

Design Process and Stakeholders Management in Airport Construction

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Abstract

This research explores the challenges associated with managing the design process in complex construction projects. The study focuses particularly on large airport projects, and their inherent complex stakeholder management during the design phase. The aim of this research is to propose a framework that integrates Design Process and Stakeholder Management in the context of Airport construction. The methodology adopted revolves around Modelling and Case Study techniques, to observe and analyse the existing situation and define the model's variables. In order to develop such a model, an in-depth analysis is carried out of the processes and design approach currently employed. The Process Protocol Model is adopted, albeit with necessary modifications, to address the research objectives. The validated and enhanced model provided a powerful tool for the design manager to administer and archive the information flow in airport projects as well as a framework for managing the stakeholders' requirements.

Keywords: Design Process, Stakeholder Management, Complex Projects, Airport Construction, Process Protocol

1. Introduction

The design of modern Airports Construction worldwide is considered one of the most complex construction projects nowadays. In such projects traditional design and construction management methods would be challenged to deal with the variety of Airport project components along with the advance technology used for airport operation. Adrem et al. (2006) add that airports design management difficulty is in handling the tremendous amount of information flow in all design stages, dealing with the various disciplines involved in Airport projects, managing the variety of stakeholders input and feedback in different projects' stages, and dealing with complexity of design and implementation of the project. Schaar and Sherry (2010) described Airport stakeholders as sophisticated with various interests in the airport building. Each stakeholder involved in the design of airport is seeking specific goal and objectives which put significant pressure on design managers in their attempt to balance between, sometimes, conflicting requirements. The technical complexity of an Airport project has a significant impact on the design process; Airport projects usually involve numerous and highly developed systems which require multidisciplinary teams' involvement in the production of the final design product. Managing communication networks during Airport

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design using more traditional management techniques usually results in considerable number of incidents of missing information and miss-coordination that could have a negative impact during construction. The handling of a complex project creates a challenge of managing a number of interlocked mini projects. Moreover, such projects generate many issues raised between the different departments representing different disciplines within the client organisation that need to work together to deliver the project. Wood and Ashton (2010) explain that such projects create difficulties in communication and handling of the flow of information generated as a result of the project complexity. It is argued that there is a need to have a generic framework that facilitate the management of the design process and the different stakeholders involved in this design process during the complex project life cycle. This study examines the main principles of design management in complex project, and focuses on airports design management process and stakeholder interface challenges in the various design stages.

2. Aim and Objectives

The aim of the research is to examine how to effectively integrate stakeholders' interests and requirement into the complex design process in Airport projects construction. The research objectives are:

- Investigate how information flows in the design of Airport construction project.
- Investigate the value and input of different stakeholders involved in the design process of Airport construction.
- Evaluate the effectiveness of an integrated framework of design and stakeholder management in airport construction as complex projects.

The research's proposed framework shall be able to:

1. Provide clear understating of different relationships interacting within complex building design process
2. Provide a guide for designers to consider the correct design criteria prior executing the design process of the project's elements which is called Design Task.
3. Provide a framework for managing design tasks and stakeholders requirement, and
4. Provide a base for interface stakeholders and their requirements within design process in order to achieve all parties' satisfaction.

3. Literature Review

The design process in both manufacturing and construction consists of solving series of problems and sub-problems (Cross 1989). Kagioglou et al. (1998) suggested viewing construction design process from the point of new product development process in order to improve the practices in construction such as coordination and communication between parties. Newton (1995) developed the Analytical Design Planning Technique (ADePT) methodology. ADePT provide a model for the Building Design Process indicating design activities and their information dependencies. Such data is linked by a dependency table to a Dependency Structure Matrix (DSM) analysis tool to define design process iteration and schedule the activities with the aim of getting optimal task.

