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**MEGA PROJECTS - STRATEGIC DESIGN MANAGEMENT, TIME FOR A
NEW FRAMEWORK**

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requirements of the
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"we see that construction has two choices: ignore all this in the belief that construction is so unique that there are no lessons to be learned; or seek improvement through re-engineering construction, learning as much as possible from those who have done it elsewhere"

Nissan UK (Part of John Egan Report 'Rethinking Construction' 1998)

MEGA PROJECTS - STRATEGIC DESIGN MANAGEMENT, TIME FOR A NEW FRAMEWORK

ABSTRACT

In a complicated and fierce ever changing economy the Built Environment endeavours to work with, coordinate and advise key Stakeholders; more focus is required on coordination and communication for the Management of the iterative design process and is intensely apparent. Lead Management must provide fresh innovative solutions with a robust capacity revived to guide and manage emerging economies worldwide. In the last decade Companies have conformed to the latest electronic tools status quo but relaxed with their 'In house' strategies. By observation and comparison they are all much the same. Strategic Design Management (SDM) has lost its capacity to act as a fulcrum to guide Design Management (DM) with very little evidence of re-acknowledgment or improvement to the process. It is clear that SDM Innovation is absent. Within the Construction and Design Consultancy industry it is typical of a 'Them and Us' scenario, Contractor, Design Consultant, irrespective of a good or bad interrelationship.

An Innovative framework with new processes and protocols is required. The electronic age has rapidly accelerated hardware that now exemplifies and eases many processes from, Design, Building Information Modelling (BIM) to Engineering inspection (I Pad PC Tablet) The resultant factor entices many forms of management techniques to 'Bolt on' where required to resolve design objectives and supply information for Construction in lieu of utilising innovative SDM approaches.

With further research, analysis, theory and ramifications an applied pattern is expected to emerge that will become apparent and can guide the future of

effective coordination protocols and strategically implement, ease, and define a better understanding of DM and its use as a device to resolve coordination of the design iteration process within the Industry worldwide. The Middle East and North Africa Regions (MENA) management protocols are similar to the West but construction ethics are totally different. The birth of a new conceptual framework is required to the mutual benefit of all Consultants and Construction Personnel, and there is evidence in the MENA Regions and Europe with emphasis on Programme, Quality and Cost that a further understanding and basis for an organised study between the processes is required; the development of an improved SDM Framework that will facilitate better DM coordination, and clarity in appointing the specialist Design Disciplines and Contractors alike is required and highly recommended.

By focusing on Management within the Construction Industry, Owner Stakeholder, Consultancy and Contractor, and by research analysis and comparison it is expected to identify significant gaps that can be reviewed with conclusions and recommendations to implement new SDM Processes and Protocols to reduce impact that has had significant adverse effect on many Projects in the last Two decades. It is also expected to identify the commencement of a much larger framework requirement which will potentially improve the Industry and provide a better future understanding of the essence to SDM and how it supports DM.

Key Words:

Middle East, Mega Projects, Strategic Design Management, Stakeholder, Coordination, Framework.

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And further thanks to my friends and colleagues and professional Institutes to which I belong and continue to gain and share professional development;-

The Chartered Institute of Building

The Chartered Institute of Architectural Technologists

The Chartered Association of Building Engineers

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LIST OF ACKRONYMS

Abbreviation	Connotation
SDM	Strategic Design Management
DM	Design Manager
P&P's	Process and Protocols
JVC	Joint Venture Contractor
BIM	Building Information Modelling
MENA	Middle East and North Africa
GCC	Gulf Cooperation Council
ORs	Operating Rooms
ICU	Intensive Care Units
PACU	Post Anaesthetic Care Units
DNA	Deoxyribonucleic Acid
LOD	Level of Design
QAQC	Quality Assurance and Quality Control
QMP	Quality management Plan
DQMP	Design Quality Management Plan.
PMC	Project Management Consultancy
DBM	Design Base Memorandum
BSI	Building Standards Institute
MEP	Mechanical, Electrical and Plumbing
FIDIC	International Federation of Consulting Engineers

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AUTHORS PERSONAL STATEMENT

The following statement explains the rationale behind the need for Strategic Design Management and the journey of this dissertation. Design is generic and a part of everyday life and that everybody wants to be involved with one way or another. Cooking, making a sandwich, you are designing. And so Design can become complicated and always remains interesting especially in industry to include Construction; everybody wants to be involved. But the initial Design that started on a Napkin over dinner with the Owner becomes a Design by an

entrepreneurial Architect followed with support from all Design related disciplines. Enter a Mega Project Development and the Napkin Design becomes a team in many instances of over One Hundred staff.

If we focus on the Individuals – The Architect by example will remain solo during the Concept design phase and only coordinate with the relevant design disciplines when required and although aware of deadlines is only acknowledgeable to the delivery date and not a programme of how the team delivers. The same transpires for all other disciplines. Contractors work in the same way and have come a long way from Concrete Bricks and Mortar to Specialist Manufacturing Façade Engineering and Components equally as elaborate to building the Space Shuttle. But the Contractors evolution paves the way for 'In House' design and BIM, again sailing into the horizon solo. So communication, Collaboration and coordination become a challenge. The author has witnessed and experienced this for over three decades.

Clientele have not really changed much either. The Majority want their New Toy Yesterday and will even politically manipulate to gain their fast track requirement. And so Clientele sub-ordinates will work to the Strategic status quo to gain attention and obtain that new commission. Should the wheel be reinvented or is the status quo acceptable? Industry is rapidly changing and Innovation is becoming very much state of the art but unless there is effective Management the fast track innovative state of the art projects reach burn out. The Design Manager has a responsibility to manage the design process effectively, ever remindful though that Designing is Taboo and left to the Design Disciplines. It is managing between disciplines and Stakeholders and Contractors that becomes problematic. Getting all Stakeholders to communicate with one another is one of the many tasks that a Design

Manager has to fulfil. Programming a Design Team is also something that the Architect does not action although very little do. And so the assault course becomes apparent to the Design Manager.

Design Management has been streamlined in the last decade with the introduction of BIM but BIM reliance has resulted in what appears to be down scaling the Design Manager. Here lies the problem. The Iterative design process follows a Project Development from concept to handover and therefore design is involved in every aspect to include the major elements such as, Stakeholder Management, Design, Commercial, Planning, QAQC, Program Management, Process and Protocols and Construction. These elements also require communication with one another and so the Design Managers tasks are endless.

The Design Manager more often than not works with or alongside the Project Director of a Development whether with the Client Project Management Consultancy or Contractor, both positions are similar. But it is at Board level where the ultimate position of hierarchy with Design Management is decided. The Manner in which a Design Manager pursues his duties is not too dissimilar now to a Project Director and in particular circumstances can have a better understanding of the Project. Stakeholder Management is now more Knowledgeable with the Design Process but specific gaps that potentially create misdemeanours require support from the Design Manager. There is also damning reports across the Globe that Clients are becoming dissatisfied with certain aspects of project delivery involving Budget, Programme, and Quality. Therefore supporting and directing the Design Manager(s) is important to tackle and provide solutions to these problems. Strategic Design Management

consists of a framework of innovative elements that provides support to the complete design iterative process and goes further to correlate, coordinate and communicate with all management aspects of a development.

The Design Manager effectively coordinates and closes any gaps between any parties ranging from Design Disciplines to Contractor and Specialist contractors. From a Strategic element, Strategic Design Management also has a fulcrum of business analogies and has a calibre of Leadership. Here it is difficult to emphasise Design Management strategy without straying into more specific factors of Strategic Management. There is a plethora of literature on Strategic Management but limited with regard to Strategic Design Management. This is perhaps due to limited information on the direct subject in the last two decades.

Improvement and acceptance of a new framework strategy will overcome Clientele dissatisfaction and this dissertation commences a Journey with an objective to commence that framework. The dissertation has generic elements that proceed through literature review, Case studies, analysis, Conclusion and recommendations. The Authors professional experience is reflective and apparent throughout the dissertation which entwines academia with realism.

