# COMPLEXITY EFFECT OF PROJECT TEAM MEMBER SELECTION PRACTICES IN CONSTRUCTION

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Within construction the activities at the various hierarchies making up the delivery process have an influence on each other. This creates interconnections and boundaries between the activities as well as the individuals within a team and teams as a whole within the project. The interconnection structures often cause complexity, which could lead to a reduction in performance if the resulting interface is not purposefully and efficiently managed. Understanding the characteristics of the complexity from these interconnections, and how these affect the selection of members into teams will enable the development and implementation of project actions that will support the management of complexity from interconnection structures. Within this paper, the authors present the results of a study of construction organisations to shed more light of the influences of complexity generated by the interconnections. It uses team selection as a proxy to investigate the level of actions / techniques used to manage the effects of complexity. The results from the study have significant implications for the way teams are put together on projects.

Keywords: complexity, project management, team selection.

## INTRODUCTION

Construction projects often involve a large number of activities that create several interconnections. The interconnections that arise can be classified into many categories and between two or more entities. These interconnections generate complexity which has defined characteristics.

While the inanimate entities involved in the project delivery can be streamlined to minimise the potential tensions and structures that could arise from workflow, the socio-organisational aspects lend themselves to this structuring in a rather limited way. This is because the conditions that give rise to changes in interactions from a social standpoint are open to more subjective factors, and less appreciated by project managers. Within this paper, the authors explore the conditions that give rise to complexity of interconnections in the management of projects and in particular the effect of team member selection. The investigation employs a quantitative and a qualitative approach to examine the level of implementation of existing practices, the understanding of complexity in projects, and the actions taken to manage complexity of interconnections by dealing with its characteristics. The study demonstrates the significance of team member selection on the management of complexity of

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interconnections in projects. It also shows how such complexity can it be mitigated by formally addressing the conditions that give rise to it.

# REVIEW

The following sections will cover a review of the areas under investigation, the description of the multi-method design, the results and analysis of the findings from the two-part investigation and will close with discussion and conclusions. In particular the review section will be divided into two sub-sections. The first part will cover the review of the project management sub-process of team selection, its importance to the project and the current status. The second part will cover and assess the area of complexity and its characteristics in the context of project management and in particular the sub-process under investigation.

## Selection of Team Members

Construction projects are considered as a temporary endeavour performed in a dynamic environment. The dynamic nature of construction projects creates a degree of complication that has an impact on the overall performance of the project (Walker, 1996; Moore, 2002). Therefore project management can be defined as: The management of transient, dynamic and complex adaptive systems/agents, so as to deliver the expected change within certain parameters that are established by seemingly ordered and stable environments.

There is a marked shift for behavioural and organisational issues to become the drivers in delivering projects (Slevin and Pinto, 2004; Cheng *et al.*, 2005). This is reinforced by the shift towards collaborative working and the use of non-pricing criteria to assess contractors (Kadefors, 2006). Selecting project team members and the career development of Project Managers (PMs) and project personnel have an important influence in the current collaborative environment (Bourgeon, 2006). Therefore consideration of personal characteristics is crucial in the formation of teams and the social capital (Belbin, 2004; Cohen and Bailey 1997). Also the influence and impact of people allocated to teams has to be considered and how this social capital is viewed (Katz and Lazer, 2002).

The key activities for selection of teams and team members are well established (Turner, 1999; Belbin, 2004; Slevin and Pinto, 2004). Selecting individuals that will understand the environment, acting as gyroscopes (Antoniadis, 1998) and have the right attitude, ability, motivation and their expectations are understood is also very important (Lawler, 1993). Some selection techniques, for certain levels / roles, are currently based on job-task and behavioural competencies (Crawford, 2005), however, Cheng, et.al (2005) emphasise that it is important to understand that competencies are an attribute of both the job holder and the job itself.

Allocation of individuals to teams and teams to projects creates boundaries. These in the socio-organisational context influence team performance (Katz and Lazer, 2002) and therefore, as in the case of project teams, should be managed. While it might not be possible to eliminate the evanescent nature of projects, the transient effect on the boundaries formed can be addressed through the selection of team members' process.