Cooper et al. (2005) developed the Process Protocol (PP) based on contemporary problems facing construction sector. PP has six key principles developed from the manufacturing industry. These principles are related to recognised problems in construction where improvement is required and they are: whole project view, a consistent process, progressive design fixity, coordination, stakeholder involvement and teamwork, feedback. The PP model consists of 10 stages grouped into four broad stages as following: Pre-project stage, Pre-Construction Stage, Construction Stage Post construction stage. The PP groups the project participants into 'activity zones'. These zones have multi-functional role and represents structure sets of processes and tasks that direct and maintain work in the direction of a common objective

Gidadio (1996) explains that complexity in construction is characterized in the need to develop many details to reveal how to execute the work. Moreover, complexity needs a logical link between the different activates as a complex projects always run into a number of modification through the project construction. Without studying the link between different activities it becomes hard to update the programme successfully in the most competent way. Gidado (1996) goes into more details and organizes the source of complexity factors that affects the objectives of managers in construction into two groups:

Factors A: that interacts with the inherent components in the operation of individual task and initiate from the environment or resources employed. Factors B: that handles the components originated from bringing different parts together to form a work flow. Wood and Ashton (2010) categorized complexity factors in five themes as following: Organisational (people involved/ relationships), Operational and technological, Planning and management, Environmental, and Uncertainty.

Airport Construction as Complex Projects: Adrem et al. (2006) investigated the characteristics that makes airport different from other construction projects. Usually the specific project is owned by certain facility management organisation within the airport that is responsible for managing and developing all the airport's building and land. However, to execute the project input from several key stakeholders in the organization is needed. Such stakeholders would be concerned with optimizing the design according to their own, sometimes conflicting, priorities. Security elements are the most challenging obstacles facing airport project during construction. Adrem et al. (2006) explained the issues of logistics inside the airport, driving vehicles, security checks for equipment, safety regulation, restricted working hours, work notification procedures, and many other construction factors which should be planned during design.

Chinyio and Olomolaiye (2010) evaluated the Design Process Model and stakeholders management, they found that effective stakeholder management improves capability in relational issues and reduces risks therein. Delivering a successful project requires design managers to manage the multiple stakeholder interests throughout the complete process of project management (Sutterfi eld et al. 2006). For successful management of stakeholders in complex projects Carroll and Buchholtz (2006) suggest the need for clarity on who the stakeholders are, what stake they have in the project, and, the opportunities, challenges or threats do they present, what responsibilities we have towards stakeholders, and finally the strategies or actions to engage our stakeholders. Clarkson (1995) emphasised the importance of having processes and modes of behaviour that are informed of the concerns

and capabilities of the different stakeholder and, consider a fair allocation of the corporate benefits activity among them. Moreover, it is very important to acknowledge the potential conflict between the expected roles of the different stakeholders through open communication.

Airport Stakeholders Perspective: The nature of airport terminal stakeholders has significant influence on the design process due to the long list of stakeholders and the variety of their requirements Schaar and Sherry (2010) presented a model (figure 1) that shows a complex network of the relationships between airport stakeholders. The model consists of airport organization which consists of Airport Management and Operations and Airport Infrastructure. The service providers are the main entity that deals and interact with the airport infrastructure while passengers use this infrastructure to interact with service provider. The model provides two outlines to the airport: Airport organizational boundary and airport service boundary, in addition to that, capital improvement bill payer-'s' boundary, local economy and community boundary; Airport's organizational boundary defines the limit of what is controlled by airport management. Schaar and Sherry (2010) explained that this can control the design matters related to configuration of airport infrastructure and the operational procedures and efficiency of its own organization.

The research would argue that advanced design management models such as AdePT and PP have the potential to address the challenges of design process in complex construction projects, such as airports, with numerous number of building components.

