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## Managing the Development & Construction of Public Hospital Projects

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# Managing the Development & Construction of Public Hospital Projects

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**Abstract.** The purpose of this research is to identify effective project management strategies for developing and constructing public hospitals in Singapore to ensure that good project outcomes are achieved. The specific objectives are to: (i) identify project management related factors that contribute to the good performance of public hospital projects; (ii) investigate the key factors that lead to the poor performance of public hospital projects; and (iii) recommend a suitable project management framework for managing the development and construction of public hospital projects. The research was based on the case study of the development and construction of two public hospital projects. Data were collected via in-depth interviews with participants involved in each project. The principal results are that these factors must be present to ensure success of public hospitals projects: well-defined project scope incorporating the inputs of relevant stakeholders; proper change control system; close monitoring and control of project cost and expenses; regular site inspection for quality control; clearly defined roles and responsibilities of project team members; adequate communication mechanism; and extensive use of communication technologies. The findings for factors contributing to poor performance of public hospital projects are: unclear project scope; absence of strategy to manage cost overrun; inadequate risk assessment; incomprehensive evaluation criteria for contractor selection; and high turnover of project personnel. The major conclusion is that project participants should systematically adopt the project management strategies recommended in this study to guide the development and construction of public hospitals in order to achieve a higher chance of success.

## 1. Introduction

Effective project management (PM) of the development and construction of public projects is critical in order to achieve good time, cost and quality performance. The knowledge gap is that hitherto; it is not known which PM strategies should be adopted in developing public hospitals to ensure that they achieve project objectives. The aim of this research is to identify effective PM strategies for developing and constructing public hospitals in Singapore to ensure that good project outcomes are achieved. The specific objectives are to: (i) identify PM related factors that contribute to the good outcomes in the development and construction of public hospital projects; (ii) investigate the key factors that lead to the poor performance of public hospital projects; and (iii) recommend a suitable PM framework for managing the development and construction of public hospital projects. The research scope is limited to public hospital projects in Singapore.



## 2. Literature review

A project is a temporary work assignment designed to produce a unique product, service, or result [1]. Projects tend to have deadlines, a budget, and require resources. Due to time, cost and quality constraints, it is difficult to deliver a project successfully without proper management. The Project Management Body of Knowledge (PMBOK) provides for 10 knowledge areas in managing projects: scope, time, cost, quality, procurement, human resource, communications, risk, stakeholder, and integration [2]. In this research, the 10 knowledge areas defined by the PMBOK Guide were adopted to construct the PM framework.

A well-defined project scope ensures the success of a project, while a poorly defined scope impacts project outcome negatively [3]. The latter can result in expensive changes, quality failure, and schedule and cost overruns [4].

Time and cost management are important as schedule and budget overruns are frequent occurrence in the construction industry [5, 6]. A study of public projects in Beijing, Hong Kong, Sydney, and Singapore found that about 60% of public projects in these four cities experienced delay, cost overrun is a common occurrence, but quality is generally higher than expected [7]. Quality management is important to ensure project success, and these may be achieved if there is competent project manager, top management's support, monitoring and feedback system [8].

Certain processes need to be followed in procurement, i.e. purchasing or acquiring required products, services and results from external sources (PMBOK, 2013). A multi-criteria evaluation method involving both financial and technical criteria should be adopted [9]. The evaluation of past performance should not be based on information submitted by the contractors only but that obtained from public recordings and archived data [10].

Successful human resource management involves clearly defining roles and responsibilities [11] and integration of each individual team member [12]. Effective communication management involves predetermined communication manners, having appropriate management structure that ensures a simple and smooth flow of information within the project team [13].

Project risk management is a formal and systematic method that focuses on identifying and controlling areas or events that can cause unwanted outcomes [14]. This involves surveying risk-related information, identifying characteristics of risk events, analyzing the probability and potential consequences of important project risks, reviewing the analysis regularly, and adopting measures to control the identified risks [15].

Stakeholder management is an important aspect of PM as it can lead to cost overrun and delay [16]. Proper stakeholder management involves having a competent project manager, transparent evaluation of alternative solutions based on stakeholder concerns, high level of communication, setting up of common project goals and objectives, and investigating stakeholders' desires and expectations [17].