CHAPTER 1

INTRODUCTION

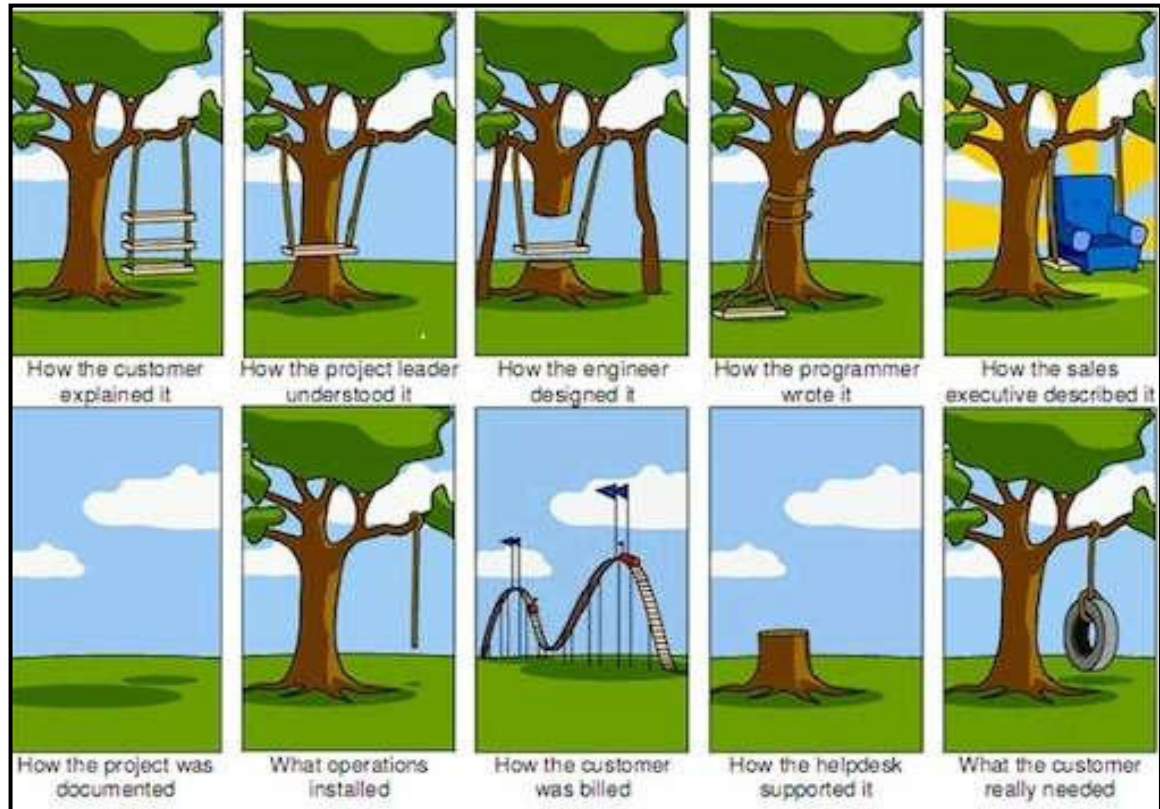


Figure Intro 1

We all like to send electronic Jokes to one another and one that springs to mind is the Design of a Swing on a Tree and how each member of the Built Environment visualises it. Truth be it, the visualisation of the Swing has never really changed. Instead there are many more ways in which it is visualised. It was seen from a pure design Perspective in its original invention and subsequently seen through the eyes of all construction disciplines until its actual realistic completion was inevitably unlike the original design. To add to the tumultuous situation it now includes BIM and how it was presented and coordinated which may also differ from the original concept Design!

Design within the Construction Industry has always been an evolving virus because everybody wants to design and 'freezing the design' in its original created form is taboo. It is taboo because it involves money and everyone hence cross pollinates the issue by changing the design 'cutting the cloth to suit' Management manages the design according to budget, quality and programme; Quantity Surveyors macro focus on budget, and the Stakeholders like or dislike the design iterative processes and often the result; And so there is a build up transgressing even the most simplest of designs such as a Swing. But what if the design did not change, perhaps similar to ancient Architects of Egypt where iconic monuments were built over a period of 500 years without change. Was it because the structure and scope of works were simple but the only struggle was the enormity or scale of the development? Programme was not a problem although budget at that point in time would have been trading assets in lieu of the Dollar.

Design programming would appear to still be part of the essence that is missing and misunderstood in Construction today together with the understanding and attributes required in coordinating the complete iterative design process. Architects in many cases provide a detailed design programme only to be rationalised by the Contractor who configures a schedule that suits procurement without knowledge of the design durations, later creating a hiatus of construction delays with the inevitable blame referred to the Architect for 'late Information' when originally the programme was implemented by the Client requiring a 'Fast track' programme only agreed with the Contractor during Tender bid. Once the contract is awarded to the Contractor, one could say that the Honeymoon period is over. These are harsh words but unfortunately realistic with many projects of today with Contractors

who do not have an inkling in terms of the design through partial fault of their own. Further, with specialist trades macro focusing on the design, additional detailed design lead in and manufacturing also contributes to further design change with the inclusion of build-ability and ultimate, Fit for purpose. A baseline strategy perhaps Generic in its form is required. The rectification is apparent but continues to ghost even though there is great potential for Clientele to provide an early fully integrated dynamic design and procurement programme agreed after freezing the design concept and sketch design period with more detailed Information.

Holistic design can encapsulate the complete design process at early stages of a Development providing sufficient information is available for Pre-Construction and commencement of Construction. This part framework invariably steers toward traditional construction contracts rather than the birth of contracts like Construction Management of the Eighties, but with new pioneering and Innovative technical designs of the future *the complexity steers toward a Strategic Design Management (SDM) Framework which streamlines all requirements to include Stakeholder. (For Hierarchal level of organisation refer appendix A1)* This is also supported by BIM, another robust design strategy that is finally emerging this decade.

The Developer can still maintain time quality and budget if only to allow a Framework to embed after concept and sketch design together with a realistic programme and a thoroughly understood clear contract agreed and implemented by all Stakeholders. The problem that developers face is that although they may require a Green state of the art building with intricate design that can sell or be put to immediate use by the public rather like the

latest mobile phone, the Developer has to evaluate where to begin. With a SDM approach the evaluation would have already commenced.

The Objectives of this Dissertation are;-

1. Provision of Integral Management Elements to support Strategic Design Management (SDM) based on literature research.
2. Based on two case studies involving the Author; to provide examples of the reflective elements that can use SDM.
3. Explore how Strategic Design Management can improve Design Management within the Built Environment
4. Initialisation of a Strategic Design Management Framework.
5. How Strategic Design Management supports Stakeholder Management

Commencing with the general literature the following chapter explains the basis of a framework and encapsulates Design Management, its Holistic requirement, BIM introductory along with interrelated dependencies and inter-dependencies such as Process and Protocols, Program Management, and subsequent potential improvement and performance of the Strategic Management process.

CHAPTER 2

THE BASIS OF A STRATEGIC FRAMEWORK

This Chapter explains the positioning of the Design Manager within the business organisation, the communication and the integral parts of Strategic Design Management (SDM) collaboration and the basis of holistic

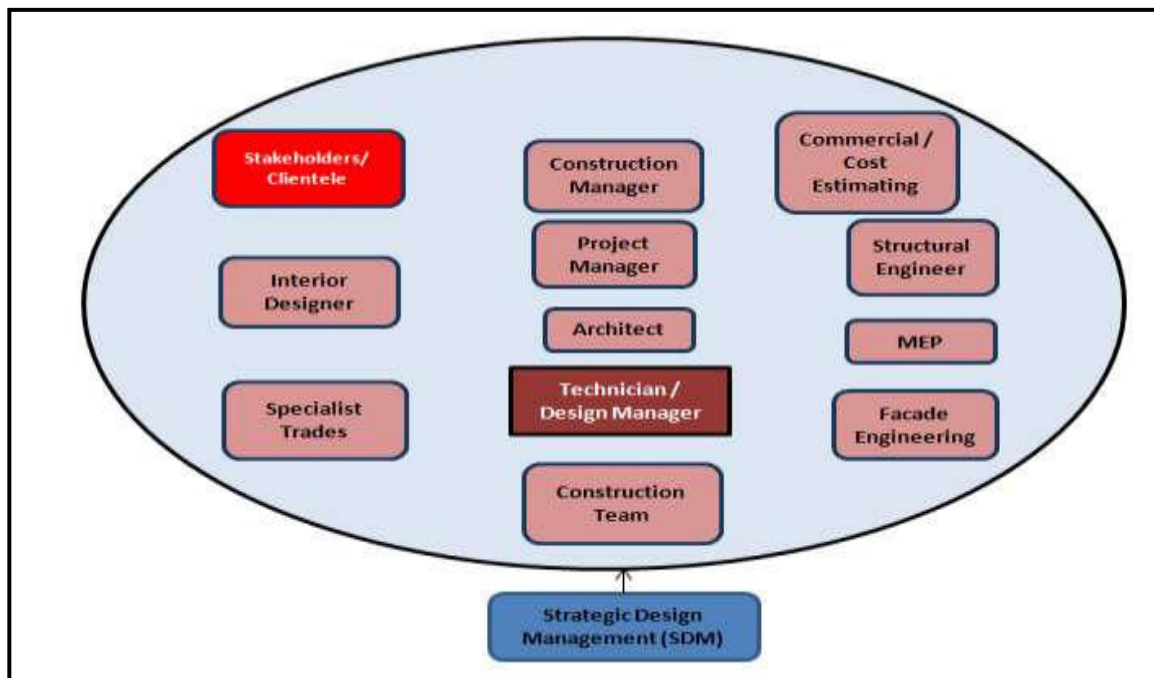


Figure 1. Technicians position within the team structure

approaches with its components such as BIM. Strategic Design Management focuses on being Strategically defined, recognizable, a set of activities and techniques that vary with each primary Integral element; Design, BIM, Procurement, Commercial, Planning, Program, Process' and Protocol Quality and Construction. One must bear in mind that the strategy includes establishing and periodically confirming the organization's mission and its corporate missions in setting goals and objectives, developing broad plans of action necessary to attain these goals and objectives striving to be extremely competitive while portraying a sharp clear explanation of a strong usable framework.