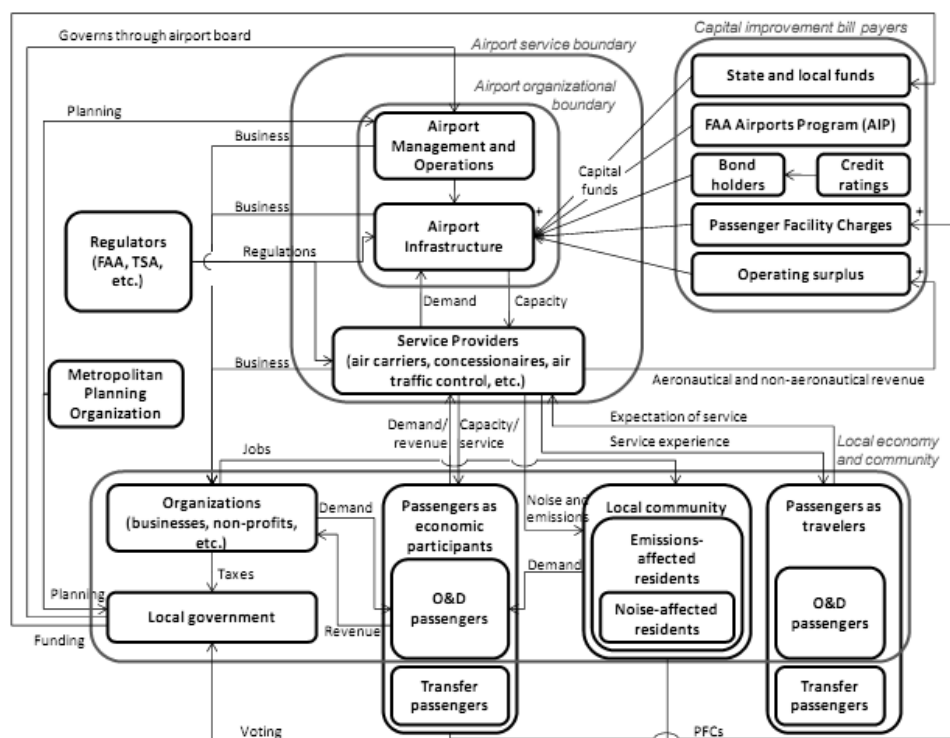


Figure 1: Relationships between Airport Stakeholders (Schaar & Sherry 2010)

4. Research Methodology

The research has reviewed current practise in Airport design management by examining documents, conducted interviews, and sought the opinion of professionals and practitioners who were involved a newly completed passenger terminal project and are currently working on existing expansion of the an Aircraft Concourse project. The interviewees included Architects, Engineers, Construction Managers, and an Airport Operation manager. These Interviewees were from the Airport Construction Authority, the Consultant, Contractors, and Airport Operation Managers. These interviews produced narratives, provided direct observations and allowed detailed document analysis. Later, these narratives are presented again to the participants to verify the narratives findings. The results were used justify the adoption of a model that facilitates the effective design process.

5. Case Study Brief

The case study analysis is conducted in a Construction Authority (CA) responsible for constructing and delivering one of the largest Airports in the Middle East. The findings are taken from this organization experience and interviews conducted with 10 staff and managers working inside this organization, 5 Engineers working with the consultants, 6 Engineers working with the contractors and suppliers who are working with this organization and having a wide experience worldwide in working in the construction of international airports. Moreover, 7 managers from the stakeholders in that particular airport are interviewed as well. CA role is a combination of providing approvals for the buildings inside airport premises as well as the project management role of the airport projects. The CA goes more in-depth in the details of design, procurement and implementation of the project, and CA is the government representative for project finance and payments.

Based on the knowledge built in the literature review, the analysis of the case study is conducted through series of questions developed in order to examine how the airport as complex project is handled in the Construction Authority.

The questions are focused on the following:

Complexity Management: the management of a large number of airport building components, dealing with different design packages interdependency, dealing and managing the sources of complexity

Design Process Management: the framework of the design process, management the design process between different departments, the overall design process of the project and collecting the project's data

Design and Organisational Structure: the role of the different departments and their relationship to the design process as well as with the consultants and stakeholders

Design Management Discipline: the role of the design manager in the CA, how far it extends beyond the traditional design management tasks.

Stakeholder Management: the roles, responsibilities, and requirements of the stakeholders. During the interviews further ideas and examples are identified and considered.

The accessibility to project documents is possible through the direct involvement of the researchers in the project.

6. Analysis of Existing Practices in Managing Airport Construction

The analysis of the design process followed in this case study seems to suffer from the following Problems:

Early Involvement: The process to develop the design is restricted to the design team without involving the CA's Construction department nor other contractors or suppliers. Several incidents showed that the formal involvement of such parties is required but in practice such involvement occurred informally through the personal relationships between designers with the suppliers.

