

A SYSTEMS MODEL FOR PROJECT DELIVERY TIME AND IMPLEMENTATION

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PURPOSE: Professionals undertake tasks as part of inter alia, the design process, which require a range of actions, which are substantially influenced by the environment. Given that the interplay of all of these forces has an impact on the outcome of the process, the study reported on investigated the relationships between actions initiated by professionals in the delivery of facilities.

ABSTRACT

Purpose: Professionals undertake tasks as part of inter alia, the design process, which require a range of actions, which are substantially influenced by the environment. Given that the interplay of all of these forces has an impact on the outcome of the process, the study reported on investigated the relationships between actions initiated by professionals in the delivery of facilities.

Methodology: The mix method of research approaches (qualitative and quantitative) were adopted in the study. The first part deals with the quantitative approach, which led to the second part the qualitative approach and that system thinking. The system thinking approach was employed to identify causes and effects of actions / decisions undertaken during the delivery of facilities. Respondents were selected randomly. The questionnaire the instrument used for data gathering was administered to respondents through post and e-mail. The data for the study was obtained from eighty-nine respondents within the metropolitan areas of the following provinces in South Africa, namely: Gauteng, Kwazulu-Natal, Eastern Cape, Western Cape, and Free State. Architects, clients, contractors, engineers, and quantity surveyors constitute the respondents.

Findings: Findings from the study include: lack of commitment to timeous completion of projects on the part of contractors, clients, and designers leads to project delay; poor performance stems from late payment of fees, and lack of adequate prequalification of professionals; late provision and issuance of instructions and approval of works leads to project delay, and contractors' inadequate skills and health and safety (H&S) plans lead to poor performance and late project delivery.

Practical implication: The causes and consequences of delay have been identified. The breaking of the circle of factors that lead to project delay based on the actions that will enhance delivery of projects should be given greater attention.

Value: The practice of the recommendations based on the findings from the study will drastically reduce delay in the delivery of building construction projects.

KEYWORDS

Project, System thinking, Delivery time, Delay

INTRODUCTION

A project consists of a series of activities, which are linked. There are start, intermediary and finish activities, and consequences that result from the level of performance relative to each activity. These have an effect on and implications for the workers, the product, image of the organisation, satisfaction of client, and the industry generally. System thinking is a process that holistically examines a chain of events, from inception to completion.

[1] quote [2] who raises the question of how organisations compete, build and maintain viable businesses in a rapidly changing global market place and environment. A major part of the answer is a commitment to creating and retaining satisfied customers.

Construction projects generally involve highly complicated activities in execution, involving many project stakeholders and interfaces, and are influenced by many external factors. Therefore, schedule delays often occur in construction projects and affect the total project duration in an unpredictable way. Studies in various developed, as well as developing countries have shown that construction delays are common [3].

Extended project duration in turn will lead to an increase in project cost, reduced return on investment, poor organisation image, disputes, abandonment, and litigation. Furthermore, [4] state that contractors may experience increased overheads, and material, and labour costs.

Others view the construction industry as a highly dynamic sector, and its operating environment, industry structures and product characteristics are changing at an ever-increasing pace. Activity in the industry is subject to influences resulting from the pace of technological change in other sectors of the economy.

Globalisation and internationalisation of the construction industry have benefited the developing economies; this is not without some challenges, which include scarcity of construction materials and human resources, which does not match increased volume and complexity of such projects. Change is one common occurrence in the process of project delivery. [5] declare that change orders can impact portions of a project directly or indirectly, and result in reduced labour efficiency and may lead to disputes between the client and the contractor. Furthermore, this may affect the image of the contractor and position the contractor at a disadvantage relative to competition.

Attempts to determine causes of poor project productivity have been traditionally subjective. The subjective nature of measuring of these causes leads to results and other causes, this continues in a circle, actions that will break this circle should be identified and promoted. This study examines causes and effects of project delivery through system thinking. As it is important to deal with all factors that could lead to a project to be delayed and result in bad industry image, stemming from the position that could be held by client categorising professionals as not being competent.

PREVIOUS STUDIES

Several research studies have been conducted in different parts of the world prior to the year 2000 with respect to construction delays. Some examined the causes as well as the effects of delays in construction project delivery, while others used a predictive model to ascertain construction period estimation. Some of the early authors who studied the causes of delays are [6] in the US; [7] in Turkey, and [8] in Australia. Others, such as [9] and [10] in Nigeria, as well as Chan & [11] and [12] in Hong Kong studied the effects of delays in construction. [13] in the United Kingdom, [14] in Lebanon, [15], [16] in Saudi Arabia, and [17] in Thailand all studied predictive models for estimating construction duration. Beginning in the year 2000, a concerted effort has been made worldwide to determine remedies to the issues of project delays. Authors include [18] in Nigeria; [19] in Canada, [20], [21], and [22] in Saudi Arabia, [23] in Ghana, and [24] in the UK.