2.1. The Modern Machine, Co-ordinating Design.

Today's technological advances such as AutoCAD and BIM are tools that are required to produce Construction information that craftsman build to, and many design and construction issues such as installation clashes have now been diminished considerably. The Technician aptitude requires knowledge old and new to technically piece together details that combine and provide valuable design deliverables. The journey to those deliverables includes tributaries of information from fellow Design Consultants to include Structural, Mechanical, Electrical, Plumbing and Interior Design (Design disciplines) and the combination also requires critique, due diligence and sanction from a cost and Client requirement perspective (Jack, 2013) The Technician has a wealth of technical knowledge and a thirst for more which can quickly resolve many technicalities realistically both prior and during Construction. Hence Hard-line design information must be in its correct format to further provide integrated data such as Building Information Modelling. The technician is an example to team positioning and Figure 1 shows the position by example, shared with other team members who also share the same communication strategy. Beyond and prior to team positioning there should always be a project plan with an organisation chart consisting of all the team players, responsibilities, and Key deliverables for each of the players. Further, each player must have a good understanding of what each fellow member's responsibility equates together with who they report to and who reports to them and a clear understanding of the final Goals to be achieved. This is provided and rationalised during the agreement of Processes and Protocols. Is the Technician taken for granted, and should there be a greater understanding of Key issues that have been recognised and continue to be somewhat ignored?

Is the Consultants Practice 'In House' Project Design Manager (DM) and the full understanding and responsibilities of this role clearly understood? In essence the DM is the key to communicating priorities as well as arranging deliverables via the team utilising the same position shown in Figure 1. It is the Technician Leader that overcomes the pressure dealt to the Technician and how managing his team clears the way for a comfortable environment and better design output.

Essentially the Technician requires a team leader, the team leader requires a DM and the DM requires team leaders from each design discipline,

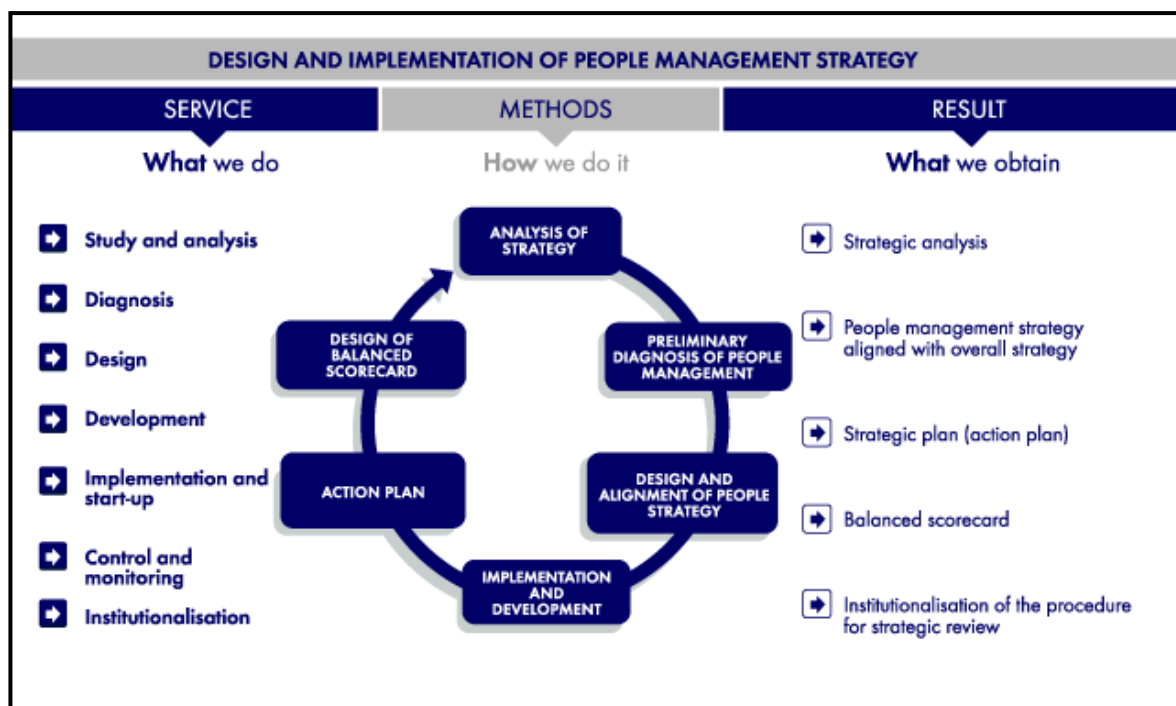


Figure 1.1 People Management Strategy

Architectural, Structural, Engineering services, Interior design, Infrastructure and specialists. The DM along with lead disciplines must create a fully integrated dynamic design Programme fully configured devised and agreed with all other Design Consultants, Construction and Trade personnel to include Client and Management to enable a better pattern of 'forward planning' the design works. The DM includes 'people management' and the Strategic Design

Manager (SDM) guides and sets protocols for the requirements and responsibilities (Figure 1.1)

It is the agreed deliverables that become part of the success to the project. The Design Programme must also integrate with Procurement and Construction Key performance indicators (KPIs) and KPIs will also be included within each Design Consultants deliverables. An effective and workable design programme is essential to improve co-ordination (Riley and Horman, 2001) between disciplines and exert managerial control over the design process (Bibby, 2003) the above factors are part of the ultimate DNA that forms a potential SDM framework.

2.2. Managing the Iterative Process Holistically

The difference between Design Manager and Design disciplines i.e. Architectural Design Manager is still not understood and acceptably defined



Figure 2 Holistic Strategic Design Team

(Emitt, 2014) Lead Architectural Management is defined in Practice Management and Project Management. The Design Office Management tends to provide a framework fit for purpose when a project commences. Lead Design Management (Strategic) supports Management of the design process, design transition into Procurement, Construction, through to Facilities Management of the building in use. It can be applied to the benefit of professional service firms and the total Construction process although it continues to receive little attention from the Client, Construction and Development industry. What are simultaneously escalating are the Clients understanding, timing and resources required for the iterative design process and a need to utilise specialist Design Management to oversee the design from a holistic approach. A success story is clearly evident from the Legacy of the Olympic bid leading up to the 2012 London Games (London Olympics 2012) which encapsulates, Design, Master Planning, Town Planning, sustainability, procurement, and Project and Programme Management. Clients tend to spend very little time with the design and initially only take advice from an Architect.

To manage any form of New Development requires a more holistic approach 'of greater understanding' A reasonable Client team may or should consist as shown in Figure 2. This is an example of the requirements at the commencement of a Major or Mega Project. The scale of the team is due to the multitude of tasks required to commence design and to prepare construction activities; to seek out the hidden problems in a proactive manner rather than reactive causing additional work and escalating programme and budget. Each lead discipline could have several subordinates that report regularly and lead personnel are coordinated by Directors and advised by Design Managers. The London Olympic Venue is a prime example where a

Team such as shown in figure 2 was utilised. Mega project Teams are far larger than project teams known of the past, accepting that projects were a lot smaller. Without having lead personnel only entices fault, delay and possible failure. This is one of the reasons for project failure in the MENA Region.

Key lead Managers need to also focus on new Innovative strategies and processes that suit today's Technology. The Process of Design; Pre-Construction, Procurement, Construction and Post Construction requires Change Management and a new strategy integrating the Design DNA generically. The Strategic Design Management DNA can only be realised with further research and future advice via seminars, presentations and the written (Media) The continuing Design Iterative process and its associated mechanics will only continue to create problematic tendencies leading to programme and budget breakdowns unless a new SDM framework is introduced. CIOB reported that many Clients were now dissatisfied (CIOB, Construction Manager, 2015) with over run programmes and escalating budgets.