Document Control: Document control part is only limited to the formal correspondence while most of the disputes or arguments tend to happen through informal channels. Moreover, it is agreed during interviews that using emails and minutes of meetings have their limitation in terms of the ability to retrieve the data from the archive.

Design Process: It is noted that there is no description for the processes taking place inside Development & Master Planning department and consultant. Interviewed managers could not show a clear description of how the design of a particular part of the building is executed nor a manual on how to handle the different parts of the design components. Although emails, design brief or minutes of meetings might describe the design considerations that need to be addressed during the design of that part of the building, however retrieving what decision was taken about a particular part is not an easy task. In conclusion the design process lack of clear updated manual or criteria for designing airport project elements.

Role Definition: The role of each department is not defined clearly. Many of coordination tasks happen on many levels therefore there is overlap of responsibility in taking decision. One of the Architects gave example of deciding the procurement method which is officially the role of procurement department while all other parties such Construction department, D&MP and Engineering have an input in such decision. It is concluded that the coordination between different departments and disciplines is executed but not identified.

Design Phase Flexibility: In terms of dealing with design phase flexibility, the implemented process shows sequential approach to the design process which means that each stage is rigid and its requirement shall be fulfilled before proceeding to the other stage. However the real practice is not like that as explained by the Architecture manager. CA tries to overcome this concept by issuing conditional approvals to make the design stages flexible.

Handling the Source of Complexity: The way the design process was set does not identify the sources of complexity in the project and doesn't address how to deal with it in the design process; such as detailed coordination process between disciplines, administrative procedures and documentation. Moreover, there is no clear description of such procedures in other documents.

Organizational Complexity: The process suffers from organizational complexity shown in the complicated relationship between the different parties, the large number of stakeholders, and the complicated decision making mechanism that needs input from many departments. This is observed in the long time required to release official document for design submissions.

Managing Complexity: The documents and manuals do not address the planning and management complexity such as handling the large number of elements in the project, handling the timeline of the project and managing the acceleration of the project.

Defining Requirements: There is no guideline for defining the project requirement and design criteria at the project initial stage; which Chief Architect explained to be critical for project success..

Stakeholder Management: End-user approval of design is essential part in the design process. However the level of end-user involvement in the design process sometimes does not help the smooth running of design process, moreover it is not clarified what the end-users are specifically approving. Establishing design criteria and end-users requirement is not given adequate attention at design brief and not organized, Airport design standards sometimes are limited in establishing such criteria as the operational requirement might be changed between airports. Documenting the followed design criteria based on stakeholder decision is essential and is in the favour of all parties. However it is observed that there is limitation in the traditional implemented practices such minutes of meetings and emails. The above identified problems necessitate the introduction of a framework that facilitates a coordinated action for an effective design process.

7. Design Process and Stakeholder management Model

This research faces limitation in applying ADePT from Airport sub-project perspective stakeholders' management, and the organizational framework of complex project. The application of PP model on the case study provides a solution for the generic frame work of the case study and it would represent a very useful tool in different levels such as the organizational, knowledge management and managing multidisciplinary from one side, and it provides an area for Stakeholders management integration within the design process, and managing design tasks. It was found that PP model can be adopted considering the following additions and modifications:

Replacing Facility Management with Stakeholder Management activity zone:

Having facility and operation managers within the design process is very costly to the CA; The tasks related to stakeholder given to Development Management zone as explained by Cooper et al. (2005) will be given to Stakeholder Management zone which will extend the stakeholders coordination through the project's life cycle.

Considering Detailed design process: It is proposed that while a designer is working at the task level of the design process, he/she will visit the master list of stakeholders and address the stakeholders affected by his/her design decision as illustrated in (Figure 2).