METHODOLOGY

Both the quantitative and qualitative research approaches were used. The sample consisted of architects (9), clients (12), contractors (23), quantity surveyors (23), structural engineers (23), and others (3) in the South African construction industry. One thousand four-hundred and forty-one (1441) questionnaires were sent out through e-mail and post. Eighty-eight were returned filled, representing a response rate of 6.1%. These were randomly selected from the sampling frame. Inferential statistics were used for the analysis of the data, for the initial stage of the data analysis.

Reliability tests using Cronbach's alpha and factor analysis were conducted. The value for the Cronbach's alpha test is $> .70$, the internal reliability of the factors in each category, which is acceptable regarding the internal consistency of the factors. The factor analysis value is $> .60$, which test the agreement between factors in each category, the specified loading for sample sizes of 85 - 99 [25].

Respondents over the age of thirty years predominated (76.5%). The highest academic qualifications of respondents were Bachelors (25%) and Honours (23%), and BTech (17%) collectively totalling 65%. Managing directors / Managing members / Principal (35%), senior staff (20%) and managers (17%) represent the distribution of respondents' status. The mean number of years of experience of respondents is 17. The types of facility respondents are involved with include residential, commercial offices, and institutional facilities such as education, and health. The mean value of projects respondents have been involved with is R866.63 Million.

PRESENTATION OF RESULTS AND DISCUSSION

Table 1 presents the ranking of mean scores (MSs) on the factor categories investigated.

Factor category	MS	Rank
Construction planning and control techniques	3.98	1
Management style	3.92	2
Economic policy	3.76	3
The quality of management during construction	3.73	4
Site access conditions	3.54	5
Site ground conditions	3.49	6
Motivation of workers	3.40	7
Constructability of designs	3.37	8
Socio-political conditions	3.16	9
Client understanding of the design, procurement and construction processes	3.12	10
The quality of management during design	3.06	11
Physical environmental conditions	2.87	12

Table 1 reveals that construction planning and control techniques (MS = 3.98) used for activity scheduling is the most influential factor category regarding the delivery of projects with reference to time, followed closely by management style (MS = 3.92), and then distantly by economic policy (MS = 3.76), and quality of management during construction (MS = 3.73). The least influential factor category is physical environmental conditions (MS = 2.87). Table 1 also indicates that with the exception of economic policy, the categories of factors ranked from 1 to 7 are construction-related. This means that the primary cause of delays in the delivery of projects is construction related. Based on this, a system model was developed to address this problem.

BACKGROUND TO SYSTEM THINKING

The evolution of a systems model for this study is an approach to develop a holistic understanding of the delivery process of building construction projects, the complexity of the interrelationships of tasks; the actions of professionals, and the influence the environment has on the process and delivery time of projects. Given that this study is investigating the relationship between actions initiated by professionals in the process of construction of a facility and its delivery time and that Illustration 6.6 presents a graphical review of the salient conclusions using a primary causal loop analysis and modelling, it is necessary to address systems thinking.[26] says that the art of system thinking lies in being able to recognise increasingly dynamic complex and subtle structure amid the wealth of details, pressures and crosscurrents that attend all real management settings. In fact, the essence of mastering systems thinking as a management discipline lies in seeking patterns where others see only events and forces

to react to. According to [27], systemic modeling is a tool that helps to organize the relationship between major project activities and anticipated outcomes.

TOOLS

The tools of system thinking, inter alia, causal loop diagrams, consisting of arrows and various actions, enable interrelationships to be discussed more easily because they are based on the theoretical concept of feedback processes.

SYSTEM

[26] describes a system as a perceived whole, whose elements hang together because they affect each other over time and operate toward a common purpose.

Furthermore, it is a discipline for seeing wholes, a general principle / framework for seeing interrelationships instead of linear cause-effect chains and patterns of change rather than static 'snapshots'. This results in seeing the deeper patterns lying behind the events and the details and this simplifies life. In addition, systems mean the basic interrelationships that control behaviour. In other words, systems are the operating processes whereby perceptions, goals and norms are translated into actions. System thinking is a set of specific tools and techniques originating in two threads:

- In 'feedback' – concepts of cybernetics, and in 'servo-mechanism', and
- It is a sensibility – for the subtle interconnectedness that gives living systems their unique character.

SYSTEMIC STRUCTURE

In systemic thinking the structure is the pattern of interrelationships among key components of the system: the art of breaking problems into fragments, which makes complex tasks and subjects more meaningful. Consequently structure does not only include the hierarchy and process flows, but it also includes attitude and perceptions, the quality of products, the ways in which decisions are made and hundreds of other factors.

Additionally, system thinking is having a deep understanding of the forces that must be mastered to move from here to there. System thinking needs the discipline of building shared vision, mental models, team learning and personal mastering to realise its potential:

- Building shared vision fosters a commitment to the long term;
- Mental models focus on the openness needed to increase shortcomings in seeing present ways of the world;
- Team learning develops the skill of growth of people to look for the larger picture beyond individual perspectives, and
- Personal mastering fosters the personal motivation to continually learn how actions taken affect the world.