Poor design Information and process performance has an effect on the subsequent construction activities. The majority of construction delays surmount to inadequate design and with poor information is more significant than site workmanship and management. This is generally attributed to coordinating and controlling the design process therefore requiring more rigorous Design Management for project success (Bibby, 2003)

With much respect to the Built Environment; Mistakes in the position agreement for a Design Manager are Tenfold and when we reminisce back to the late Seventies and early Eighties the Construction companies allocated Design Management to the Document Controller or Technical Manager who

may have an Architectural and or design background. But more often than not the position would be awarded to the Planner, Project Manager, Construction Manager, or Site Manager – Superintendant, all with professional expertise in construction but lack in knowledge regarding the full design process, design disciplines practice management and design personnel allocation. Complex designs and challenging process' are another factor, and the one anomaly that has forever struck the Construction Industry is Design Planning and a fully integrated dynamic design programme which encapsulates not only the design process but all procurement and sequence of construction that achieves building success. There are many avenues prior to construction that any of the above construction personnel would not cover hence the continuous 'Blame culture' that is seen within the industry even today – Late construction work – 'It was due to late and inaccurate design' It is possible to override this construction culture with a new framework of SDM. By focusing more on the design process, creating efficient design programmes and giving more advice on the strategic design element to Clientele, and working closer with Contractors and specialist suppliers is a definitive way forward.

2.3. Building Information Modelling (BIM)

Since the new Millennium BIM has become more of a focal point especially in the present decade. Companies within or associated with the Built Environment are adapting to suit the requirement of New Technologies and it is rapidly changing with Information that can now ultimately allow potential design and construction of 'Green' sustainable buildings that considers 'The Carbon Footprint' amongst many other challenges that will be self supporting and life cycle effective for many years to come. BIM can and should be utilised throughout the complete iterative design process from 'Cradle to Grave'

(Kouider et al 2009) There is a UK requirement with Government initiatives for provision of BIM within industry from 2012 (BIM Industry Working Group, 2011) and inclusion into every Major Project by 2016 (CIC/ BIM Pro, 2013) even though BIM has been around for the last decade. It provides a structure of Design Information that is relatively free of design clashes and moderates design clutter (Leon and Laing, 2012). It does not foresee the Iterative Design process holistically without the coordination techniques of the DM. BIM is an 'Information Model' and the overall requirement of the model can only be seen in the mind of the DM like a hologram.

Trade Contractor specialists are also under strain to comply with BIM inclusion and software is very expensive to allow electronic information collaboration; Dissemination amongst site craftsman is difficult but further electronic soft and hardware now exists; Printed design information still prevails although the Electronic Tablet (I pad) is rapidly being adopted. Through innovation printing components via BIM is now possible.

A feature of BIM modeling software is that it allows for phasing in the building process from concept design through to Facilities Operations. With the phasing the procurement model can be developed with all information produced generically until post tender and award of contract where working design becomes a phase of fabrication drawings and actual components that can be manufactured. It is important to populate such information so that later maintenance information is easy to establish (Information model) this allows the 3D space to occur without compromising the Geometry (Harty, 2012) it must be stipulated that this is a process. There is new software on the market however, with the design of mega projects the hardware requirements are becoming more and more sophisticated and software such as Revit is now

being stretched to the limit. Clients are also faced with a process that unless thoroughly explained leads to misinterpretation and potential additional cost especially when changes occur and the Contractor is providing the BIM working design. The BIM execution plan must be agreed during the Brief prior to award of contracts (BSI, PAS 1162-2, 2013)

Hierarchy are still very much reliant on their Managers to understand BIM requirements but further reliance down the ranks tends to return to the Design Technician (Chapter 2.) and all of the associated Consultants on the Projects. Therefore Company Leaders tend to not understand the process and protocols of BIM and fail to create a robust strategic policy. This can be considered generic across the Design and Construction Industry worldwide.

Leadership requires further acquaintanceship and collaboration with the Team and the likes of Specialist professionals with better communication, understanding and commitment to support the Specialist, further allowing Leaders to be more transparent and focused on creating a strategy that encapsulates design Information production utilising BIM to its maximum potential. Introduction of BIM at an early stage of Concept design (Leon and Laing, 2012) is but an example.

By further example; Health (Hospital) projects are the complicated pinnacle end of design and involves much more coordination. Hence the prime Master plan for the BIM delivery must accurately support 'Information' and build up of the Model with an agreed understanding by all Stakeholders. For Health projects this includes, end user, Clinicians, Doctors, Specialists and all support staff. A typical example of the design process for Operating Rooms - ORs (Theatre) can be incorporated into BIM as follows;-

LOD-Level of Design (CIC/BIM Pro Appendix 1; 2013)

- ❖ **LOD1 Concept.** The master plan that will require further design development and macro focus on divisional areas and departments. **OR's**, Imaging, Cardio, Accident and Emergency, Triage, Magnetic Resonance Imaging (MRI) this is basic layouts and several sketch proposals.
- ❖ **LOD2.** Sketch design. More detail following LOD1. The **ORs** require input and advice from the Stakeholders and the sketch design may be changed at least 3 times before finalising areas, equipment locations and the amount of equipment and all Mechanical and Electrical requirements to support specialist equipment together with floor wall and Ceiling finishes. All of this must be accurately coordinated and agreed.
- ❖ **LOD3 Design Development.** Further continuity of LOD 2 but with more technical focus in detail to encapsulate information for construction. Position and installation of medical equipment is also important and installation to consider weight factor and subsequent structural steel supports requires close coordination.
- ❖ **LOD4 Specialist Shop/Fabrication Drawings.** To be provided by the Specialist Contractors – suppliers. This is a further repeat of LOD3 but in such detail allowing Fabrication and installation. These drawings will be used on site.

BIM must be acknowledged as a tool for seeking out conflicting information and smoothing the design process journey, what it will not do is to manage that process. It is infinitely important to pre-assess the coordinated design

prior to getting to the LOD4 stage. Hence all services and finishes can be fully coordinated for an OR prior to construction. In succession BIM still requires strategic design process's and protocols i.e. for streamlining the reviews and adding more efficiency.

- ❖ **LOD5** is the 'As Built' Operation along with maintenance manuals; this information will have been included during the various LOD submissions but the final drawings will be subject to site surveillance and comparisons so that final installation drawings are accurate. This is especially important for maintaining ORs.

The Overall BIM strategy is gradually gaining momentum but further SDM inclusion is required to equate the misunderstood technicalities, if only to assist Stakeholders such as the Client in explaining the strategy easily rather than explaining a simple Personal Computer like NASA Houston Control. A Government report (BIM Industry Working Group 2011) stated that a BIM global cohesiveness was required and a risk of failure could occur without having an agreed strategic approach to BIM. Further that with future synergies the UK is in a position to Steer BIM with International efforts of implementation and mobilisation strategies. These actions would further require efforts in SDM to explain support and implement such protocol with Clientele.

2.4. Specialist Engineering

A Strategic Forum for Construction was established in the United Kingdom in 2001 as the primary point of collaboration between UK government and the major construction organisations. It enabled different representatives of the UK industry to discuss strategic issues facing the Built Environment and to develop joint strategies for industry improvement succeeding the Construction

Industry Board (Egan, 1998) and Changed in 2002 to an Independent Industry group (CIC, 2015) The Group does not speak on behalf of the entire Industry and further does not cover an International status. The Strategic Forums Structure covered major Key Sectors to include Clientele, Professionals, professional Institutes, research institutions, and specialist construction associations along with Contractors, product suppliers, manufacturers and site workers.

The Strategic Forum promoted and to monitored industry progress within six key areas; Procurement and integration, Commitment to people, Client leadership, Sustainability, Design quality and Health and safety. Considerable changes have evolved in the past decade with recent focus for example in Design Management. The Design Management (DM) philosophy can be well explained following recent research explaining that the management evolution from document control exchange through to Board Room Executive is apparent (Eynon, 2014) All Six key areas are very much the focus of DM and all aspects are included during the iterative design process to include BIM. Specialist Engineering Contractors will also encapsulate the six key areas and is an important set of functions during BIM LOD4 fabrication shop drawings. Apart from considering all the specialist trade contractors involved in Hospitals for example; the crucial specialists are Mechanical, Electrical and Plumbing (MEP) and Façade Engineering. MEP surmounts to a considerable amount of engineering services during construction of a Hospital project and the Façade has an important coordination integration especially for departments such as 'Skin and Burns' (Glass, environment, comfort, healing) the integration with MEP for low Carbon emissions regarding use of plant is also important from an environmental aspect.

All of the coordination aspects are crucial for the success of a Hospital project and acquire a streamlined SDM Framework to improve the design process. To focus more on SDM and inclusion into Hospital Health projects amongst other highly technical schemes more seminars, presentations and events are required to enhance and make the Built Environment aware of a necessary SDM framework. SDM is explained in more detail and its tributaries of management processes and protocols in the next section.