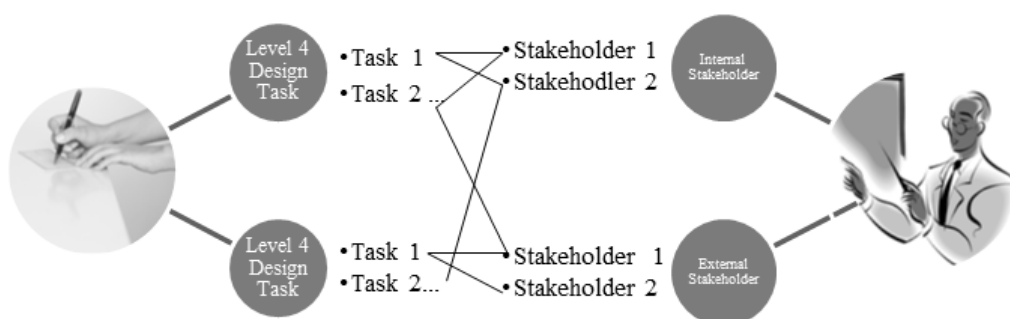


Figure 2: Stakeholder Interaction with the Design Process

While a designer is working on the detailed task level he/she will come up with issues not addressed in the design criteria or design guideline. Therefore, the designer will update the design criteria which will contribute in building the design manual of that part of the project the designer working on. The later designer can send the proposed decisions to the stakeholder managers who will coordinate the approval of these changes. The task of preparing the list and getting stakeholder approval is collaborative work between Design management and Stakeholder management zones. It should be considered that the approval on design decision is judged by balancing the point of view of all involved parties. Once the design decision approved it will be documented in the IT software and added to the design criteria which will be used for similar future projects.

Addressing the Multi sub-projects issues: PP will be considered for each sub-project at the airport terminal to avoid the complication of mixing different disciplines works from technical and procurement point of view. This segregation can take place at Phase 4(Outline Conceptual Design)

Adopting Stakeholder Management Strategy: The Stakeholder management strategy was achieved through: Producing Generic Airport Stakeholder list, Define Internal and External stakeholders to the design process, Develop stakeholder power – interest matrix, Produce design process stakeholder list. Identify stakeholder requirement and needs from the design process, and Define tasks and deliverables of the Design Management and Stakeholders. It is found that stakeholders of the design process in the case study can be classified as shown in Figure 3. The internal stakeholders are the departments who are producing the design and interacting with the external stakeholders to make sure that the design is meeting their requirements according to their power and interests. In this case study, CA is representing the neutral organization which tries to find balance between all involved parties requirements. The power of the involved parties varies according to their needs. The Local airline carrier in the case study is the most important stakeholder since the airport is being built to fulfil the business expansion needs of that entity. Also, the airport operation needs are important in order to meet the business requirement of these stakeholders. Commercial organizations such Duty free are also very important since they provide significant revenue. The government funding authority has a high power since it provides the capital for project execution; however, the design process is not their main concern since it meets the allocated budget. Governmental federations such as the police, immigration and customs are in a similar situation. Business organizations such as food outlets operators and foreign air carriers have an interest in running their business at the airport; although they usually do not have power to influence the design process, it is important to provide them a facility that attracts their business and provide them with adequate facilities. Passengers, communities and NGOs don't have direct impact on the design process. However it is important to keep an eye on these stakeholders since they are providing the data index to the design process.

Based on the case study stakeholders' management observation discussion and literature review, a map of design management and stakeholders' task and deliverables in each design stage is developed. This map is achieved through collaborative work between consultant, CA and stakeholders. This map addresses the issue of pre project activities, design brief and design criteria. Moreover it presents a control point through forms and

reports that can control the project documentation. Table 1 shows a matrix of tasks and deliverables of CA and Stakeholders in the initial phases of the project.

Example of applying the model in preparing initial statement of needs:

This stage is part of Phase 0 which is the demonstration of needs phase. The first task in this stage according to Salford University (2002) is to develop Initial Statement of Needs as Level 1 of the deliverable. Level 3 and dependency stakeholders are shown in Figure 4. In order to define the Level 4 and 5 of tasks involved, a table sheet has been developed in order to identify the lower level of the tasks, time required to complete the tasks, stakeholders' dependency, and result of the conducted task. The example shown in Table 2 shows the Level 3, 4 and 5 of "Discussing Business Requirement" presented at Level 2. It is proposed that this schedule will be linked to a software that records these tasks and stakeholders' dependency and the input of each task will be saved in the project history and the process manager will add the results that come from that task to the initial report of the design criteria which will form a contract between different stakeholders. These design criteria will be developed further through the progress in each phase of the project and it will end up at the end of the project by developing a manual for the design of this airport. By adding the time to this sheet a planning schedule will be formed and the high level task manager will have an idea about the completion date of the high level task.