Integration management serves as a chain to link the other nine PM knowledge areas together [18]. The success of construction projects is highly influenced by the project manager's ability and skill to combine individual beads and informative pockets of knowledge into one thread [18].

## 3. Research method

A qualitative study, using case studies, was conducted to investigate PM strategies for developing and constructing public hospitals in Singapore. In the last 10 years, two public hospitals were completed in Singapore. Both were used as case studies to inform the research. The project team members of these two hospitals were invited to participate in this study and they agreed. Data were collected through in-depth interviews and archival information. A set of interview questions was designed based on findings from the literature review of the 10 PM knowledge areas covered in the PMBOK Guide [2]. It was sent to the participants prior to the interview to allow them to prepare for it. This was to enhance the effectiveness and efficiency of the interviews. The interview guide consisted of two main parts: general information about the interviewee and PM practices adopted in the project. The interviews were not limited to the set of questions. Interviewees were also encouraged to share their opinions on the management of public projects in the construction industry.

Those who were directly involved in the PM of the two hospitals were interviewed. Interviews were conducted face-to-face or through e-mail. The face-to-face interview provided interviewees the opportunity to further explain and expand their answers. E-mail interviews were conducted only when the practitioners' busy schedules did not permit face-to-face interviews. E-mail interviews provided the flexibility for interviewees to respond in their own free time. The personal details of the interviewees are shown in Table 1, while project details are shown in Table 2.

Secondary data were collected through an archival search. Project information was obtained from published data, news reports and project files. Information obtained from the interviews was examined through the cross-case synthesis method to enable data from each case study to be extracted, compared and contrasted, and in turn new knowledge could be developed [19]. The collected data were first grouped according to the 10 PM knowledge areas and analysed within each individual case study. Subsequently, the data were cross-examined between the two cases and against the existing body of knowledge to uncover new knowledge.

**Table 1.** Details of interviewees

Hospital	Interviewee Code	Designation/Job Title	Experience (Years)
West	PM-1	Principal Project Manager	8
West	Arch-1	Principal Architect	12
North	PM-2	Director (Program)/Project Director	34
North	Arch-2	Principal Architect	12

**Table 2.** Project details of North and West Hospitals

Description	North Hospital	West Hospital
Location	Singapore	Singapore
Project type	Public Hospital	Public Hospital
Client	Ministry of Health	Ministry of Health
Funding source	Public funds	Public funds
Budget approval by	Development Planning Committee (DPC) comprising Minister for Finance, Minister for Trade and Industry and Minister for Health	Development Planning Committee (DPC) comprising Minister for Finance, Minister for Trade and Industry and Minister for Health
Estimated original & final project cost	SGD500 million (USD380 million) SGD700 million	SGD700 million (USD532 million) SGD800 million
Site area	34,000 m <sup>2</sup>	56,000 m <sup>2</sup>
Gross floor area	108,000 m <sup>2</sup>	169,000 m <sup>2</sup>
Total beds	550 beds	1,100 beds

## 4. Case study of North Hospital

### 4.1. Project information

North Hospital is a healthcare hub comprising a community hospital, an acute care hospital, and specialist outpatient clinics. The community hospital and acute care hospital are connected by skyline bridges to provide convenience and easy accessibility for the public, patients, and healthcare teams. This project took about six years to complete, from inception to its official opening, with the construction process taking about four years. It was awarded the BCA Green Mark Platinum Award for incorporating environmental-friendly features.

### 4.2. Project performance

North Hospital achieved high quality outcome as evidenced by the low amount of reworks. However, the project was completed four months longer than its contract period (5.6% schedule overrun). This was due to: (i) change and increase in scope of works; (ii) sand and coarse aggregate shortage due to

export ban by a foreign government; and (iii) inclement weather. In order to mitigate the delay, more manpower, machines and equipment were deployed, which caused the actual project cost to exceed the approved budget. North Hospital was completed at  $\approx$  S\$700 million (40% budget overrun). At that time, there was an overall increase in project costs in the construction industry owing to the high demand for construction projects and high cost of raw materials.

#### *4.3. Key factors that affected project performance*

The key factors that contributed positively to the quality performance of North Hospital are: regular site inspection for quality control; clearly defined roles and responsibilities of project team members; and effective communication channels and use of the latest communication technologies. North Hospital however suffered significant budget overrun, and this may be having due to: unclear project scope; absence of strategy when cost overrun occurred; irregularly updated and inadequate risk assessment.