2.5. Processes and Protocols (P&P's)

British Standards (BS) 7000 Part 4; 2013 gives reasonable guidance on Design Management within the Built Environment and selects divisions of responsibility common to all methods in; 1. Clientele and the ongoing need for construction work involving design, 2. Design capability, build ability, established and distributed across organisations, 3. Development of Design produced by Clientele and described within a Brief. The Brief documentation along with the agreed contracts can be the success or failure of a project. Often the game players are too swift to fully comply and understand these two key factors leading to incorrect assumptions and subsequent arbitration with escalated budget costs and delays prior to project completion.

A hierarchy management function or organisation chart is shown within the BS but then only refers to its aspect for large projects and goes on to explain that the smaller the project the more direct responsibility is given to the individual who from a DM perspective puts the position in potential overload and risk. SDM can streamline this dilemma and provide a better design journey to success by coordinating and disseminating the design functions to the team rather than the individual while the DM has a general oversight in ensuring

that the design is functional and not compromised. The DM in effect has a similar function to the Architect but without designing.

BIM is becoming more and more significant within the Built Environment. Clientele tend to want to provide a comprehensive Brief written both by them and their defined consultants, however, there is evidence especially proven within the last Decade that many of these documents have failed due to misinterpretation or that technical information has been incomplete, incorrect or not included (Oracle 2011). The long term resultant factor is projects that are late, over budget or unsatisfactory when complete.

This is partly due to the vast change in Architects responsibilities. The Architect was once the main Interpreter of the design brief but now the Client and the like have become more involved, and so the function of the DM has increased especially in support of the Client. What is often not included is the strategic element. If an Architect can discuss design concepts with his team then the Design Managers should be entitled to discuss with fellow managers and a Strategic Design Manager; Consider that the Architect could be novated to the Contractor and Construction DM at contract stage and that a strategic route would lead to a better journey through construction by including and coordinating all design elements such as highly technical Façade Engineering or Mechanical Plant and Equipment early allowing sufficient time to utilise design information to its maximum for procurement. Often a 'Two stage tender' has comparisons allowing micro detail to occur in the final stages of an agreed tender. This process is advantageous in allowing additional design time but has a programme limit. SDM would allow overriding and controlling the design programme and improve design deliverables without causing time stress which potentially provokes mistakes.

The Clientele would be in a more lucrative position if the strategy of the design was implemented prior to the actual design brief. With the knowledge of SDM an overall dynamic and reasonable programme of design, procurement and construction can be established. More often than not clientele tend to fixate on a period that is unrealistic and only suits the budget creating potential cataclysmic problems for the design and construction teams.

The Success of a Project Development relies to a great extent in the preparation of the Project Plan (BS7000 Part 4 2013;Project Planning) The plan will include an overall programme but design should include a dynamic integrated programme agreed by all to include Design Consultancies, Stakeholders, Manufacturers and Construction teams. The Framework for P&Ps utilising a Hospital project by example is more extensive than any other form of project. The Design Manager is extensively involved with QAQC and integrates design information with all Stakeholders including Contractors and specialist Contractors warranting specific P&Ps throughout the design and construction period of the Hospital and beyond. Improvement with streamlining the P&Ps would also enhance the overall design and construction process which necessitates further elements of SDM. Streamlining P&Ps involves focus and coordination of three main elements namely, The Project Management Plan (PMP) The Quality Management Plan (QMP) and the understanding and implementation of the Design process with Program management. BIM P&Ps by example is now part of the design sections of both the PMP and QMP (BSI PAS 1192-2:2013)

2.5.1. Program Management

Design Information Management is by far one of the most important responsibilities and involves all Design disciplines and every Stakeholder.

Applying Program Management can support and guide other related projects, often with the provision of increasing the organization's functions. In practice its aim is often related to systems engineering including QAQC. Reviewing the progress status of a project or the oversight of the purpose can be used to support project activities, better known to the construction industry as a 'Forward planner' This is a useful Management tool and ensures that an overall program series of goals and Key Performance Indicators (KPI's) are adhered to. The programme of events is generally reviewed on a 2 week, One month and Three month look ahead. Specific focus leads to a series of decisions to either improve performance or ensure that the programme is not failing in any manner. These actions provide decision-making capacities that often cannot be achieved at Project level or by providing the Team with a program perspective when required and stimulates ideas in solving project issues. This method is often adapted for Design, Procurement and Construction. The key issue is that the programme of events must be realistic hence 'Fail to plan, plan to fail'

The programme identifies a cross pollination of events and the DM has sufficient holistic views to spot specific issues often in more detail and accountability than the Project Directors. The DM is often well placed to provide this insight by communicating with all Design disciplines and Construction personnel gaining robust information to ensure that the overall program goals are achievable. The Goals can be from a Design or Construction Deliverables Programme along with design Information that is further required on site or amendments to suit Build ability.

SDM journeys one step further and visualises the design and or its requirements holistically and enables DM's through discussion and Macro

analysis to create a guidance design programme that can be discussed further with all stakeholders and Clientele at the offset. Processes and protocols related to the QMP (Appendix A3) would be included. The critical elements from those listed are;-

- ❖ **Management**

- ❖ **Administration**

- ❖ **Investigation and testing**

- ❖ Monitoring procedure before, during and after construction

- ❖ Investigation and testing

- ❖ **Design**

- ❖ Design quality procedures (DQP)

- ❖ Construction shop drawings

- ❖ Design Changes / Design Changes during Construction

- ❖ **Construction**

- ❖ Non conformance work

- ❖ Resolving discrepancies

- ❖ **Surveying**

- ❖ **Maintenance**

- ❖ 'As Built' Documentation

- ❖ **Utilities**

- ❖ Data gathering procedure

Additional inclusion

- ❖ BIM, before during and after Construction

- ❖ Prototype work Mock ups Benchmarking (Commencement of final components on site – Testing monitoring and reporting)

The Project team will focus, identify and understand the key stakeholders and their respective requirements, and then to work positively influencing them (for Hospitals; Doctors, Nurses, Surgeons, Clinical Auxiliaries, Administrative Staff) and guide them through the critical elements reducing opposition and enhancing support. 'The only ethical way to change Stakeholder perceptions and expectations to the benefit of the project is targeted communication within effective relationships' (Weaver, 2010)

2.5.2. Strategic Management Process

Strategy, 'A plan of action or policy designed to achieve a major or overall aim' the word "strategy" is derived from the Greek word "stratēgos"; stratus (meaning army) and "ago" (meaning leading/moving)

(Encarta English Dictionary)

SDM is the process of planning product design, promoting within the company and avoiding 'reinvention of the wheel' and managing with the overall best interests of the company in mind. It is a method of creating one unified group of product designs rather than a disconnected collection of offerings. The process also includes creating designs with future needs in mind, such as upgrades, new innovation, and ease of production. SDM incorporates a variety of forms of field research such as feedback from Clientele. The goal of the process is to create a strong, unified series of processes and protocols that can be clearly communicated.

SDM is an objective that is or could be defined within companies of the Built Environment in attaining more of the Organisations Goals (Nichols and Ledgerwood, 2005) The general direction set is all about integration, coordination and communication of activities utilising specific resources to meet present day to day objectives partly resulting from strategic planning

along with other management tools (Newton, 2008) Design planning is essential and must be realistic instead of wishful which will enable successful management. This is part of the essence of SDM. Planning a design strategy is essential and any final decisions should be agreed by a team although SDM must lead and prevail.

SDM is also knowledge of the set goals, the uncertainty of events and the need to take into consideration the actual behaviour of others. Strategy is the Vertebrae of decisions in an organization that shows its objectives and goals, reduces policy while adhering to process and protocol and plans for achieving these goals, defining the business objective that the company is to carry on with, and the contribution it plans to make to its Stakeholders, Clientele and business generally. Strategic Design Management is a continuous process that appraises Project design and integration with a multitude of functions associated with ultimate construction. It is a function that also supports QAQC.

Strategic Design Management process - four main functions:-

1. **Analysing Design-** refers to a process of collecting, scrutinizing and providing information for strategic purposes. It assists in analysing the internal and external factors influencing an organisation. After completing the analysis process, management should evaluate it on a regular basis and continue to improve it.
2. **Strategic Design Management Formula-** SDM is the guiding and supportive process of considering the best course of action for achieving specific objectives whether Pre-construction or site orientated achieving organisation purpose.

3. **Strategic Design Management Implementation-** Strategy implementation is creating a strategy of works for putting the organisation's chosen strategy into action.
4. **Strategic Design Management Evaluation-** The final step of the SDM process. The key activities are appraising internal and external factors that are the root of present strategies. Measuring performance, and taking remedial and or corrective actions. Evaluation makes a confident and positive organisational strategy and its implementation meets the organisational objectives.

