

Virtual Collaboration in the Management of Construction Projects: A Review

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Abstract— This article reviewed an overview of Virtual Collaboration as it applies to management of construction projects. It reviewed the project environment, the impact of the virtual team on the organisation, and the strategic decision-making process. It also looked at the impact of the Information Technology and Information System Strategies on the construction business throughout the project life cycle. The risks involved in the adoption and implementation of virtual collaboration in construction projects and how to manage them was also reviewed. Some management models such as the Johari's window model, John Adair's action-centered leadership model, De Bono's six thinking hats model, and Kurt Lewin's change management model were incorporated into the process of managing and working with the virtual construction team.

Index Terms — Management of Construction Projects; Virtual Collaboration; Virtual Team.

1 INTRODUCTION

Organisations today have gone beyond doing business within a particular geographical location(s). In addition, projects can have variety of information combined from various sources and partners, in order to gain additional capability and to share the risks [1]. According to [2] collaboration involves mutual objectives and continuous measurable improvement. However, the virtual collaboration is a business approach where a network of organisations or teams unite its workers to carry out tasks from various locations through web, Mobile, and Information technology. However, the concept of virtual collaboration is a bit uncommon to the construction industry. It has been argued by [3], that outsourcing in a virtual network will result in a serious strategic weakness in the long run, since the organisation is void of core competences and organisational learning, which could only exist in-house. They add that knowledge creation and innovation only occur within the specialist "boxes" represented by the virtual knowledge workers, hence no one will be of competence or authority to integrate the knowledge so created. In addition, insufficient communication, little trust, and numerous conflicts due to location and cultural differences, are some challenges that construction companies are likely to meet in adopting virtual collaboration in their projects. However, [4] have developed a Web-based trust estimation system (WTES) to support trust activities in the virtual team.

This study explores the concept of virtual collaborative project webs and teams, taking into consideration, the current thinking on organisational management, strategic decision making, impact on organisational and project processes, what implementation strategy will be adopted to solve the organisational issues, and how the risks will be managed, if construction companies will adopt virtual collaboration.

2 CURRENT THINKING ON PROJECT ENVIRONMENTS

The project environment of a virtual collaborative project, like every other kind of project environment, involves drivers such as project life cycle, organisational structure, competitiveness, strategy, and change. The lifecycle describes the start and finish points.

2.1 Thinking on Organisational Management

Virtual collaborative project team technology has come to stay in today's business environment. Construction companies will stand a lot to benefit from adopting virtual collaboration. According to [5], by virtual team collaboration, the best employees can work for the organisation from anywhere in the world with increasing technological sophistication and personal flexibility. However, [6] have argued that team members in a virtual team run the risk of having lower cohesion and trust than in the usual face to face team, because of the abstract means of communication involved.

2.1.1 Organisational Structure

Virtual collaboration often uses a flat (or horizontal) organisational structure. According to [7], a flat organisational structure is one that has a few levels of organisational hierarchy, and decisions are easily taken because of the small amount of bureaucracy. [7] adds that organisations today are adopting the flat structure because it brings about a greater efficiency, competitiveness, and profitability. [5] explain that, with the use of virtual collaborative teams, organisations can build teams with optimum membership while retaining the advantages of a flat organizational structure. [8] also explains with fig. 1 and 2 that the flat organisational structure runs in alignment with the work breakdown structure (WBS).

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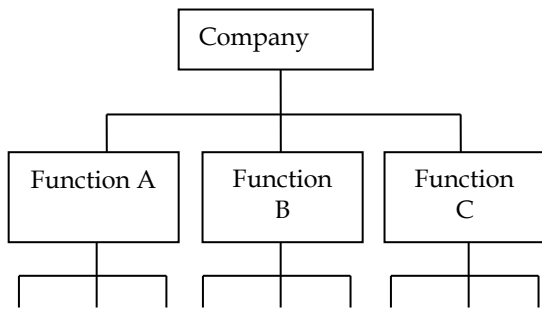


Fig. 1: Functional hierarchy of a flat organisational structure. [8]