System thinking makes understanding the subtlest aspect of the learning organisation – the new way individuals perceive themselves and their world. A learning organisation is a shift of mind – from seeing itself as separate from the world to being connected to the world. It enables the organisation to see problems not as caused by someone or something 'out there', but to see how its own actions create the problems it experiences. A learning organisation is a place where people are continually discovering how they create their reality and how they can change it.

THE LANGUAGE OF SYSTEMS THINKING: LINKS AND LOOPS

Language shapes perceptions. The language of system thinking is the language of circles and also actions documented and arrows link these actions in a loop or circle. These present certain patterns of structures, which are called archetypes. System archetypes help people to see those structures and thus find the leverage, especially amid the pressures and crosscurrents of real-life business situations. Leverage is eliminating the extreme instability that invariably occurs within a process.

REINFORCING AND BALANCING LOOPS

Reinforcing systems are the engines of growth. These are the new ideas, changes, actions integrated into the system which leads to experiential growth and collapse, in which the growth or collapse continues at an ever-increasing rate. A vicious or virtuous cycle cannot exist by itself, as somewhere it will run up against at least one balancing mechanism that limits it. Balancing processes are the mechanisms, found in nature, and all systems that fix problems, maintain stability and achieve equilibrium. Balancing refers to the various actions that are taken to maintain objectives, goals and productivity.

Basis of Models

System dynamics are models which explain the behaviour of structure in a system, while system thinking is an approach to display interrelationships of factors. Models help to generate statements of relations between structure and behaviour called 'dynamic hypotheses' [28] and [29]. The behaviour of the system is based on decisions-making that results in feedback which in turn drives knowledge in function of understanding how these feedback structures explain the behaviour of the system. Figure 1 explains how environment influence information gathering and leads to decisions and decisions made in form of policies influence action, and in turn affect the environment in the space of time.

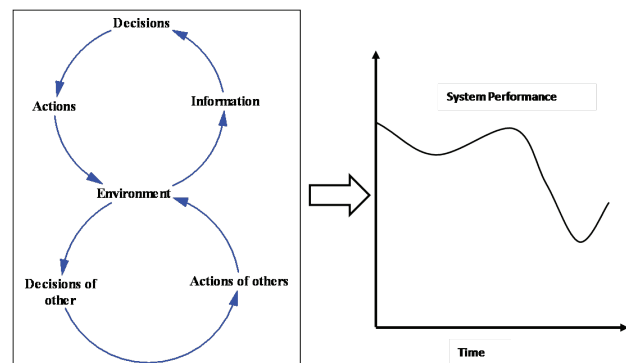


Figure 1: Feedback mechanism and system behaviour [30]

GRAPHICAL REVIEW OF THE SALIENT CONDITIONS

The scope of the study entailed an investigation of the association between actions initiated by professionals in the industry and their impact on project delivery time. Project delivery is influenced by numerous factors and the fact that these factors impact on other factors. Several illustrations have been used to explain and highlight the salient conclusions. Therefore, the various illustrations constitute models for improving performance relative to the parameters and the industry overall.

Relative to South African construction, Illustration 1 indicates the influence of clients, PMs, designers, and contractors on project delivery time in the form of a series of concentric circles, the aspect or action in the outer circles, directly exert influence on the aspect or action in the inner circle.



Illustration 1: Influence of actions initiated by construction professionals on project delivery

Illustration 1 requires further explanation:

- The South African construction industry is characterised by slow growth. This may be due to, non availability of qualified personnel's both supervisory and skilled workers, lack of managerial skills, and so on, despite the high demand for construction activities. Negative growth and high interest rates have all had an effect on construction;
- Client understanding of the design, procurement, and construction processes impacts on project delivery through, inter alia, a lack of understanding of project constraints, ineffective briefing, a lack of ability to contribute to the design and construction team, slow decision-making as well as the inappropriate nature of decisions. These individually and collectively marginalise construction progress;
- Design-related problems marginalise performance relative to project delivery. Investing quality time at the design stage is crucial to design being devoid of revisions, missing or ambiguous information and dimension ambiguity. Design-related problems result in increased pressure, stress, and ultimately project periods that may be incompatible with the objective, which is the scheduled delivery of projects;

- There are numerous problems with respect to the management of construction processes of which the South African construction industry is not free. These are poor construction methods, late inspection and approval of works, inadequate planning, a lack of knowledge of activity sequencing, a lack of a health and safety plan as well as inadequate knowledge of forecasting / scheduling of materials, plant and equipment and human resources to and from site. All of these exert influences on the delivery time of projects. South African culture disregards procedures, regulations and rules, which in turn manifest itself in, inter alia, the taking of risks and ultimately a high level of occupational-related fatalities;
- Motivation is important in terms of managing productivity, and remuneration contributes substantially to motivation. Generally, South African labourers' wages are low which does not complement the motivating activity of the management function of leading. Poor motivation and productivity may result in a delay in the delivery of projects. Therefore, consideration should be given to motivational factors such as good pay, recognition of achievement either in kind or in monetary terms, a sense of belonging – sourcing for workers' ideas, as well as an opportunity to enhance skills. The aforementioned factors affect delivery time in the form of sub-standard work, which in turn results in cost increases and rework. Rework in turn leads to delays;