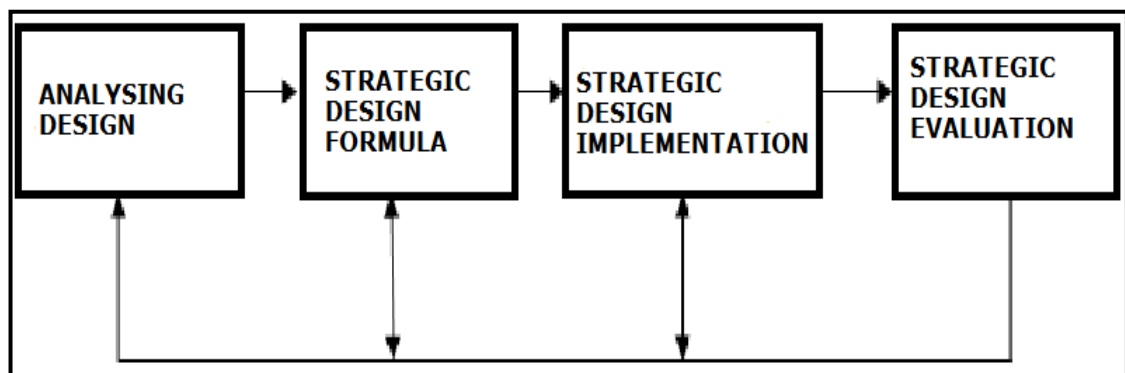


Figure 3 Components of Strategic Design Management Process

The SDM strategy is shown (Figure 3) and carried out in a chronological order and creates a new Strategic Management plan. A given SDM plan should always revert to these sequences as per the situation required so as to make essential changes. Strategic Design Management is an ongoing process. It must be acknowledged that each component coordinates with the other components and that this interaction often happens together. Dependencies and inter-dependencies require focus and filtration to gain the ultimate process.

Chapter Conclusion

The basis of Strategic Design Management

The Integral elements have been referred within this Chapter and explain the basics of a SDM Framework. The Design Manager (DM) has many responsibilities and SDM will support the role which in turn allows the DM to create a comfortable framework utilising the integral elements described.

- BIM is a lucrative tool but requires creative Management to drive deliverables more efficiently. BIM must be acknowledged as a tool for seeking out conflicting information and smoothing the design process journey. As a reminder, what it will not do is to manage that process.
- The Hierarchy is still very much reliant on their Managers to understand BIM requirements but further reliance down the ranks tends to return to the Design Technician. SDM supports DM's and associated design disciplines.
- The DM along with lead disciplines must create a fully integrated dynamic design programme fully configured devised and agreed with all other Design Consultants, Construction and Trade personnel to include Client and Management to enable a better pattern of 'forward planning' the design works. The DM includes 'people management' and the Strategic Design Manager guides and sets protocols for the requirements and responsibilities.
- The Clients understanding, timing and resources require an iterative design process and a need to utilise SDM to oversee the design from a holistic approach.
- The Clientele would be in a more lucrative position if the strategy of the design was implemented prior to the actual design brief. With the

knowledge of SDM an overall dynamic and reasonable programme of design, procurement and construction can be established. The Goals can be from a Design or Construction Deliverables Programme.

- SDM goes one step further and visualises the design and or its requirements holistically and enables DM's through discussion and macro analysis to create a guidance design programme that can be discussed further with all stakeholders and Clientele at the offset. The holistic approach encapsulates management of the design, procurement and Construction process.
- Key lead Managers need to also focus on new Innovative strategies and processes that suit today's technology. The process of Design; Pre-Construction, Procurement, Construction and Post Construction requires Change Management and a new strategy integrating the Design DNA generically.
- SDM Leadership requires further acquaintanceship and collaboration with the Team and the likes of specialist professionals with better communication, understanding and commitment to support the Specialist further allowing Leaders to be more transparent and focused on creating a strategy that encapsulates design Information production utilising BIM as an example to its maximum potential.
- In comparison to the smaller projects, large projects have more direct responsibility given to the individual who from a DM perspective puts the position in potential overload and risk. SDM can streamline this dilemma and provide a better design journey to success by coordinating and disseminating the design functions to the team rather than the

individual while the DM has a general oversight in ensuring that the design is functional and not compromised.

- SDM is the process of planning product design, promoting within the company and avoiding 'reinvention of the wheel' and managing with the overall best interests of the company in mind.
- SDM is an objective that is or could be defined within companies of the Built Environment in achieving more of the Organisations Goals.

Chapter 3 focuses on the analysis of SDM and explains its holistic approach and includes BIM, Risk Management, QAQC and Stakeholder Management.

CHAPTER 3

STRATEGIC DESIGN MANAGEMENT (SDM) ANALYSIS

3.1. Introduction of Strategic Design Management - Holistic and Panoramic

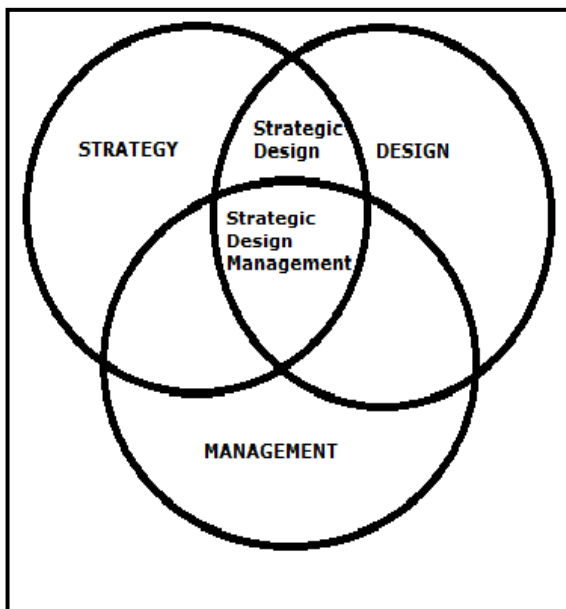


Figure 4 Strategic Design Management Construction

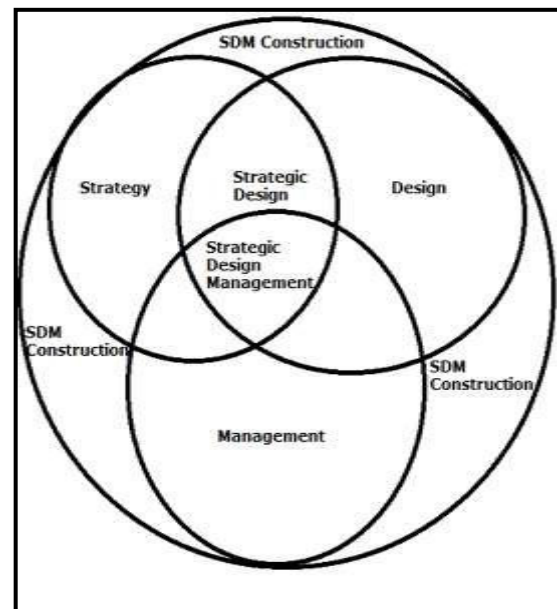


Figure 5 Strategic Design Management (Gillespie, 2002)

The Three elements (Figure 4) Strategy, Design and Management cross relate to form SDM (Gillespie, 2002) But by encapsulating the three circulars with another (Figure 5) presents SDM Construction, and if all were encapsulated by a further Circular can represent strategic Client Control. SDM Construction only partly exists at Pre-construction tender and tends to integrate with DM and QAQC and together with Estimating and Procurement departments the pre- construction process is lead by the Project Manager.

Design Management within Construction has filtered into BIM whereby much of the Construction design progress is and will be disbursed from BIM and the BIM Manager (Refer BIM Chapter 2, 2.3 for levels of design) BIM must be clearly separated from other Management tools and clearly understood not only to be an extension arm of AutoCAD; Further BIM is only recognised by many Clientele as a '3D walkthrough' and not Information modelling at the present time. This will be eradicated over a period of time from a new learning curve. From a Strategic stance, the SDM in support of the Clientele can set Strategies from the Initial format of the Brief and it is essential to get the initial BIM set up correct if to avoid major misunderstandings after tender award (RIBA Plan of works, assembling a collaborative Project Team, 2014)

Does SDM require reviving or rejuvenation? Did it predominantly exist in the past? Should it be further exploited at all levels? Should it be maintained? Does it have that Wow factor? Is it or can it be innovative? Does it have its 'Past Sell by date? Is it just another form of management expression? Does it control? Can it lead? Can it metamorphosis? Does it have strength and Capabilities to improve many aspects of construction? Does it or can it journey into analytics? These are just a few of the many aspects of further focus on SDM.