8. Model Validation

Model validation is done by organising focus groups to present the developed model to experts who can provide their own judgement as to the comprehensiveness and usefulness of such model. Three meetings are conducted for three groups, where each group consists of 2 to 3 members. All participants agreed that the modified model and the application example showed is generic and describing the complete design process of the Airport design from wider point of view than the existing practice. The described activity zones simulate the discussions conducted between different disciplines in each phase to take decisions about the project however in more systematic manner. The stakeholders' management strategy and the matrix of design management – stakeholders' tasks and deliverables gained the participants acceptance and it is agreed that it represents a clear framework for the relation between stakeholders and design management.

Many participants agreed that the idea of decomposing the design process into documented individual task is a useful way to record the design process and save it in the project history and design criteria which will contribute to solving the issues related to information management and design standard. Some of the participants stated that this model is valid since that the CA is implementing the stakeholder management and design task management using traditional tools without the aid of software that records the design tasks and stakeholders inputs. Issue is raised against the organizational matrix of the different disciplines. The suggested teams seem to be adding additional complexity to the project organization. Hence such implementation requires more studies on the organizational levels. Additional concerns raised regarding managing the complexity of the coordination network between different disciplines and stakeholders when tasks and stakeholder list become more complicated, therefore it is suggested to have a clear framework that describes the IT

solution provided to manage this network and how can this IT software being extended to manage the different activity zones including change management. Some concerns were raised about the culture of the employees in the CA, such model might be resisted by highly experienced staff used to the traditional way. The result of this focused group revealed that the adopted model for design process and stakeholder management is valid and can represent the design of Airport construction as a complex project. Extending the scope of the IT software, studying the organizational implication of implementing the model, and defining the structure of the process documentation framework needs to be developed further