- Soil investigations should be conducted to obtain information about the prevailing geophysical conditions of the ground. When this is not done, the estimation of project duration may be inappropriate. The structural stability of ground, the extent of ground water contamination, the impact of the water-table and archaeological findings can negatively impact on project delivery time;
- The nature of site access to any project will impact on project delivery. The extent of traffic flow with respect to the transportation of human and materials resources will depend on the nature of site access. Sites that are not accessible throughout the year, that experience congestion at site entry points and are far from resources, may reduce the productivity of workers and may negatively affect project delivery time;
- Construction industry design teams undertake the design, detailing and specifications. Constructability reviews should be conducted at the design stage. This will be useful in terms of ease of construction and realisation of an on schedule project. A lack of constructability review may result in constant revision of the design, and ultimately delay project delivery time;
- Construction activity is described as: hard; difficult; cumbersome and masculine in nature. The management style employed in construction may positively or negatively affect project delivery time. Project delivery time may be negatively affected when: goals are not specified; time lines for activities are not set; the work situation is not organised, and workers' opinions and concerns are not sought;
- Techniques for planning and control should be simple and easy to understand by all workers. This will facilitate productivity. Conversely, complex planning techniques may result in misinterpretation and a lack of sequencing of construction activities, resulting in project delay;

- Workers should be provided with protective clothing against cold and high temperature, and personal protective equipment (PPE) to avert injuries. This will reduce the frequency of accidents and absenteeism, which have a negative impact on productivity;
- Economic policy affects interest rates, trades / operatives and equipment availability, and insolvencies and bankruptcy impact on project delivery time. High interest rates may result in reduced investment in the industry. Labour policy may also affect the availability of trades / operatives and equipment availability to execute construction tasks. This, in turn may result in a negative impact on project delivery, and
- The socio-political conditions of a nation such as civil strife or riots, which are natural occurrences any project can experience, can negatively affect project delivery time.

Illustrations 2 to 6 are based on causal loop analysis and modelling, and provide a graphical presentation and explanation of the salient findings and conclusions of the study. The right-hand circle in Illustration 2 indicates that the acceptance of poor performance reinforces poor performance. The only way to break this cycle represented by the break in the arrow between poor performance and acceptance is for contractors to acknowledge that poor performance can be remedied. This acknowledgement invariably results from an awareness engendered by internal and / or external influences. Management commitment invariably follows the acknowledgement that a problem exists and is a prerequisite to remedying the poor performance. The implementation of an improvement process using TQM entails primarily the following steps: the preparation of an improvement plan; enhancing quality; enhancing plant and equipment efficiency; improving labour productivity, and enhancing H&S. The aforementioned result in: enhanced performance, as a result of individual contributions, and the synergy between them. The enhanced performance both reinforces the awareness that poor performance can be remedied, and engenders management commitment which sustains the cycle. TQM being a strategy to realise continuous improvement eliminating delays i.e. a process as opposed to a programme, also contributes to sustaining the cycle.