### **5. Case study of West Hospital**

#### *5.1. Project information*

West Hospital is an integrated healthcare development comprising a 2-level basement, a 12-story community hospital block, a 16-story regional hospital block and an 8-story specialist outpatient clinic block. The three towers are linked by overhead bridges providing connectivity and access to public amenities. West Hospital was awarded the Building Construction Authority (BCA) Green Mark Platinum Award for its eco-friendly design. The whole project took about six years to complete, from inception to its opening.

#### *5.2. Project performance*

The project experienced about 6 months of delay (8.3% schedule overrun). The delay occurred in the construction of superstructure works which were attributed to: (i) inexperience of main contractor and project personnel; (ii) coordination gaps between contractor and consultants; (iii) additional requirements by stakeholders; and (iv) government restriction on import of foreign workers. West Hospital was completed at  $\approx$  S\$800 million (14% budget overrun). Due to the main contractor's inexperience in constructing healthcare projects, the quality standard fell short of expectations. Hence, reworks were necessary to resolve quality issues.

#### *5.3. Key factors that affected project performance*

The key factors that contributed positively to the performance of West Hospital were: well-defined project scope incorporating the inputs of relevant stakeholders; proper change control system; close monitoring and control of project cost and expenses; regular site inspection for quality control; clearly defined roles and responsibilities of project team members; adequate communication mechanism; and use of the latest communication technologies. The key factors that contributed to the poor performance of West Hospital were: inadequate risk assessment; incomprehensive evaluation criteria for contractor selection; and high turnover of project personnel.

### **6. Discussion**

**Scope management:** Both case studies adopted the same change control system, which comprised the Change Request Register, Notice of Variations Register, and Request for Approval to Order Variation (RAOV) Tracking Register. A superior change control system requires categorization of the types of change requests as well as the reasons for the changes (Khan 2006). What made West Hospital had better budget performance was that it had a well-defined project scope whereas the unclear project scope of North Hospital resulted in unnecessary changes leading to increased project costs. The finding confirms that a poorly defined scope negatively impacts projects resulting in expensive changes, quality failure, and schedule and cost overruns [3, 4]. Additionally, from West Hospital, early sign-off of the project scope by clients helped avoid major changes. Early freezing of the project scope brings about a reduction in delivery time and project overall cost [20].

**Time management:** The two case studies show that detailed master programs with clearly identified activities were prepared by project managers. The duration of identified activities was properly estimated and float catered for at the planning stage. Regular senior management meetings were adopted by both case studies to effectively mitigate further delay. However, delays still occurred in both case studies due to unforeseeable circumstances. North Hospital, which was delayed to a lesser extent had a control strategy implemented to minimize or mitigate delay. In West Hospital, additional personnel were deployed to closely monitor the main contractor's progress to arrest the delays. The close coordination with various authorities was important to accelerate the approval process.

**Cost management:** Both case studies use monthly cost updates to monitor and control project cost. This shows that the frequency of budget updates and the budget control system are the factors related to the planning and control of cost performance [21]. West Hospital was developed after North Hospital. Therefore, West Hospital had a more accurate cost estimate by referring to the cost analysis of North Hospital and making necessary adjustments. The lesson learnt from North Hospital is that if there is indication that the budget is expanding, strategic cost management measures must be implemented quickly to minimize the gap.

**Quality management:** Both projects had a set-out quality plan at the beginning of a West Hospital and these were used to determine whether the works carried out by the contractors met the required standards. The end products show that North Hospital had higher quality than West Hospital. The main contractor for West Hospital was a foreign firm which specializes in plant, power, infrastructure and leisure projects, and this hospital project could possibly be one of its firsts. On the other hand, North Hospital was led by a local-foreign joint venture. The foreign firm is famous for its high quality construction, and had track record of constructing major hospital projects. It was familiar in the types of quality control and site inspection to achieve high-quality performance.

**Human resource management:** In both projects, there was clearly defined roles and responsibilities of project members and integration of individual project team members. The regularly updated project team directory, which contains all project team members' contact information, improves the effectiveness of information exchange and enables the right personnel to be contacted. West Hospital suffered more schedule overrun because there was a high turnover among project staff. This created gaps in communication [11].

