. All these projects have the potential to change the construction process, affecting the way information is processed, the sequence of exchange of information and how decisions are made. Because of this potential for change there is a need to understand what happens at the point of design, specifically the degree of discretion the designer has and the influences on a designers' decision-making ability.

Differences between construction and manufacturing
Having shown that manufacturing principles can successfully be applied to construction there is an important distinction about the construction industry to be made. In construction, design forms a large proportion of the overall activity, whereas in manufacturing, typically, design is a small part. In manufacturing the product typically is prototyped and has long production runs so the design time per unit of production is short. In construction the time spent designing the building is a large proportion of the procurement period. This difference illustrates why the direct transfer of methods between industries shouldn't pass unchallenged and highlights the need to investigate the effect of systemisation (a specific manufacturing approach) on the work of the construction industry designer.

Effect on productivity
In the UK building industry designers of buildings face pressures to economise, rationalise and rely on tried and tested solutions (Latham 1996). There is a trend away from bespoke detailed design solutions to the re-use of details and junctions (Gray and Fowler 1997) not only because of economies of scale and issues of consistency and quality, but also because of the effect on productivity. For many years international studies have shown that the use of repetitive elements and design standardisation contribute to different levels of construction productivity across the globe (United Nations 1965, Gray 1996). The relationship between productivity, competitive advantage and wealth creation is well known. What is needed in parallel is an understanding of the soft-systems, human-terms implications of a systemised approach. Previous construction management research has demonstrated that performance benefits can be obtained from organisational changes, social intervention, team building etc. (Cherns and Bryant 1984) as well as technological developments.

Effect on quality
Seymour and Low (1990) expressed the view that the essence of quality arises from the exercise of discretion at the point of production. In construction, the professional role of the designer makes it also relevant to consider how discretion can be exercised at the point of design. Any approach which reduces the discretion and autonomy of designers and craftsmen challenges the value of the skills they bring to projects. Thus, systemisation may devalue the design process to a mechanical routine. There is a need to study the value of design and the design process to establish whether a systemised approach to design removes any sense of responsibility from the individual designer.

HYPOTHESIS

Based on the findings of the literature search and this argument, the hypothesis put forward is that;

Systemisation carries with it inherent characteristics which constrain the autonomy or discretion at the point of design production by a designer. This may reduce the designer's input and decision making abilities and generally devalue the design process.

RESEARCH METHODOLOGY

To test the hypothesis that systemisation has an impact on the designer's autonomy and discretion at the point of design, this study will draw upon social science, job design theory and organisational research methods to inform the research design.

Measures of a designer's autonomy

Much job design research has tried to establish the criteria which have a positive effect on an individual's satisfaction with, and commitment to, work. These have included measures of autonomy which can also be considered to be an indicator of an individual's discretion.

One of the co-ordinating devices observed by Galbraith (1973) was the creation of self-contained tasks. This gives greater discretion to the individual making a decision and reduces their dependency on, and referral to higher management. In this way it reduces the need for the management system to process information and thus autonomy is an economical means of reducing the need for co-ordination. Turner and Lawrence (1965) developed a measure of requisite task autonomy including a method for rating the autonomy of a job. Gulwosen (1971) identified a range of parameters which indicate the autonomy of a group which has more recently been investigated by Evans and Fischer (1992).

A variety of theories of job design have evolved ranging from job restructuring, enlarging, rotating etc. (using the individual job as the unit of analysis) to the work organisation approach (which views the organisation as a socio-technical system). It is now considered that although *work* has a technological aspect, social skills and people are acknowledged as being very important in completing a task. There are other approaches, such as structurally altering an organisation, which are not true job design techniques but have implications for socio-technical systems theory. An example of this is autonomous group working (Pearson 1992) where there is an independence between the social and the technical aspects of the work. A characteristic of autonomous group working is the system of decision making which will involve some empowerement of the group and define the boundary of the work. This way of thinking will have an effect on the autonomy of decision making and should be measured when investigating the design process.