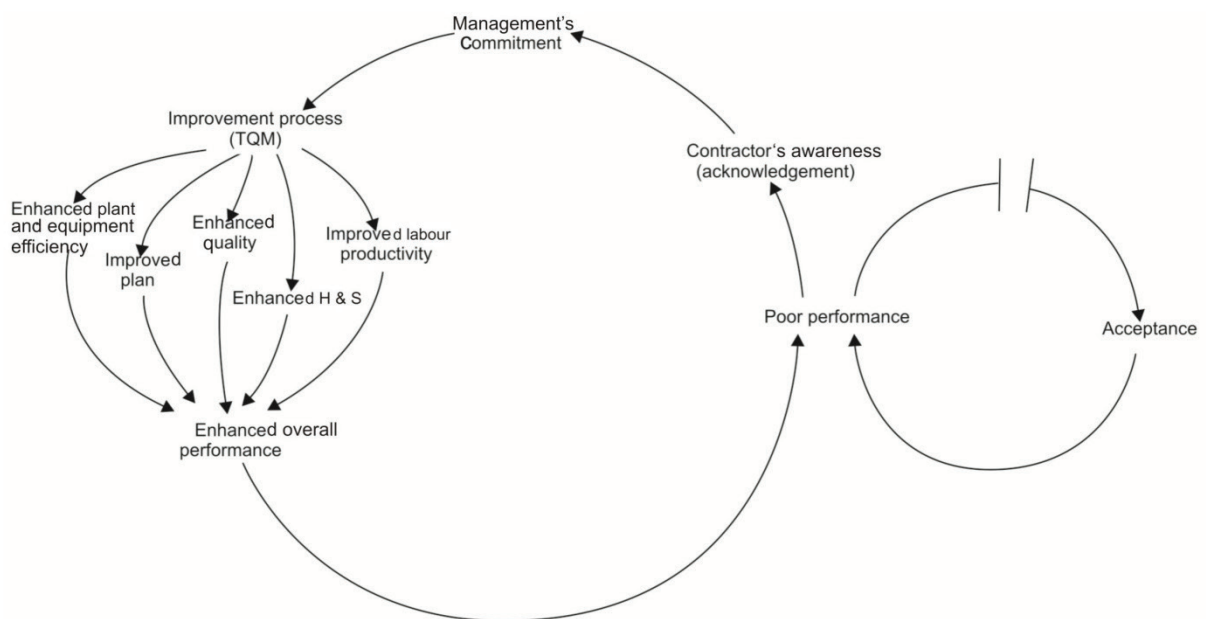


Illustration 2: Contractor-driven improvement of construction process

Illustration 3 presents a contractor resolution of a 'lack of commitment' vicious circle. Similar to the case of poor performance, the only way to break the cycle, represented by the break in the arrow between a contractor lack of commitment and a lack of an H&S plan, inadequate planning and rework. The problem is that an endeavour to minimise cost by the employment of unskilled labour, inadequate planning, and a lack of implementation of a H&S plan results in accidents, injuries and fatalities, which ultimately lead to a reduction of productivity and falling behind schedule.

Ultimately this leads to late delivery of the project. The aforementioned result in late delivery as a result of both their individual impact and the negative impact they have on each other. The late delivery of the project which results from a contractor's lack of commitment, inter alia, non-implementation of an H&S plan and employment of unskilled labour sustains the cycle.

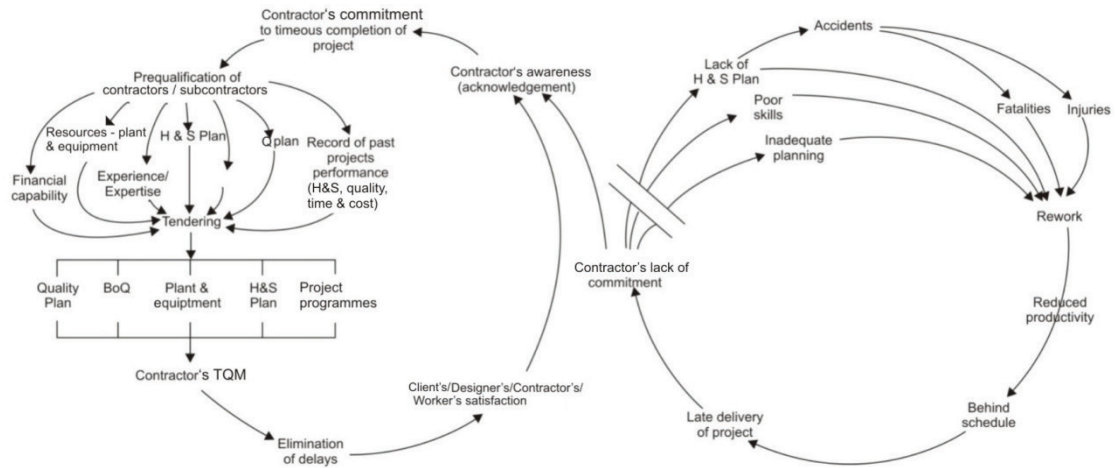


Illustration 3: Contractor resolution of lack of commitment vicious circle

The right-hand ellipse in Illustration 4 indicates that certain practices and / or the downstream impact of a lack of designers' commitment may result in the project programme deadlines not being met.

However, the late revision of design, late resolution of design ambiguity, late provision of information, late issuance of instruction and slowness in approval of works could result in the project being behind schedule.