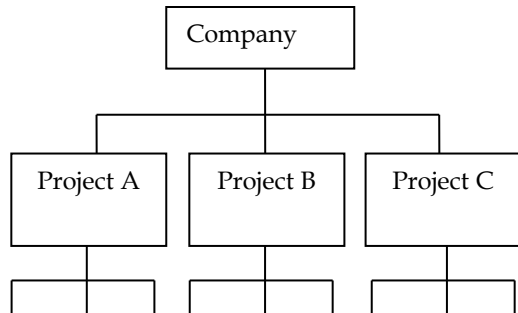


Figure 2: Project hierarchy of a flat organisational structure. [8]

Virtual collaborative project environments operate within a social system, which constitutes the team. However, [9] posit that, to understand virtual collaboration, there has to be first an understanding of the social structure, since patterns of interaction may emerge from the social structures and the development of the social systems on the behaviour of the participants.

2.1.2 Organisational Culture

All organisations have norms, policies, beliefs, and values. An organisation's culture plays a strategic role in the changes required by that organisation. Several researchers such as [10], [11] have contended that culture has been very widely used without much understanding. However, organisational culture is defined by [12] as shared basic assumptions learned by the organisation while solving its problems of external adoption and internal integration, which have proven valid to be taught to new members as the correct way to think, perceive, and feel the organisation's problems. [10] describes the main determinants of the business/organisational culture in fig. 3 below:

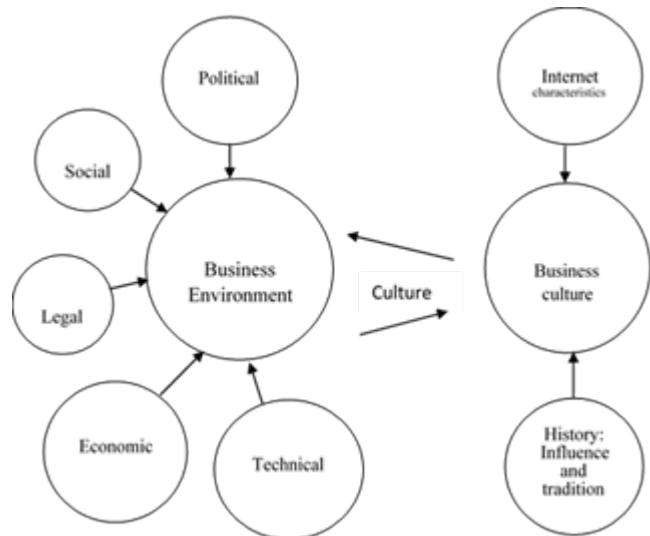


Fig. 3: Relationship between business environment and business culture [10].

2.2 Thinking on Strategic Decision-Making

Decision-making determines business flow, profitability and competitiveness in an organisation. In a virtual collaboration, decision making is usually within team members. This is because of its use of a flat organisational structure. According to [7], in this kind of structure, decisions are made very fast because of the agility and mobility of the organisation. Such decisions are usually strategic, since they determine the long-term goals and objectives of the organisation. Strategic decision-making often brings about an organisational change. These changes will make consideration for the future of the business, and the organisation's goals and objectives.

2.2.1 Organisational Change

Change creation is the ultimate goal of Projects. Doing business in the same way, executing projects in the same manner or making use of the same technology and expertise will more often place an organisation on a low competitive advantage. It has been argued by [5] that, in a competitive business environment, modern organisations have moved from the face to face teams to virtual teams as a result of the following drivers of change:

- The increased prevalence of flat or horizontal organisational structures.
- Changes in worker expectations of organisational participation.
- The emergence of environments that require inter-organisational co-operation.
- The increasing globalisation of trade and corporate activity.
- A continual shift from production to service/knowledge work environments.

A paradigm shift from the traditional approach of getting goals and objectives, to a technological approach can move an organisation's profit margin and competitive advantage to a greater height. It has been found by [13], that the change of business environments as regards management structures has brought about new leadership, technological work practice, and management challenges to address the increasing eco-

conomic and organisational complexities. Hence, change should not be viewed as a mere technology effort, but should rather be viewed as an emerging strategic business initiative [14].