**Communication management:** Both projects show that an advanced electronic information system, enables the sharing, storage and retrieval of important documents. West Hospital used multiple communication means, such as e-mail, telephone calls, messages, and meetings, which enhances project team communication [22]. North Hospital practiced colocation of team members, whereby consultants, contractors and client representatives frequently spent a large amount of time in the same site office to discuss and iron out issue.

**Risk management:** The case studies show that the development of risk assessment must take note of historical data and current market situation so that potential risks can be identified and preparations made. Furthermore, close supervision and regular review and update of risk assessment serve to eliminate the unexpected risks that are not identified initially [15, 18].

**Procurement management:** The case studies show that the selection of contractors for public projects is not based merely on the lowest price, but also depends on the non-price attributes, using the Price-Quality Method (PQM) of assessment. However, the case studies show that although the PQM framework provided the quality attribute to be evaluated, it is necessary to create sub-attributes that are relevant to the project, and assign points for each of these sub-attributes. There should also be a critical

sub-attribute, such that if it is not fulfilled, the whole quality attribute should be rated zero. This would ensure that an incompetent contractor, who submitted a low bid, would not be selected for the project.

**Stakeholder management:** The case studies show that like other major public projects globally, the presence of a large number of stakeholders is unavoidable. High-level meetings involving relevant stakeholders were effective to resolve issues as they allowed requirements and constraints to be better understood by all. In addition, team bonding and value engineering workshops helped ensure that all stakeholders were working together towards the same goals and mission. However, there is a need to carefully select which stakeholders should attend meetings and make decisions. In West Hospital, the presence of periphery stakeholders added more requirements, created tedious procedures, resulting in conflicts and difficulty in stakeholder management.

**Integration management:** Both projects management integration by having effective communication and the establishment of common project goals and objectives. The case studies show that scope, communication, and procurement management are the most important management practices in Singapore's public projects. These three management areas are directly related to the time, cost and quality outcomes of a project.

## 7. PM Framework for developing and managing public hospitals

Based on the findings of the case studies, a PM framework for managing healthcare projects is designed (see Figure 1). As public clients play an important role in the development of their projects, it is recommended that they lead and persuade the project team to adopt the PM framework in managing public healthcare construction projects. It is recommended that consultants adopt the guidelines developed in Figure 1 on how to manage the construction of public healthcare projects.