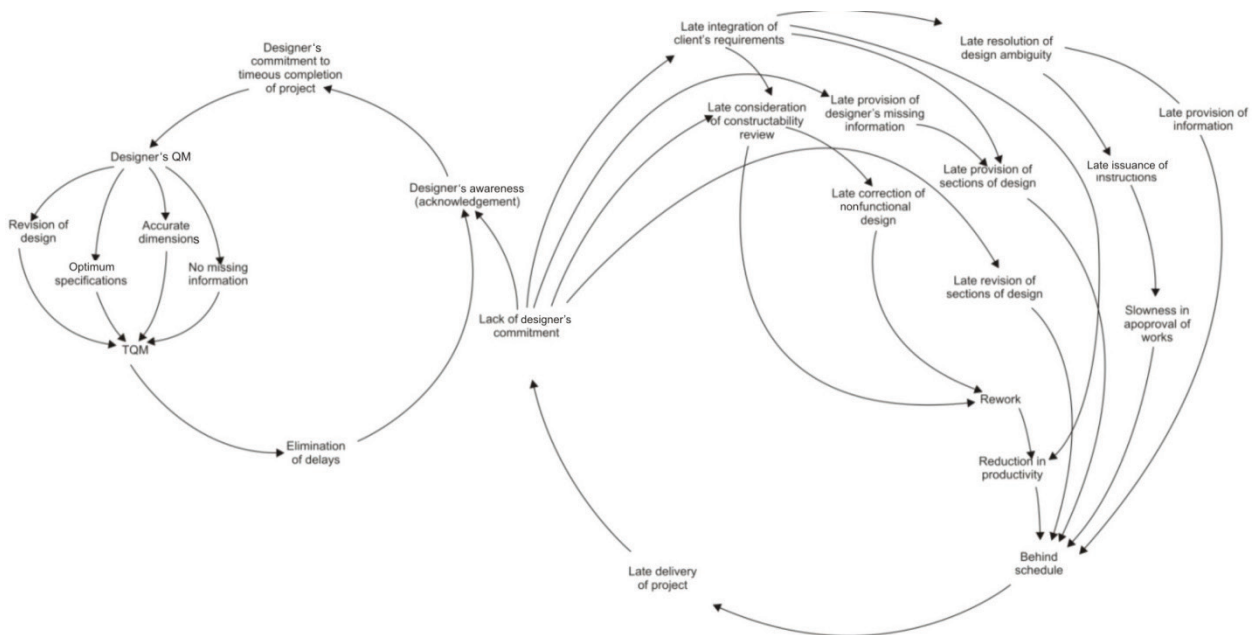


Illustration 4: Designers' resolution of lack of commitment vicious circle

The right-hand circle in Illustration 5 reveals that client commitment to and appreciation of the role of appropriate procurement systems in enhancing performance engenders the selection thereof. An appropriate procurement system in turn engenders client commitment to enhanced performance. The client commitment to enhanced performance is essential for the selection of an appropriate system where the appointment of designers precedes the selection of the procurement system and contractor. Client commitment to and appreciation of the role of design quality management (QM) in enhanced performance is essential for the implementation thereof.

Client lack of commitment engenders slow decision-making and the withholding of payment, which results in the contract falling behind and ultimately leads to late delivery.

An appropriate procurement system will facilitate pre-qualification of contractors, and constructability review. Designer and client commitment and contributions to TQM in turn are facilitated by design QM, constructability review and TQM contractors.

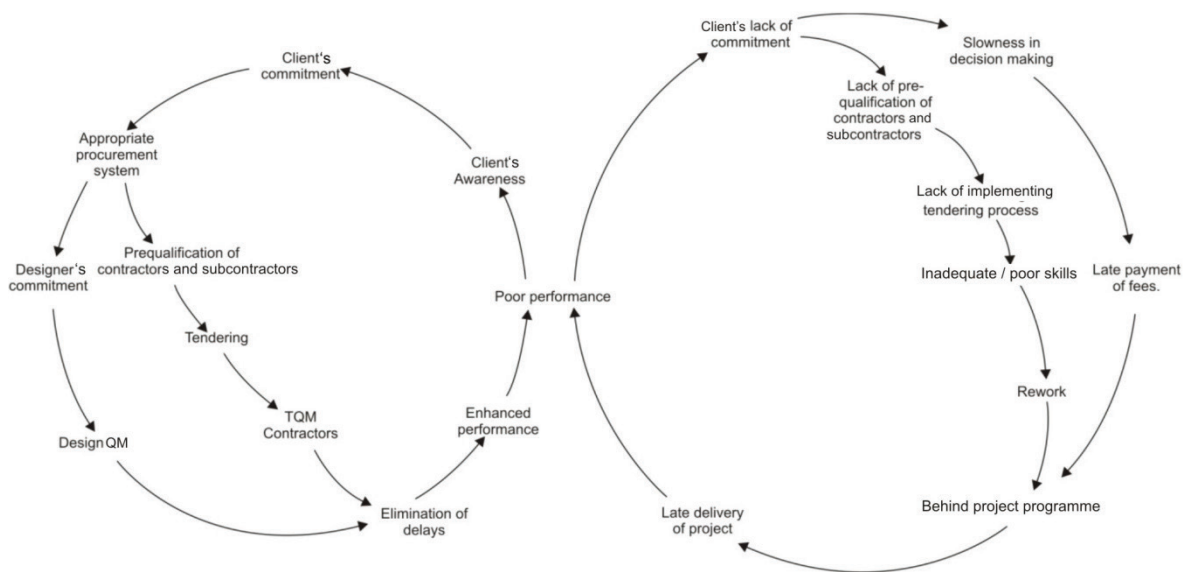


Illustration 5: Client resolution of lack of commitment vicious circle

The implementation of constructability reviews constitutes an essential intervention in design QM.

Pre-qualification of the contractor on H&S, productivity via technical expertise, and plant and equipment; a record of past projects; work schedule and human resources schedule, as well as quality criteria, engender the engagement of TQM contractors. A constructability review enables a contractor to contribute to the realisation of optimum design, which in turn engenders TQM.

Quality design: Lack of TQM contractors and constructability reviews engender poor quality product and ultimately affect project delivery time, but quality designs engender TQM and enhance performance.