Human interaction and team formation is a complex phenomenon (Dal Forno and Merlone, 2005). This interaction together with the very short period contractors have to put together the team and the employment of command and control approach to human resource management (Green, 2002) obviously does not help the process of selecting project team members. Usually, up to contract award, only the PM would be

identified based on a subjective assessment (Ogunlana, *et al.*, 2002). The remainder of the team, below the PM level, would be represented as a lump sum of money and the 'system' would not consider issues relevant to project staffing (Ogunlana, *et al.*, 2002). Also case studies (Hinds *et al.*, 2000) and (Green, 2006) have shown that selection is race biased and the lowest levels are 'structured around nationalities' (Green, 2006).

Concern is raised with regard to the lack of implementation of team selection and formation processes as a number of social systems, in the form of micro-worlds, will have to come together to 'make sense' and deliver the project (Green, 2006). Concern is also raised in terms of how much the management 'scripts' influence those who do the work (Green, 2006). These findings are disquieting if one is to consider implementing team work principles. Unless of course the team is only considered to be the units at the management system level (Walker, 1996).

**Complexity**

The management of project transpires in a complex environment (Bertelsen, 2004). The application of complexity theory to the management of projects can therefore, enable the systematic considerations of the conditions that give rise to such complexity. A number of authors have indicated that in construction interfaces cause complexity (Baccarini, 1996; Gidado, 1996; Williams, 1999), however Lucas (2000a) argues that complexity can be associated more with the interconnection structures that link various objects and not the objects themselves. Therefore considering the prevailing conditions in projects the argument can be easily juxtaposed to the project environment. In one sense therefore, project management can be considered as optimisation of the structuring of the interconnections that link up the delivery systems and subsystems.

Understanding the characteristics of these interconnections especially from a socio-organisation standpoint can contribute to the design of more efficient project delivery systems. In particular, it should enable project managers to respond with the necessary actions and improve the setting up, the management style and the decision-making process for the delivery of projects. Lucas (2000b) has suggested that complexity arising from interconnections reflect distinct characteristics. Those characteristics directly relevant have been mapped onto project conditions and detailed description has been presented in Antoniadis *et al.* (2006).

Construction projects are typically characterised by complexity; under time and/or cost pressure and requiring both creativity and cooperation. This view about projects is shared by Bertelsen (2004) who has also indicated the considerable potential for conflict both internal (within the team) and external (between the team and the client) as a result of the nature of construction projects. Previous analyses of complexity in construction projects have been conducted mainly from the technical perspective (Gidado, 1996; Lillieskold and Eklstedt, 2003). It is only lately that the subject of complexity has been linked to other non-technical project aspects such as behavioural, social, communication (Kallinikos, 1998; Geraldi, 2008; Girmscheid and Brockmann, 2008). The delivery system for most projects reflects a dynamic process involving non-linear procedures (Bertelsen, 2004). It would appear that much of the socio-organisation complexity can be associated with the organising and structuring systems designed for the management of projects, and forms the focus of investigation in this paper.

## RESEARCH METHOD

The literature review has provided strong indications regarding the implementation of appropriate team member selection techniques in construction projects. This coupled with the established view that construction projects are immersed in complexity of interconnections led in the formulation of following hypotheses as part of a wider research into complexity of interconnections, as defined above, in construction.

Hypothesis 1: Project team members are selected using personal profiling

Hypothesis 2: Characteristics of complexity of interconnections are considered when selecting project team members.

The breadth and depth of the issues and the topics under investigation demanded the design and implementation of a multi-methodology research design. For hypothesis 1 which is to investigate the implementation of current techniques it was considered appropriate to carry out a postal survey. For hypothesis 2 and because of the intricacies of the subject of complexity and its characteristics it was considered appropriate to carry out open-structured but closed response interviews investigating the current understanding of complexity, its characteristics and the implementation of techniques that will manage its effects.

Questionnaires for both hypotheses were prepared and piloted with 10 professionals from three organisations and minor corrections were made. In order to consider both sides of a project the stratified sampling technique was followed with the two main strata comprising of three major construction client organisations and three major construction companies. Postal questionnaires were issued to the Project Management divisions which encompassed professionals from Site Manager to Project Director level. For the complexity investigations 31 interviews were set up from the same organisations and again with the same levels of professionals.

Hypothesis 1 was operationalised by establishing three sub-hypotheses in order to understand levels of awareness, guidance received and implementation of personal profiling techniques for selecting team members and thus formulating three sub-hypotheses (shown in table 1 below).