2.2.2 Strategic Management

According to [1], strategic management is the management of a business enterprise with its future considered very important. Innovative concepts, long-term business competitive ideas, and quantifiable goals and objectives are common features in the strategic management of businesses. The strategy must be planned, implemented, and evaluated, so as to ensure a good strategic decision-making.

Strategic Planning: Strategic planning is the process of setting out the strategy and means of achieving organisational long-term goals and objectives. It is the stage of a strategic management process that assesses the expertise, finance, risks, culture, and key performance indicators (KPI). It identifies the processes that contribute to the performance, the effectiveness of those processes, and how to improve them, in order to bring about the desired change.

During this stage, missions, visions, goals, and objectives are defined; the internal drivers are addressed by the Strength Weakness Opportunity Threat (SWOT) analysis; the external drivers (macro-environment) are addressed with the Political Economic Social Technological Legal Environmental (PESTLE) analysis, which will make an impact on the micro-environment; while the organisation's business environment is analysed by the use of Potter's five forces model; finally, the desired strategy is formulated by the use of Porter's generic strategies. The ultimate goal of a business strategy is for an organisation to achieve a competitive advantage over its competitors or rivals [15].

Implementation: This stage utilises organisational and managerial tools to assign resources towards achieving the outcomes from the strategic planning stage. Several researchers such as [3], [16], [17] have maintained that this stage is the most difficult in the strategic decision-making and management process. This determines the success factors of the business, which also makes it the most important stage. Information from the outcomes of the strategic planning stage is made available to leaders and team members in the organisational structure through information and control systems infrastructure, and, where necessary, training is given to concerned team members and knowledge workers. A responsibility table is then prepared to show how the various responsibilities will be assigned.

Evaluation: The purpose of this stage is to ensure continuous improvement. Measurement and controlled of performance can be done by the use of management tools such as Benchmarking, Gap analysis, Balanced scorecard, Egan and Lean management concept, or four-stage quality management model. According to [18], there should be continuous measurement of the current performance status, and the information about the critical success factors should be made widely available. The following are some of the key performance indicators (KPI) to be evaluated:

- Strategic advantage
- Level of integration or operational streamlining

- Communication or process improvement
- New business benefits
- Technological innovation
- Reduction in data or process duplication
- Cost reduction
- Client satisfaction
- Change
- Reduced level of data redundancy
- Internal and/or external evaluation.

Quantitative and qualitative metrics are utilised to evaluate the KPIs so as to ensure more detailed, critical, interactive, and analytical results for the IT/IS strategies. Some evaluation methods that could be used are:

- Business reports
- Data collection
- Statistical analysis
- Questionnaires

3 IMPACT OF COLLABORATION ON ORGANISATIONAL AND PROJECT PROCESSES

The integration of strategic and operational objectives will have an overall impact on an organisation's competitive advantage, performance, time, budget, and profit margin. Hence the strategic decision-making process earlier described will create a shift in the overall portfolio. [11] discovers from a study that the Business process re-engineering (BPR) has an impact on the organisational culture and organisational change. Hence there is need for change management, and Information technology and Information systems (IT/IS) alignment with the business strategy. There is also going to be positive and negative impacts on the projects as a result of the adoption of virtual collaboration. These impacts will cover areas such as trust, communication, stakeholder focus, and suitability of the virtual teams on the organisation's portfolio.