Enhanced performance contributes to the sustainability of the cycle through the reinforcement of client awareness and consequently, client commitment.

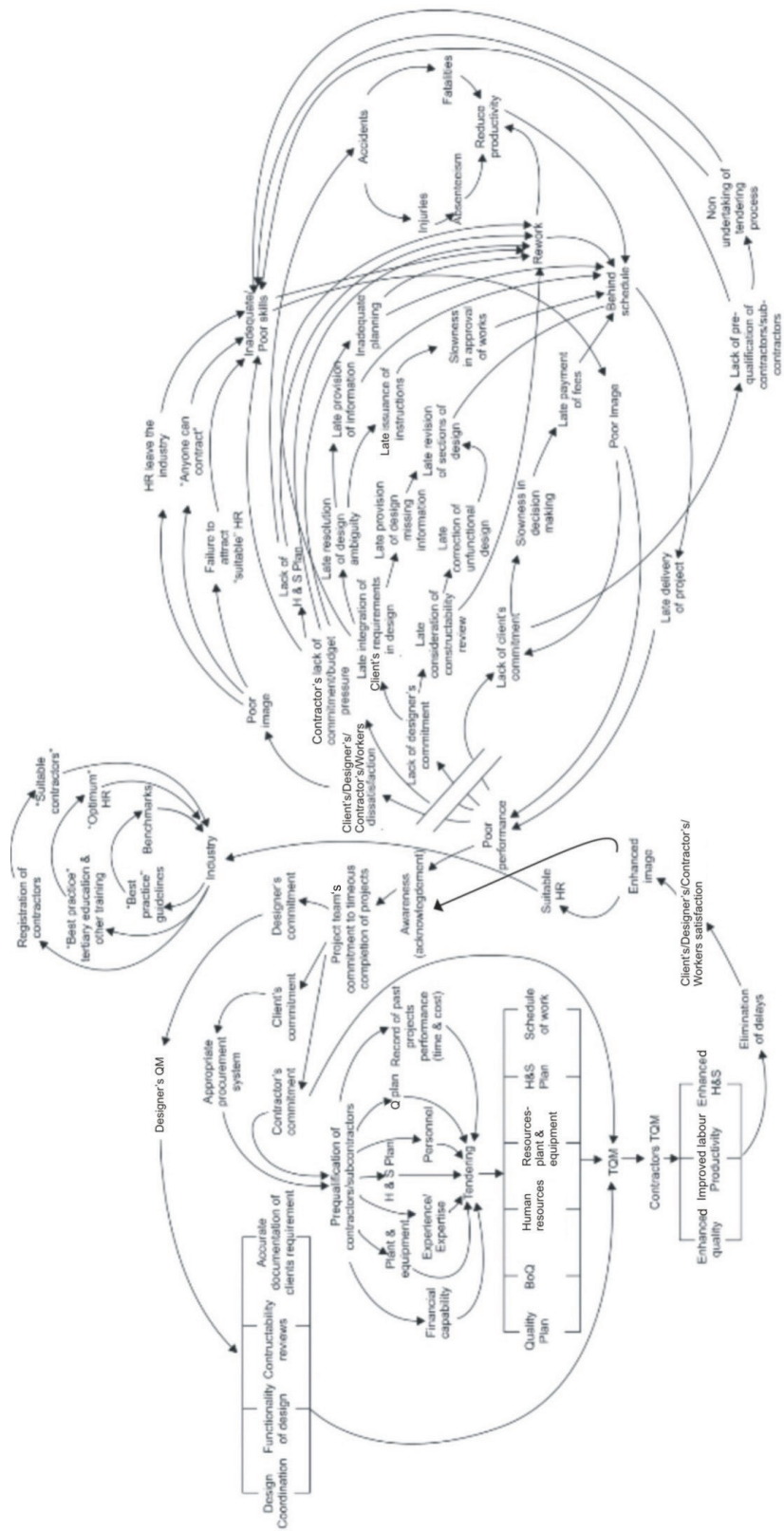


Illustration 6: The holistic role of influences on construction project delivery time in industry performance

The right-hand ellipse in Illustration 6 indicates the holistic role of the pre-qualification of contractors, commitment of designers to improve design, tendering documents and TQM contractors in overall performance, directly and indirectly, and ultimately the image of the construction industry. Clients are the initiators of a project. Whatever affects the client has a direct or indirect effect on other professionals in the industry. A lack of client commitment facilitates a lack of designer and contractor commitment to the processes of construction. A client lack of commitment as a result of poor performance, which will lead to, inter alia, clients' non-release of funds and slowness in decision-making, ultimately resulting in the contract being behind schedule.

A lack of commitment by the client leads to; inter alia, a lack of commitment by the designer and contractor. A lack of client commitment results in client prioritisation of cost, which in turn results in budget pressure on the contractor in an endeavour to be price competitive, marginalises H&S and engenders accidents, injuries and fatalities, which result in absenteeism and reduced productivity. Further, it engenders the use of inadequate / poor materials and unskilled labour, which ultimately results in rework and the project being behind schedule.