Similarly hypothesis 2 was operationalised by establishing a response greater than 75 points (from a scale of 0 to 100) of the average weighted effectiveness of the actions taken towards managing the effect of each complexity characteristic. Therefore for each complexity characteristic the sub-hypothesis shown in table 2 was investigated.

*Table 1. Operationalisation of postal survey sub-hypotheses*

| Sub-hypotheses | Null sub-hypotheses |
|---|---|
| H1.1: Construction companies provide guidance and implement personal profiling techniques when selecting PMs | Organisational guidance given for using personal profiling to select PMs is not implemented (zero use) |
| H1.2: Construction companies provide guidance and implement personal profiling techniques when selecting site team members | Organisational guidance given for using personal profiling to select site team members is not implemented (zero use) |
| H1.3: There is a difference between client and contractor PMs in the use of personal profiling techniques as selection criteria for project team members to the lowest project organisational level | There is no (zero) difference in the use of the personal profiling techniques between client and contractor PMs |

*Table 2. Operationalisation of interviews sub-hypotheses*

| Sub-hypotheses | Null sub-hypotheses |
|---|---|
| H2.1: The average weighted effectiveness of the actions taken to manage the effects of the complexity characteristic, when selecting project team members, exceeds a level of 75 points in a scale of 100 points | The average weighted effectiveness of the actions taken to manage the effects of each complexity characteristic, when selecting project team members, is less than 75 points in a scale of 100 points |

*Moderating factors.*
The following five moderating factors – duration, budget, location, type, and procurement method – were considered in order to understand if these influence the sub-process and respondents were asked to identify the level of influence of each moderating factor, using a Likert scale 1 – 5, from 'Very Little' to 'Critical'.

# RESULTS

The implementation of the multi-methodology research design was over a period of ten months from May 2007 to February 2008 with presentations to respective Senior Managers on the aims and objectives of the research.

## Postal Questionnaires

The questionnaire was issued to 180 randomly selected project management professionals from within the two strata and 91 valid responses were returned (51%) of which 57% were from the client strata and 43% from the contractor strata. The sample of respondents represented 32% and 8% of the Client and Contractor project management populations within their organisations respectively.

From the responses received 7% were at Director level, 37% at Senior PM level, 46% at PM level, 7% at Assistant PM level and 3% at Site Manager level.

Results obtained established prevailing conditions in the project environment to be mostly Dynamic, Complex and Friendly (Antoniadis *et al.*, 2008). Respondents indicated that they are aware and given guidance on team member selection but personal profiling techniques are not implemented at any project organisational level. Subjective criteria for selection of PMs and project team members are still dominant.

*Moderating factors.*
Response results indicated that none of the moderating factors are considered either critical or very important in terms of influencing the selection of team members.

## Interviews

The 31 interviews conducted comprised of two parts. The first part consisted of questions regarding perception of complexity within their organisation and actions taken. The second part involved the explanation of complexity characteristics, their application in project management and particularly in selecting team members, and the implementation of actions which will indicate management of complexity as this can be generated if its characteristics are not considered.

Majority of interviewees, from Project Directors to Site Managers, indicated that their organisations do not give a definition nor any tools or techniques to identify complexity (Antoniadis *et al.*, 2008). Figures 1 and 2 indicate the interviewees' response regarding identification of complexity and factors which are source of complexity.

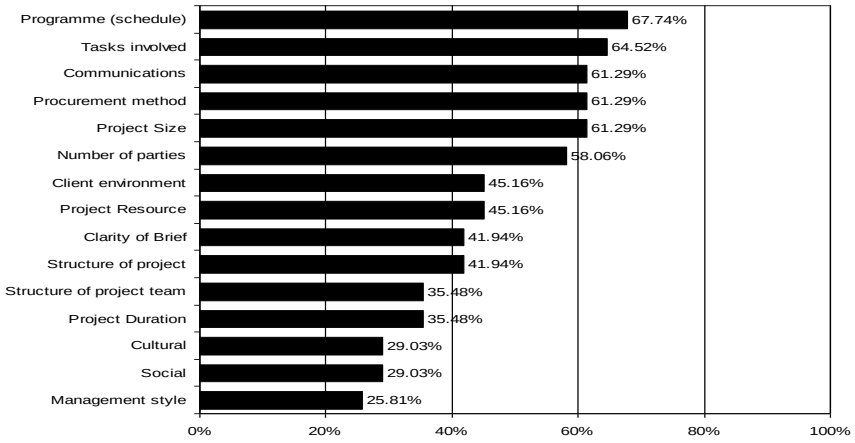


*Figure 1: Percent response regarding the identification of complexity in projects*