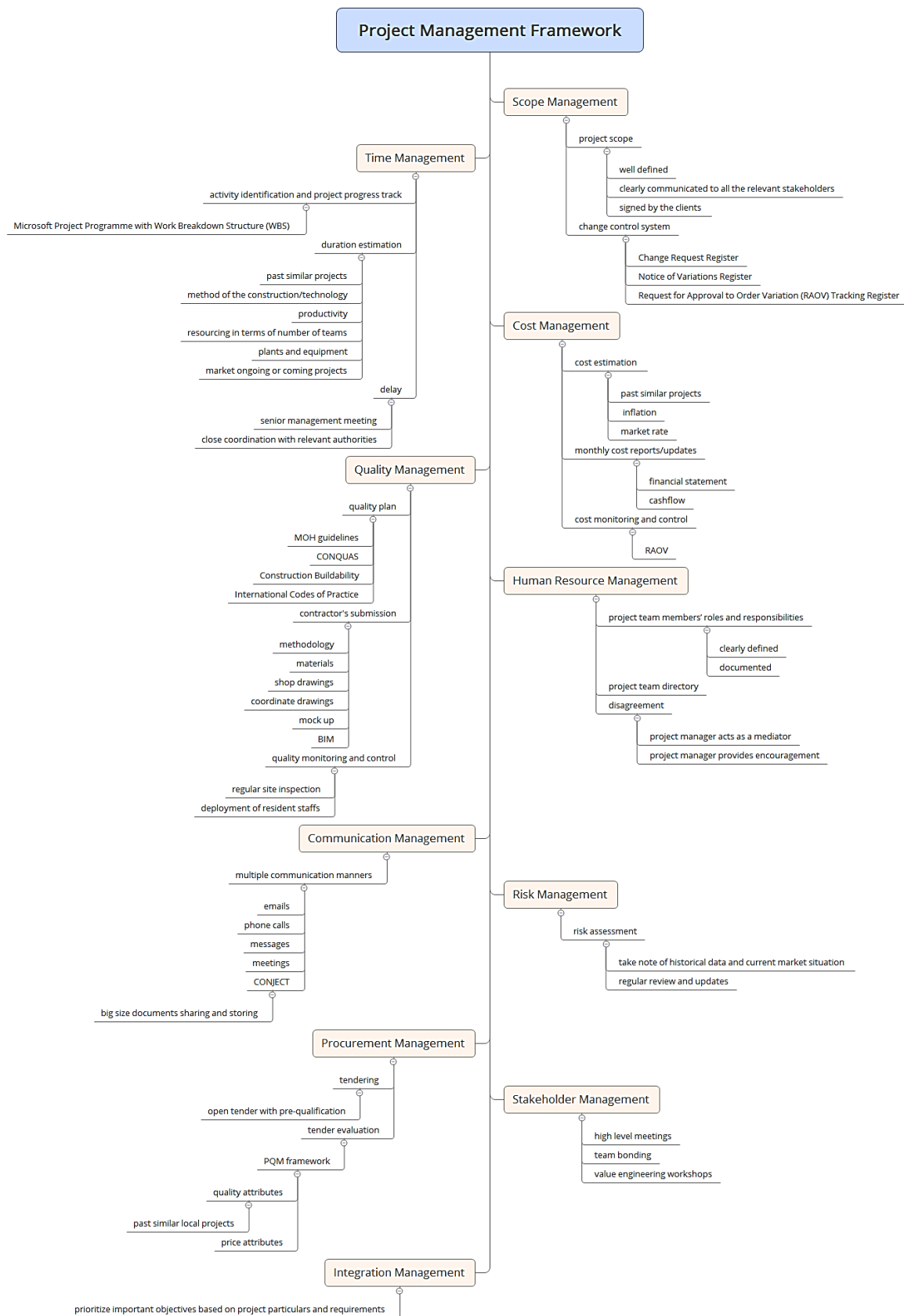
## 8. Summary and conclusion

Using the case study approach, the development and construction of two public hospital projects were investigated in detail. Interviews were conducted with the project participants involved in each project, including the project managers and architects. Cross comparisons were made between the two case studies.

The PM-related factors that contributed to the good performance of public healthcare projects are found to be: a well-defined project scope with the input of relevant stakeholders, a proper change control system, close monitoring and control of project cost and expenses, regular site inspection for quality control, clearly defined roles and responsibilities of project team members, an adequate communication mechanism, and the use of the latest communication technologies. Parallel to this, the key factors that lead to the poor performance of public healthcare projects were found to be: an unclear project scope, the absence of a strategy to be adopted when cost overrun occurs, irregularly updated and inadequate risk assessment, incomprehensive evaluation criteria for contractor selection, and the high turnover of project personnel result in project failure.

A PM framework for managing public healthcare projects in Singapore has been developed. It is recommended that public clients familiarize themselves with the PM practices in the framework so that they can encourage the whole team to adopt the framework.

There are some PM practices directly related to public clients, such as scope management and human resource management. In scope management, it is recommended that clients define a clear project scope before the execution of the West Hospital and not add to the scope once it is fixed. This will minimize changes during the construction process and avoid delays and going over budget. In human resource management, the clients must set clear roles and responsibilities for project team members to avoid disputes on the work scope of different members, which will in turn avoid miscommunication.



**Figure 1.** Project management framework for managing public healthcare projects



Consultants need to develop a proper change control system, pay close attention to the monitoring and control of project cost and expenses, conduct regular site inspection for quality control, and use an adequate communication mechanism and the latest communication technologies to increase the chances of attaining good project performance. Consultants should take full advantage of the findings of this research to manage future public projects.

It is important to select competent contractors to undertake the construction of hospitals. Contractor's quality offering should be given high weightage vis-à-vis the bid price. The quality attribute and criteria for evaluating quality should be specified clearly in the tender document. The public client should approve the quality criteria and scores before tenders are invited. Without specifying the criteria clearly, some of the important criteria could be missed out, resulting in the selection of an incompetent contractor who caused delays in the project.

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