The autonomous group working approach has parallels with changes in approaches to manufacturing. It is often applied to cellular, small batch production although the distinction is made that autonomous group working is a socio-technical approach used for psychological as well as technical benefits whilst cellular manufacturing is concerned solely with the technical advantages of batch production.

Research Method

A case study approach was used by Cycert, Simon and Trow (1956) to investigate decision making processes in businesses. This approach has the advantage that a rich picture of the case can be established as there is the opportunity to mix a number of qualitative and quantitative research methods. Combining the use of research methods was an approach used by Sutton and Hargadon (1996) when looking at brainstorming groups in a design firm. They showed that many established studies of organisations and research methods are still relevant today. A criticism of case studies has been the difficulty to generalise the findings, so that observations from one case can be used to comment on the whole population (Yin, 1979). This criticism can be mitigated by the use of multiple cases until no new categories of data are found i.e. data saturation

(Glaser and Strauss 1967) is reached. To test the hypothesis that systemisation has an effect on the designer's activity there will need to be several case studies of buildings with different levels of systemisation; highly systematised, with minimal systemisation and intermediate cases to allow comparison of findings amongst each level of systematisation. In this way there should be sufficient cases for data saturation and ample variety to study the effect the main variable, the extent of systemisation, has on the design activity.

The unit of analysis will be the design of a particular building element or package of work by the project architect/ designer. This will allow constancy across the cases studied in terms of the individual being surveyed; which will be critical when making comparative observations of the level of autonomy in a design decision. It also acknowledges that although a package may be designed by more than one person within a firm, with input from other specialists, the project architect/designer will look at the design at intervals throughout the design process. In this way the iterative nature of the design process is a useful characteristic providing natural intervals between which the design can be monitored. The design of a building element or package throughout a stage, or part of a stage of the RIBA Plan of Work (1967) is an interval of appropriate duration to provide sufficient data. Monitoring the development of the design throughout the Concept Stage (Roy 1967) of a project seems more appropriate than any other stage as packages of work have been identified but they are still sufficiently loosely designed that the range of design options and decisions yet to be made are diverse.

The case study approach allows data to be collected by a combination of research methods. Background information about each case will be collected when interviewing the project architect/designer to establish commonalties and discrepancies between the cases and place each in context. Structured observation techniques will be used to monitor the activity of the designer. This approach allows the researcher to witness and code the design activity, a method which will supplement the participant's perceptions of their activity and provide some quantitative data. The combination of these approaches will triangulate the data and enrich the description of each case and the opportunity to make generalisations about the influence of systematisation upon design. The questionnaire and observation schedule are research instruments which will be developed to study the designer's autonomy in decision making and measures of their responsibility (Gulwosen 1971, Birchall and Wild 1974, Evans and Fischer 1992).

Pentland and Rueter (1994) developed a research method for studying the sequential structure of work processes which on first inspection could not be characterised as routine. This has similarities with the apparently non-sequential or routine work of a designer and provides a useful framework for analysing the data and to developing a grammar to classify work processes. Applied to design this would allow comment on subtly different activities and levels of discretion being exercised by a designer in different circumstances, in this case levels of systemisation.

The structured observation schedules state the range of possible actions which a designer may take. The schedules from each case will show which actions and decisions have been made by the designer. The analysis of this data using the Pentland and Rueter (1994) model begins by looking at the sequence of actions made by the designer, looking for patterns of actions or recurring sequence of decisions made by the designer. This is unbound analysis, that is letting the internal logic of the

data emerge rather than imposing an a priori structure to analyse the findings, which has similarities with a grounded theory approach Glaser and Strauss (1967). This process would be assisted by the use of research mapping software which clusters the concepts involved in decision making and allows the structured analysis of qualitative data. By studying the patterns of actions and decision making it will be possible to develop a grammar, a method for classifying work processes. It is hypothesised that different levels of systemisation will show different patterns of decision making and discretion being exercised by the designer.

CONCLUSION

This research is still at the proposal stage. The next stage of the study will be to develop the research instruments to quantify the variable of the designer's autonomy and to develop the grrammer to analyse the data. Using this method it should be possible to test the hypothesis and to draw conclusions on the effect systemisation has on the activities of the designer.

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