SDM Definition: '***A business process that incorporates design and its management into the strategy formation process and implemented at every level of the organisation***' (Gillespie, 2002)

Acknowledging today's management methods within the Construction Industry, SDM requires an alarming rectification if the leading arm is going to continue processes aligned with the likes of BIM, QAQC, Design and Construction. The fast lane of the electronic communication world warrants processes and protocols that everyone can clearly understand and more importantly work with. To succeed in this aspect you need a solid understanding of your organisation's business strategy and the rationale behind it (Bredemeyer, 2006) Organisations continue to follow the Status Quo, however, streamlining and setting a new SDM framework that analyses each sector of a Development with various design disciplines would favourably reduce potential early misunderstandings, improve design performance and ultimately deliver in a timely manner with a quality completion of work within programme. From a site perspective and with exception to the few, the reverse is occurring all over the Globe (Glenigan Report KPIs, 2014) Clients are then confronted with late completions, budgetary and quality issues (Kaplan, et al 2005) that often terminate by decision through arbitration.

A CIOB Design Management Symposium 2012 was shared by a group of very experienced Construction and Management personnel to include Paul Hartman - Olympic Development sponsor, Peter Jacobs - President of the Chartered Institute of Building, Gavin Maxwell Hart - Project Director T5 Heathrow Airport, Rab Bennetts of Bennetts Associates and Mark Bew Chairman of the UK Government BIM Group. The objective to discuss and explain further avenues of the Design Manager, analyse 'what is Design Management' and

discuss prominent Design Management issues to enhance what would later become a Design Management handbook created by John Eynon (chairman of the event) Paul Hartmann explained that the Olympic 2012 development took more than Ten years to complete and involved a plethora of design Consultants. The Key to effective design delivery and the subsequent advice to all future Mega Projects are to ensure that stakeholders have a Team of Design Managers that can holistically foresee requirements of the whole iteration process. For the effective delivery of a bid for, and staging of, the Olympic Games, the management, decision-making and administrative mechanisms have to be absolutely right.

The strategy and objectives have to be clear, as does the allocation of responsibilities' (Third report of session 2002-2003, HC268, London, The Stationary office Limited) Further it may be hard to accept but the majority of Construction companies still do not grasp the total remit of what Design Managers should be aligned to focus on as well as disseminate their true responsibilities, capabilities and overall remittance. The symposium was a great success and the Design Management book was published.

The Holistic Design Management approach can also be considered from a *Strategic Design Management (SDM) Guideline*;

3.2. Features of Strategic Design Management – Function and Coverage of a Framework

SDM is applicable because it is not possible to foresee future design without a reasonable foresight and SDM tends to extract the foresight potential from DM's and design leaders which constitute competition within the business of the Built Environment. SDM focuses on long term achievements and target requirements within the Built Environment rather than the status quo of the

normal tender and presentation; SDM looks at innovative potentials, new designs and methods of production and manufacture, bearing in mind new products or new markets that can simplify improved budget, programme and quality.

SDM understands and assists Clientele and Stakeholders behaviours and their competitors to make them more competitive and ease any ambiguity. SDM is a well defined route to an organisation. It guides and leads the overall requirements and goals, vision and direction of an organisation and in turn becomes very competitive and minimises strengths of competitors. SDM places an organisation in the direction that Clienteles design wants to be. SDM gives a greater insight of Design Management to the Employees of the organisation and fellow Personnel of the Built Environment. It can explain Design Management principles and gain a better understanding of how the position integrates into the entire organisation and its structure. The employees become more understanding toward their position and responsibilities, more motivated and further satisfied as they can coordinate themselves very well with each goal or objective. They understand the environmental changes with the organisation and the responses of the organisation with the support of SDM. Hence Clientele can see the impact of any change management on their Development and can effectively absorb changes.

One of the major areas of SDM is to integrate and coordinate various departments of the organisation as well as ensure that the functional areas communicate and coordinate efficiently. SDM shall also keep a continuous focus on the goals, objectives and deliverables of the organisation from a holistic approach to maintain the Clienteles primary objective. The SDM

process means defining the organization's design strategy. It also defines the process by which Managers make a choice of setting out strategies for the organisation that will enable it to achieve a better performance, hence a robust SDM Framework.

3.3. Strategic Design Management and Building Information Modeling (BIM)

Stakeholders including ownership in a model have a requirement for overall coordination and it is becoming more and more apparent that there is a need for Management to share and assist with all BIM design integration as well as tracking, reviewing and maintaining data. A BIM Manager has this responsibility but the coordination of BIM into the overall project perspective is the role of the DM as a Leader. With traditional procurement, other disciplines in the design team can be reluctant to become involved beyond the basic observations prior to the Architects substantial building design. Generally other team members are there at this stage to ensure that space allocation is correct rather than getting involved at a less turbulent stage; Service Riser coordination is a classic example or the placement of Plant and Equipment. The question arises if whether the Architect remains in taking the design lead or, unlike a number of technical mega projects with exception to design concept, DM and BIM Managers are taking over the role of Architect or Designer which is potentially generated from the Technician.

A SDM solution would be to work with the Clientele and a BIM Third Party operator to obtain and coordinate building information from all the design disciplines before tendering for the Main Contractor. This policy would best be served from a SDM perspective ensuring that the Clientele fully understands

all BIM processes and forms a complete dynamic scope from concept to completion and beyond to Facilities Management.

3.4. Strategic Design Management - Risk Management

Analysis of possible loss - 'the profession or technique of determining, minimizing, and preventing accidental loss in a business, e.g. by taking safety measures (Encarta English Dictionary) Strategic Design Management risk may occur from making decisions or indecisions from substandard design or insufficient information or from inadequate resource allocation, or failure to respond well to changes and subsequent cost. The risks associated with design are considerable and should be controlled from Inception of a project through to handover. Risk is associated with all elements of a project and consequently involves design. In most projects a risk register is the normal practice and described within the Project Management Plan (PMP) however risk is quite commonly associated with change management.

Strategic risk associated with SDM assists CEO's and their Executives to understand multiple and large design changes that stray from the original contract, how to understand, diagnose, and facilitate effective changes to meet demands of the Clientele. It is therefore sacrosanct to strategically agree the risk process and reporting from onset. The Project purpose and definition; needs, objectives, costs, are all part of a SDM element. Some of the risks to be SDM assessed or have an association with the DM are;-

- Inadequate Brief and or inadequate well explained requirements.
- Weak contracts open to misinterpretation (Design /Construction)
- No control over staff priorities, Deliverables
- Deliverables are poorly defined or misunderstood
- Too many projects work overload or Burn out.

- Consultant and or contractor delays
- Commercial errors
- Communication breakdowns
- Lack of coordination
- Inexperienced workforce/inadequate staff / resource availability

It is important to assess and monitor all potential risks in a project and undertake all necessary actions or make provisions for eliminating or preventing them from occurring. The effects of risks may be reduced and allocated to the party best prepared for managing them. This requires a systematic approach to risk management, but in one way or another design is often part of the equation and early dilution of risk guided and advised by SDM can eliminate later potential failures and additional cost and time charged to the Clientele.

3.5. Strategic Design Management Quality Assurance Quality Control

Although the Project Management Plan (PMP) is the main guide and proposal to a Development it cross-pollinates with the Quality Management Plan (Appendix A2) The Author confirms from working on Mega projects that considerable focus on QMP is directly or indirectly associated with design. The Design Quality Assurance Manager is responsible for Quality of the project design. The responsibility can be allocated to the Design Manager or Construction Manager but ultimately it depends on the size and technicality of the project. The normal is to have the Design Manager liaise with the Construction Manager and QAQC Manager.

One of the many uncoordinated processes involves the Design disciplines QAQC processes and protocols and it is not until the Construction phase that these processes have to be faced and a common agreement met between all

stakeholders. Often, it is QAQC that is blamed by the Contractor for Inspections and disagreement to qualities provided leading to defences of specification and design misunderstandings or misinterpretation. An effective design programme is essential and improves coordination, however, a quality assured design programme is not always reviewed by the Quality Manager and Design Manager at tender or contract award; The majority of Project personnel only review content of programme from a design deliverables perspective and do not include micro analytics such as design transition at procurement and construction stages. The ISO standards can be a good introduction to the processes required to achieve a Strategic Design Quality assessment that can be monitored on a regular basis. The majority of developments at commencement are dictated by the Project Director and Construction Manager and the design initially becomes fraught with budget and programme compromises which ultimately lead to value engineering and design changes. From a strategic stance the Design Manager should be given the ability to warrant decisions and agreements with the same authority as the Project Director. One of the definitions of a 'principle' is a basic series of rules that has strong influences on the way in which design processes can be carried out. Design quality management principles (DQMP) are a fundamental group of rules and values that can be accepted as true and can be used as a basis for quality management (ISO 9000, 9001;2015)

Utilising quality principles and with controlled information release and by example, BIM can build structures that can be further streamlined in preventing component clashes and detail fragmentation. The design programme exerts control over the design process and can further assist in procurement strategies however, many programmes are provided to attribute

toward construction accounting therefore any inefficiency is often pointed at the design and quality of programme without any effort in providing a strong dynamic strategy that would eliminate any contentions toward design.