Inadequate / poor skills, inadequate materials as well as, inadequate plant and equipment engender poor practices which result in: accidents; poor labour productivity; rework, and poor schedule performance. However, the aforementioned result in poor performance as a result of both their individual impact and the negative synergy between the other manifestation of poor practices, fuelled by the catalysts of accidents and rework.

A lack of client commitment manifests itself in; inter alia, a lack of pre-qualification of contractors and subcontractors constituting poor practice. A lack of designer commitment manifested in, inter alia, the lack of design QM also constitutes poor practice.

Although poor performance results in client, designer, contractor and workers' dissatisfaction due to, inter alia, late completion, increased supervision and reduced profit directly as a result of rework and accidents, a further aspect is that of poor image. Poor image marginalises the ability of the industry to attract 'suitable' human resources at both management and worker level.

An associated problem of poor image is the perception that 'anyone can contract', which results in unqualified people entering the industry at both management and worker level. These, in turn, force skilled human resources, at management and worker level to leave the construction industry for other industries owing to the working and other conditions. The aforementioned merely worsens the situation relative to the level of skills.

The left-hand ellipse indicates that the only way to break the cycle represented by the right-hand ellipse, represented by the break in the arrow between poor performance and client / designer / contractor / owner dissatisfaction, lack of designers' commitment and lack of contractors' commitment, is for the industry and the primary construction industry stakeholders to acknowledge that poor performance can be remedied. The acknowledgement of a problem and the fact that the problem can be remedied is a prerequisite for commitment.

Industry commitment is essential. Registration of contractors based on criteria engenders a core of suitable contractors. Professionals and industry associations should embrace promote and engender 'best practice', so too tertiary education and other training bodies which lead to production of 'optimum' human resources. Professional and industry associations can evolve 'best practice' guidelines, which constitute benchmarks, and enforce construction activities to be practiced according to the benchmark of industry stakeholders. Industry commitment reinforces client, designer and contractor commitment, which is engendered by benchmarking, optimum human resources and 'suitable' contractors.

Client commitment engenders designer and contractor commitment and is essential to realise the selection of an appropriate procurement system for the practice of pre-qualifying contractors, for effective project delivery as well as for constructability reviews.

Contractor commitment is important for the implementation of an H&S programme, the proper planning of resources, plant and equipment, materials, adequate sequencing of activities and the engagement of skilled workers which collectively realise TQM contractor and facilitate TQM.

Designer commitment engenders contractor commitment and is essential to realise the selection of an appropriate procurement system, for the implementation and practice of design QM as well as for effective constructability reviews. An appropriate procurement system facilitates constructability reviews and engenders the pre-qualification of contractors. Design QM complements constructability reviews and the practice of TQM.

TQM results in enhanced H&S, improved labour productivity, and enhanced quality and schedule, which individually and as a result of the synergy between them, result in enhanced performance.

Enhanced performance results in: enhanced client, designer, contractor and worker satisfaction, which in turn results in the project being delivered on schedule, as well as an enhanced image, which reinforces the acknowledgement and awareness that poor performance can be remedied. However, a critical aspect is that enhanced image enhances the ability of the industry to attract 'suitable' human resources culminating in improve productivity and projects delivered on schedule. The relationships expressed in Illustration 6.6 are the salient deliverables, which this study has identified in terms of the influences on project delivery time

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION

A lack of client's commitment relative to responsibilities on a project will lead to poor performance. An awareness of the phenomenon will lead to a selection of TQM contractors and consultants, high performance, high quality products, and client commitment to timeous completion of project.

Lack of designers commitment leads to poor performance. A break of the circle of lack of commitment on the part of designers will lead to designers embracing timeous project practices, inter alia, Design Quality Management and Total Quality Management.

Contractors' lack of commitment and budget pressures leads to poor performance. A break in the circle of lack of commitment will lead to contractors' commitment to timeous delivery through contractors' commitment to prequalification, tendering, TQM and selection of TQM conscious contractors, which in turn results in enhanced quality, improved labour productivity and enhanced H&S, which will result in the elimination of delays on projects.

RECOMMENDATIONS

The study recommends that contractors, clients and consultants be made aware of the need to commit to project realisation. This will afford investing quality time and effort into the projects, which is required for its success.

Clients are advised to pre-qualify contractors on the basis of commitment to TQM. This will ensure the selection of quality conscious contractor relative to engaging them on for a contract.

Designers commit to quality management via commitment to coordination and functionality of design, adequate documentation of clients' intentions, and constructability reviews. This will ensure designs being free of ambiguity.

When all of these are observed, it will culminate in enhanced H&S, quality, and labour productivity, which will contribute to the elimination of project delays and enhanced industry image.

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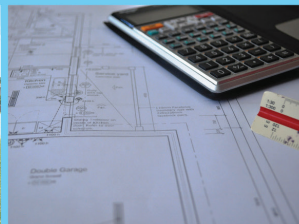
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