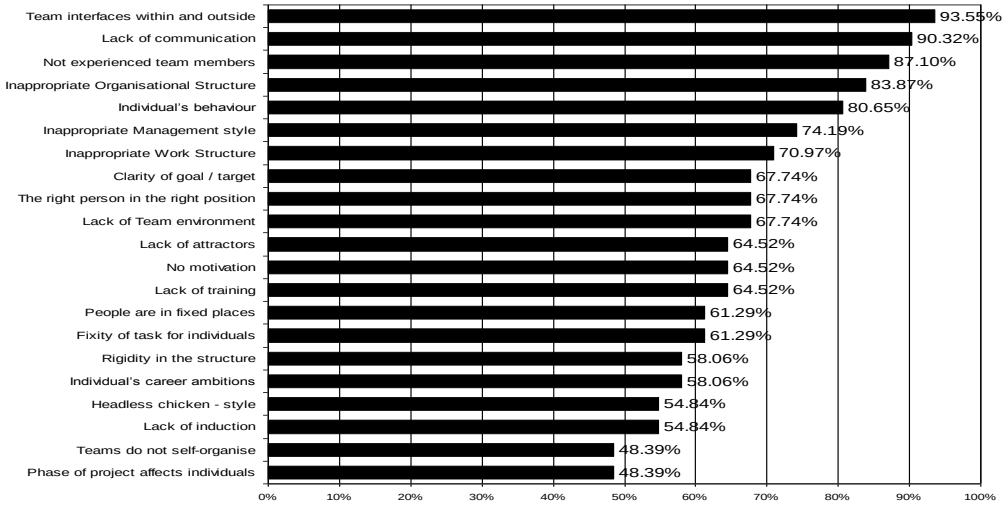


*Figure 2: Factors identified as source of complexity*

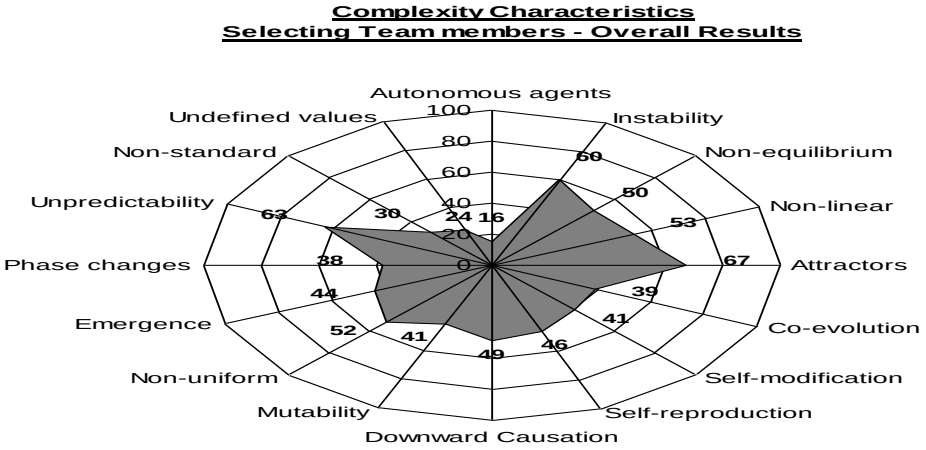


*Figure3: Average weighted effectiveness of managing effects of complexity characteristics*

For the second part – the complexity characteristics figure 3 provides an overall indication of the average weighted effectiveness of the actions taken to manage the effect of each complexity characteristic when selecting team members. For example for 'autonomous agents' the overall average of actions taken covers 16 points of the required level of actions which will ensure a 100 points management of complexity.

It should be noted that all proposed actions for all the characteristics were reviewed with the interviewees and any additional actions were included in the listings and considered in the overall weighting.

# ANALYSIS

### Postal questionnaire

Responses in terms of the prevailing conditions provided an interesting feedback which actually represents the changes that have occurred in construction for the last decade since the Latham and Egan reports. That is, an environment which is becoming more 'friendly', but which has not lost neither its dynamism nor its complexity.