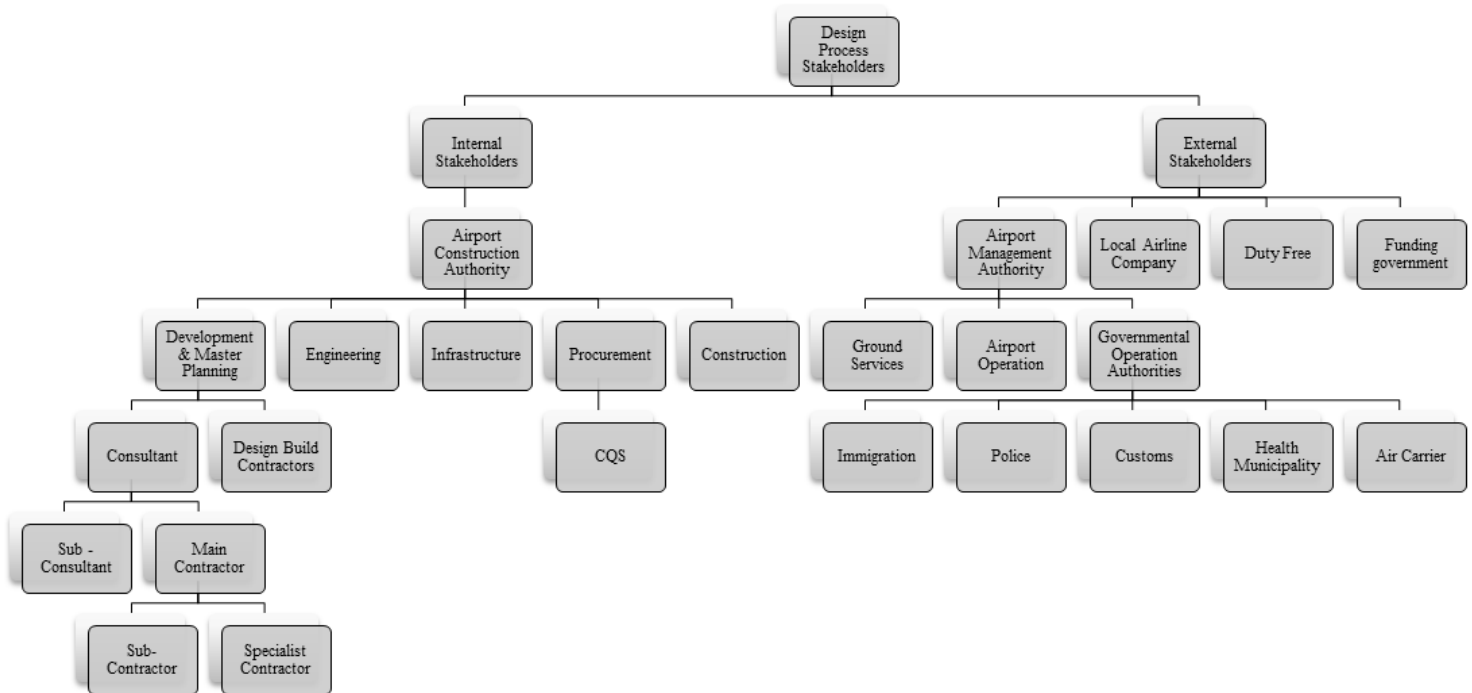


Figure 3: Internal-External Stakeholders to the Design Process

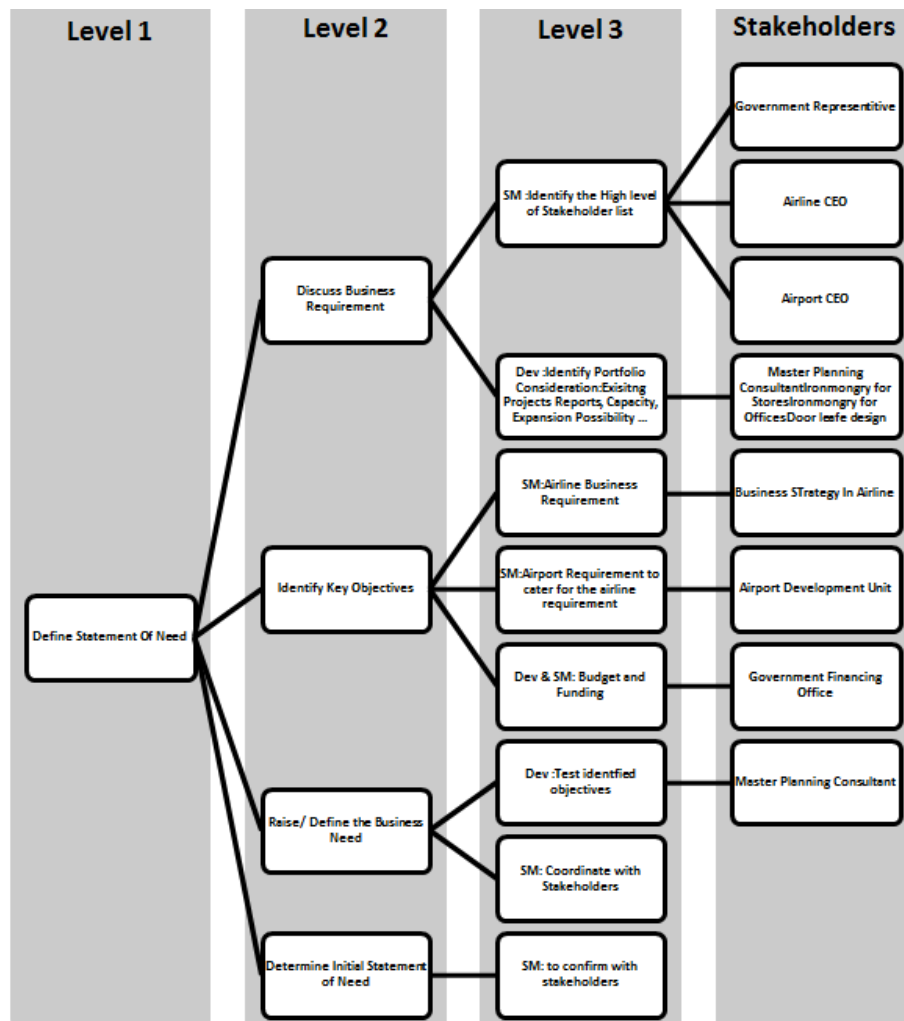


Figure 4: Level 3 of Details and Stakeholders List Matrix

Table 1: Tasks and Deliverables of Design Management Authority and Stakeholders

Stage	Design Management	DM Deliverables	Stakeholder Tasks	Stakeholder Deliverables
1 Identification of Need	Depending on operational or planning requirements arising for DM or stakeholder.	Strategic Brief including 'opportunity identification plan' and early cost	Identification of business requirement through strategic planning or operational feedback	Project initiation letter to DM Form 1
2 Feasibility Stage	<ul style="list-style-type: none"> Pre-feasibility Assessment Collection of data. Any other necessary pre-conditions Requirement management Macro analysis 	<ul style="list-style-type: none"> Project Charter* Solution Brief / Project commitment which clearly articulates business scope, cost, business quality and time targets for a solution 	<ul style="list-style-type: none"> Goals and objectives Initial commercial input Business case formulation 	Initial Data Report Form 2
	Developing Solution / Project Brief <ul style="list-style-type: none"> Feasibility analysis Defining: <ul style="list-style-type: none"> Options (strategic choices, strategies, policies...) Practical solutions (constraints) Defining direction What to be constructed? What is the budget? Codes, regulations, guidelines and standards governing the solution 	<ul style="list-style-type: none"> Data Collection Report Report 1 Feasibility study Report 3 Project Brief Approval Form 3 	<ul style="list-style-type: none"> Gathering and consolidation of initial stakeholder input Production of traffic forecasts (annual/seasonal/ design day schedules) 	<ul style="list-style-type: none"> Data Collection Report (Stakeholders)* Report 2 Business Case including: <ul style="list-style-type: none"> Level of service definition Operational considerations and regulations input
3 Project Design Brief Stage	<ul style="list-style-type: none"> Development of the Design Brief. Sketch ideas, moods, key finishes and color palette. Preparation of budgetary estimate and preliminary cash flow forecast. System consideration (integration) System optimization Generating concepts Evaluating Concepts Design criteria for project elements 	<ul style="list-style-type: none"> Project Design Brief Report including design criteria Report 4 Budgetary Cost Report. Report 5 	<ul