Fig. 4: Interrelationships of project objectives and organisational fit [1]

3.1 Impact of IT and IS on the Business

The information emanating from the outcome of the strategic planning stage is made available to leaders and team members

in the organisational structure through an information and control systems infrastructure. This is enhanced by the Information systems strategy (ISS) and Information technology strategy (ITS) that are aligned to the Business strategy (BS). Fig. 5 shows a relationship between the BS, ISS and ITS. According to [19], the ISS supports the BS, while the ITS delivers the ISS. The alignment between the BS, ISS and ITS according to [19] will give the following:

- Dynamic base of Information
- Management oriented value added services
- Quality assurance
- Advanced information and communications
- Progression towards integrated services



Fig. 5: Alignment of the IS and IT strategies with Business strategy [19]

3.2 Impact on the Organisation’s Competitive Advantage

The strategic decisions taken, if well implemented, will enable the virtual teams achieve and maintain excellent performance in the business environment. Cost, time, and quality will be well controlled, and value will be added to the business processes. By these, the organisation will rise up above major competitors in the construction industry, and its profit margin will increase. [20] has argued that, though the competitive strategy chosen by an organisation or a firm in an attractive industry may have a long-term profitability, such firm may still not earn attractive profits if it fails to gain a good competitive position. Therefore, the most vital impact expected from the strategic management process of the business is to gain competitive position in the business and project environments.

3.3 Impact on Organisational Culture and Change

The changes taken by the management and team of the organisation will affect its policies, knowledge, beliefs, and values. The implementation process, while informing the stakeholders especially the virtual team, of the strategy, included some sort of training. This is a form of cultural change. The business environment consists of the micro-environment

and the macro-environment. According to [21], the micro-environment consists of the stakeholders of the business that have direct interest on the activities of the firm, while the macro-environment consists Political, Economic, Social, Technological, Legal, and Environmental factors that all contribute to changes in the organisational culture. [21] adds that the decisions made in the micro-environment, usually have a direct effect, as managers regularly interact with other stakeholders in making decisions. These stakeholders are suppliers, employees, distributors, customers, and competitors. Virtual collaboration has also had a huge impact on the roles and functions of team members in the organisational structure. A study carried out by [22] revealed that the use of virtual collaborative toolsets has improved the interaction between members of the virtual team as it customises their roles and functions.

4 PROJECT LIFE CYCLE

Every project or project portfolio has a life cycle.

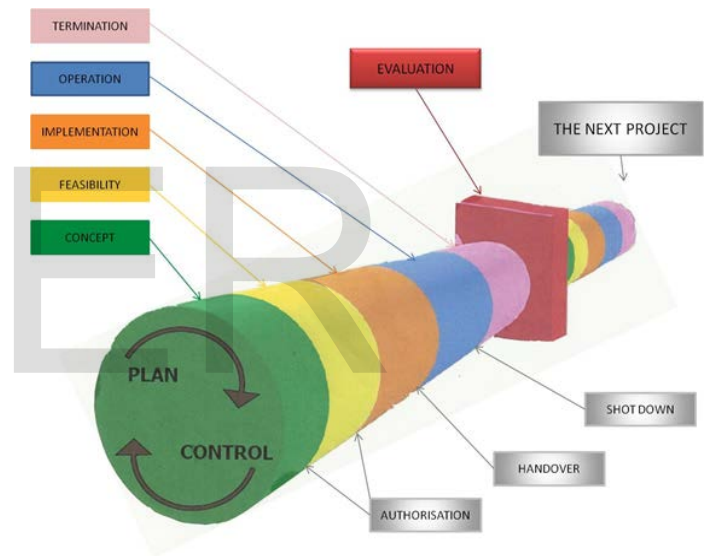


Fig. 6: Project life cycle [23]

To be able to successfully execute each project, the strategies adopted must be integrated through the entire stages of each project.

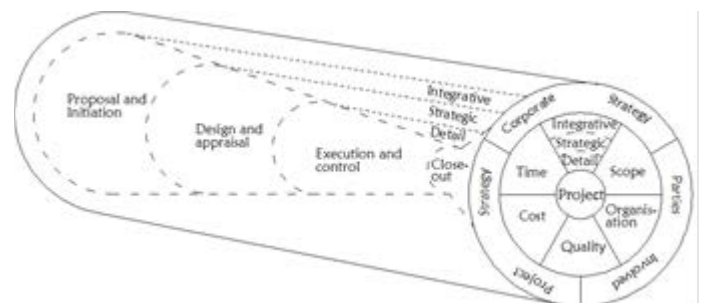


Fig. 7: The Project system [8]

A study carried out by [24] shows that integration of strategy with project life cycle made by managers in communication, decision-making, and leadership patterns determines the success or failure of a project.