The significance of these responses, in terms of the consequences to the selection of team members, is that despite the change to a friendlier environment, awareness of and guidance given on personnel profiling this is not considered when selecting PMs nor any other team members. In particular, majority of the respondents indicated that personal profiling is not carried out at all for any project team member. Majority also indicated that no techniques are used for the lowest project team level by supervisors. This is despite the fact that in one of the participating organisations the internal project management process indicates that Belbin or Myers Briggs should be used when selecting the project team members. The results obtained are triangulated by very recent literature (Keegan and Turner, 2003) and also confirm Green's (2006) conclusion.

Standard subjective criteria, such as capability and availability, are still used for appointing PMs and other team members (Ogunlana, *et al.*, 2002, Raiden *et al.*, 2004).

Statistical analysis, using chi2 was performed for testing sub-hypotheses 1.1 to 1.3 and on all three cases results the null sub-hypotheses were accept. So, although guidance is given personal profiling techniques are not used for selecting the PMs, although guidance is given personal profiling techniques are not used for selecting site team members and finally there is no difference in the implementation of personal profiling techniques between client and contractor PMs.

Thus, despite the acceptance that the project environment is more complex and dynamic, no formal techniques that support the selection of PMs and team members are used. Practitioners from both sides – client and contractor, are aware and are given guidance in selection techniques, however, theory is not converted into practice and mundane team selection criteria are used.

In terms of the effect of the moderating factors responses indicated that only those of project type and budget are slightly considered to influence the sub-process. This indicates that the transactional and technical character of the industry has a small affect on the sub-process, however, not to a critical level.

### Interviews

With regard to the interview responses for the general complexity part and from the breakdown provided in graph 1 it is clear that mechanistic sub-processes are considered as the main identifiers of complexity. Soft issues are considered as very low in the reasons for identifying complexity. However, the relatively high response towards the two non-mechanistic reasons of 'communications' and 'number of parties' indicates that there is a shift towards identifying complexity caused by the number of interconnections.

When asked about ‘factors/sources of complexity which originate from the project organisation’, see graph 2, there is a clear shift towards the behavioural causes.

As far as taking appropriate actions, from within the selection of team member sub-process, to manage complexity through its characteristics, interviewees (see graph 3) indicated that very little is done and that no consideration is given to using techniques to manage complexity.

From the results on the average weighted effectiveness of the current level of actions taken for each complexity characteristic none has reached the 75 points level of acceptance. Thus, complexity of interconnections characteristics are not considered when selecting project team members.

## DISCUSSION

Regarding the sub-process of selecting team members the findings provide a statistical confirmation that in the construction industry and for both sides - client and contractor - supporting techniques are not implemented. Responses indicate that professionals are aware and guidance is given regarding team selection techniques however these are not used, thus hypothesis 1 is refuted. As a result the importance, influence and criticality of the individual, their relationships, behaviours, and boundaries formed when coming together to deliver a project, are not considered.

Considering the evanescent nature of projects and the interconnections established when individuals come together to form teams it is obvious that these will cause complexity. It is apparent that although the theoretical background has been established, techniques for selecting team members exist and project management professionals are aware of them, all these are not channelled through to the management of projects in a manner which will enable the management of the effects of complexity. The results here also indicate that hypothesis 2 is refuted.

Therefore the potential exists whereby overcoming such barriers like 'it will take time and money', or 'people will resist', utilising the understanding of complexity of interconnections and its characteristics and by implementing existing techniques a framework can be developed with which to manage the effects of complexity for the sub-process investigated.

## CONCLUSION

The investigation into techniques used for selecting project team members and the consideration of complexity characteristics by practitioners, has established that neither is implemented in construction projects, from either the client’s side or that of the contractor. The results also indicate that determination and management of complexity remains within various mechanistic tools which have been established within the construction industry.

Practitioners require a higher initiative to move away from the subjective selection of project team members, as well as a greater understanding of complexity and in particular that which is caused by interconnections. From the employers' side as well consideration should be given to the balance of benefits against concerns of time and cost taken to complete such processes as personal profiling.

Having linked the complexity characteristics to construction, it is of interest to all parties to implement actions that will manage the effects of complexity on the numerous project management sub-processes.

In a friendlier and more dynamic environment, where both clients and contractors allow for a more open and extended front end project period, selecting the appropriate PM and team members based on already established profiling techniques is feasible and achievable. Additionally in a more complex environment by implementing appropriate selection techniques and understanding complexity this should enable the formulation of a framework of actions which will manage the effects of complexity characteristics.

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