style="list-style-type: none"> First level operational simulation Initial production of facility requirements Stakeholder review and feedback to the Project Design Brief Report Review and analysis of Budgetary Cost report 	<ul style="list-style-type: none"> Consolidated stakeholder feedback on Project Design Brief Report Form 4 Stakeholder Financial Assessment of Budgetary Cost report. Form 5

Table 2: Level 4 and Level 5 Tasks Sheet

Level 3	Task owner	Time	Level 4	Time	Stakeholder dependency	Result	Level 5	Time	Stakeholder dependency	Result
Identify the high level of stakeholder list	Stakeholder Management	7 days	Define government representative	7 days	Government	Assign VP Funding				
			Define Airline representative	7 days	CEO Airline	VP Business strategy				
			Define Airport organization representative	7 days	CEO Airport	VP development				
Identify portfolio consideration	Development management	7 days	Provide fact sheet about existing facility	7 days	Master planning consultant	Report				
			Study the ability to expand the existing facility	3 days	Development Management Master planning consultant	Level 5	Study apron plot	3 days	Infrastructure Department	Report
							Study the capacity of child water utility	3 days	Mechanical department	Report
							Capacity of transformer	3 days	Electrical department	Report
							Network expandability	3 days	IT	Report
							Baggage handling system	3 days	SAS	Report
			Study existing operational constraints	5 days	Stakeholder Management	Level 5	Initial report of end-user complains	5 days	Service provider	Report
								3 days	Airport operation	Report

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9. Conclusion

The modified PP model addresses the issue of stakeholder management through presenting the Stakeholder management activity zone which deals in coordinating the requirement of different stakeholders in the project from one side, and identifying the targeted stake holders of the design task from the other side. The modified PP model seems to be able to help addressing the decomposition of top levels of the project into sub-projects that can be further decomposed to different levels according to the sub-project complexity in order to reach the individual design task that helps coordinating different disciplines and stakeholders. The work in this paper although specific to Airport projects the proposed framework can be considered for projects that are technically and organisationally complex.

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