5 THE VIRTUAL TEAM

To understand the team building, interpersonal relationship, communication, and employer/employee relationship, the Johari window model shown in fig. 8 should be used. This will guide the management of the organisation on the virtual team members' network of communication and relational efficiencies.

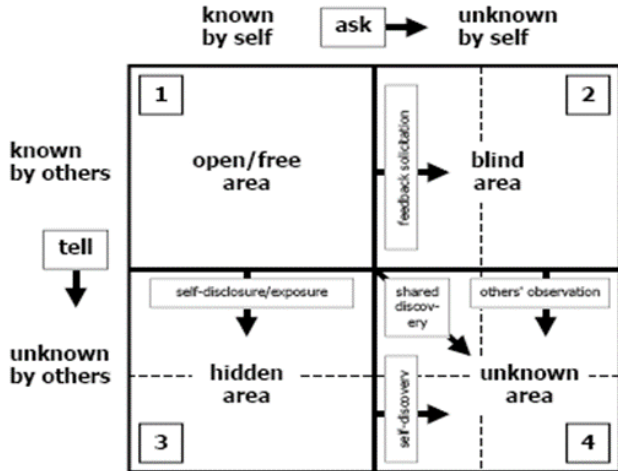


Fig. 8: The Johari window model [25]

It is very useful to manage the tasks, individuals and team with an integrated approach. Hence John Adair's action-centered leadership model in fig. 9 should be used with responsibilities assigned to team members.



Fig. 9: Action-centered leadership model [26]

6 CHANGE MANAGEMENT

When there is an innovation of strategy, policy, or culture, it is usually uneasy for team or organisational members to adapt. Hence the concept of change management will be a strategic tool to control this. This means putting thinking to bring about an easier and faster means of getting something done. Such thinking could be governed by De Bono's six thinking hats showed in fig. 10.

Fig. 10: De Bono's six thinking hats [27]

6.1 Kurt Lewin's Change Management Model

Kurt Lewin's change management model should then be used for the effective implementation and control of the strategic changes made by the organisation. The model according to [28], [29] is described as follows:

Unfreezing stage - Melt the existing structures and policies to identify and strengthen the drivers for change. This means getting ready to move out from current comfort zone.

Moving or changing stage - Identify and access new patterns and implement the changes needed. This means moving towards a new way of doing things.

Re-freezing stage - Fix the selected structures, processes, and behaviour patterns. The newly changed processes and patterns are made to stay as part of the organisation.

The change management process will be led by a change champion, who is either a member of the virtual team, or a technical executive of the company. [28] argues that although Lewin's model being established in 1947 has had minor changes and some criticism for its simplicity, yet most recent change management models and theories are based on it.

7 RISK MANAGEMENT

The management of risks is critical and should be identified, assessed, and mitigated.

7.1 Risk Identification

According to [30] projects are exposed to both internal risks; financial, design, contractual, construction, personal, involved parties and operational, as well as external risks; economic, social, political, legal, public, logistical and environmental.

7.2 Risk Assessment and Mitigation

Either a qualitative or quantitative analysis approach can be used to assess and mitigate risks in construction projects. The SWOT analysis can be used to tackle the internal risks, while the PESTLE analysis can be used to tackle the external risks. With these the risks will have been managed [8], which should be built into the management of the projects and should span through the project life cycle and portfolio [31].

8 CONCLUSION

Strategic decision-making brings about actualisation of long-term goals and objectives. In addition, the concept of change from the traditional means of doing business to an innovative one, gives an organisation a competitive advantage. Such organisations can align their business strategy with the Information strategy and Information technology. Project Engineers, Construction Managers, and Project Managers in con-

struction companies can begin to adopt virtual collaboration in strategic decision-making for their organisations.

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