3.6 Stakeholder Management

Stakeholder Management is the most important element within any Project of any size and complexity. There is a diverse range of Clientele involved; this ranges from Land and or Building ownership, companies with shares or part ownership to Banks and Development Partners Public Funded Initiative (PFI) Hospitals is a good example of Stakeholder Clientele. (Weaver, 2010) With the Built Environment in mind, the majority of Stakeholders have the one well remembered Cliché 'Time is money' and the Communication, Understanding and collaboration is most important from a Management perspective.

The Authors experience found that there is a different type of experienced Clientele on every project but due to their diversity of knowledge, consulting and supporting with them in different ways represented true value to them. The most valuable asset to gain is a structured and well detailed brief along with what would be an agreeable contract. Consideration to the span of construction methods must also be agreed and tend to suit the scale of a project, for example; most Clientele tend to opt for a Design and Build Contract because of the responsibility relief over design especially working design whereas the greater complexity of a project could be controlled and managed equally efficiently under a Construction Management contract (CMAA, 2012)

Clientele irrespective of their construction knowledge to include design must be supported at all times during the complete project process. The Integral primary SDM elements are a major asset to any Clientele and Budget,

Programme, Quality, Risk and Design are amongst the critical management requirements which are inclusive within this dissertation.

3.7 Planning

Planning (Gant and Scheduling) are of primary importance to any Project Development. Planning misdemeanours often fall back on Design (Newton, 2008) and Construction programmes often reschedule deliverables with regard to Design and transition into Procurement. However, European Planning always maintains the completion Date or at least agrees the revised completion date within reason with the exception to potential Extensions of time (EOT) Lead Designers often fail to provide a programme and it is often the Construction Planner that provides and agrees such a schedule for the benefit of organising and agreeing Design deliverables.

3.7.1 SDM Planning in the MENA Region

The Authors experience of adherence to Planning in the MENA Region is tangibly different and on many Projects fundamentally flawed (CIOB 2015).

This is mainly due to a number of factors such as;-

- Incorrect planning at Tender (Client and Contractors)
- Fundamental Design Changes
- Late Procurement
- Value Engineering (Increasing and Decreasing) Commercial Cost
- Delayed Decisions
- Payment Diversity
- Under- resourcing
- Quality Issues

All of the above has a fundamental effect on Construction performance and becomes a potential Cauldron of delays. SDM can provide Master programme

Planning consultations to the Stakeholders and a resultant programme that can be enhanced by all teams prior and during Construction (Section 2.5.1) diluting potential mitigations and consequential claims.

3.8 Limitations

Strategic Management literature on subjects such as Project Management, Business and Economics are plentiful however, with exception (Gillespie, 2002) focused literature on the Strategies of Design Management is minimal and unapparent in the MENA Region. The SDM Framework consists of the Focused Integral Elements generally used in Construction Project Management and Stakeholder Management (Section 3.6) The Framework surmounts to supporting Design Management with the Integral Elements and providing a Business Process incorporating Management into a Strategy formation process (Section 3.1) but there is minimal literature directly associated with Strategic Design Management.

3.9 Chapter Conclusion

Strategic Design Management Analysis

- The Literature on the Subject of Strategic Design Management is minimal and limited.
- The analysis within the chapter has focused on strategic Clientele control and that SDM is part of a business process amongst many others which is implemented at every level of the Built Environment within organisations.
- Businesses must have a clear understanding of their strategies to succeed. The chapter further explains the Strategic and Holistic approaches to Design management (Olympics 2012 and Terminal 5 Heathrow Airport)

- The main features of SDM such as BIM and the need to assist Clientele with its use and understandings and coordination into the complete project from inception to completion.
- Risk Management and its association with all of a project and the need for Hierarchy to understand the Design risks and change management. The importance to strategically agree the risk process and reporting from onset and to provide a systematic approach.
- QAQC. The Project Management Plan (PMP) is the main guide and proposal to a Development. It cross-pollinates with the Quality Management Plan and Design must be coordinated across all management departments.
- SDM Stakeholder Management is the most valuable asset to gain and should be structured and supported with a well detailed brief along with an agreeable contract and Programme. Clientele irrespective of their construction knowledge must be supported at all times during the complete project process.
- Planning within Europe differs in comparison to the MENA Regions which are fraught with a number of factors such as progress, budget, Design and Quality issues.

The next Chapter explains the Methodology of research and Analysis and continues within the Case studies on different Stakeholder Management problems and subsequent analysis and recommendations.

CHAPTER 4

Research Methodology

4.1 Introduction

The purpose of this chapter is to emphasise the methods that will be used to obtain the relevant data towards fulfilling the objectives which revolves round formalising a Strategic Design Management (SDM) Framework, Provision of Integral Management Elements to support SDM and to also discuss the selected methods in order to collect data that will aid in actualising the objectives of the research. This chapter begins with the identification of strategy suitable for this research, thereafter the technique for data collection and identify the technique that will be most suitable for appraisal and aid the researcher in gaining relevant data. This chapter will also explain the case studies, evaluation and comparison, and its limitations in order to provide valid and reliable data that will help accomplish the research objectives.

A guidance on Methodologies covers concerns in quantitative and qualitative research, including research ethics and employee's research into Management (Fellows, 2015) Fellows refers to the Oxford English dictionary (1995) with a more extensive definitive of research as 'The systematic investigation into the study of materials, sources etc. in order to reach new conclusions' hence new knowledge. The dictionary continues 'an Endeavour to discover new or collate old facts etc. by course of critical investigation' According to Fellows the Authors case studies are 'situational' hence a distinct style of research. This dissertation considers functions of the Design Manager based on theoretical analysis of its very own integrated responsibilities (Integral Elements) with all other personnel within the Built Environment to include presence on and off site. The processes and protocols, the hierarchal position of the DM and how

SDM can further guide and support the DM with a non exhaustive list of guidance details that commences a journey to a new SDM Framework.

4.2 Research strategy

The Methodology diagram below (Figure 5.1) illustrates the designed route of the methodology. Starting with the requirement for a new Strategic Design Management (SDM) Framework, and how to commence the journey by first researching quantitative_documentation focusing primarily on the Design Management Integral Elements and comparing them with the case studies Of Primary qualitative data sourced from the Authors Projects (live at the time of writing) in the MENA Region which includes Consultant Designers, Commercial, and Project Management companies as well as Two Contractors within a Joint Venture as the Main Contractor and assists in utilisation of the reference(s) to the case studies material from the Built Environment. This gives an overall insight into how the Industry is currently operating in the MENA Region and the scenarios of organisations operating within its Environment. The analysis is also intended to highlight realistic Design Management Integral elements. Further, collating and comparing both and drawing in the Authors reflective professional experience and thus completing with a robust analysis conclusion and Framework along with considerations and recommendations.

4.2.1 Quantitative research

'Research that gives detailed descriptions and explanations of the phenomenon studied rather than providing and analyzing statistics' (Encarta English Dictionary)

The Quantitative research is collective and provides references appertaining to Design Management relevancy which includes the exploration of the Integral Management elements appertaining to the design process. It also traces

similarities to past research designs (Yin, 2008) which triggers comparisons between Quantitative and Qualitative Case Study Projects. Fellow and Liu (2008) describe quantitative strategy that it aims to collect factual data, to investigate relationships between facts and how such facts relate to the findings of the literature research and to provide measurable data with scientific techniques. Naoum (2007) stated that quantitative data are "hard and reliable". Quantitative strategy tend to address questions like what, how much and how many? (Fellows and Liu 2008)

4.2.2 Data Sources used Quantitative data information was sourced from associated literature and resources related to Design Management within the Built Environment. Essentially from a Consultancy perspective with a realisation of the lack of Strategic Design Management while utilising a background basis for the dissertation along with Integral Elements. Considerations of literature such as Design Management Planning (Newton, 2008),

Design Management Handbook (Eynon, 2013), Processes and Protocols (British Standards, BS7000, Part 4, 2013), and BIM, (BSI, PA 1162-2, 2013).

Past and present Design Managers literature is also part of the data;

(Bibby, 2003), (Elson, 2012),(Emitt, 2014), (Eynon, 2013), (Gillespie, 2002), (Harty, 2012), and (Newton, 2008) White papers and Institutes such as The Chartered Institute of Building 'Weekly Global Review' and Governmental reports such as 'Rethinking Construction' (Egan Report, 1998) were also used as study material.

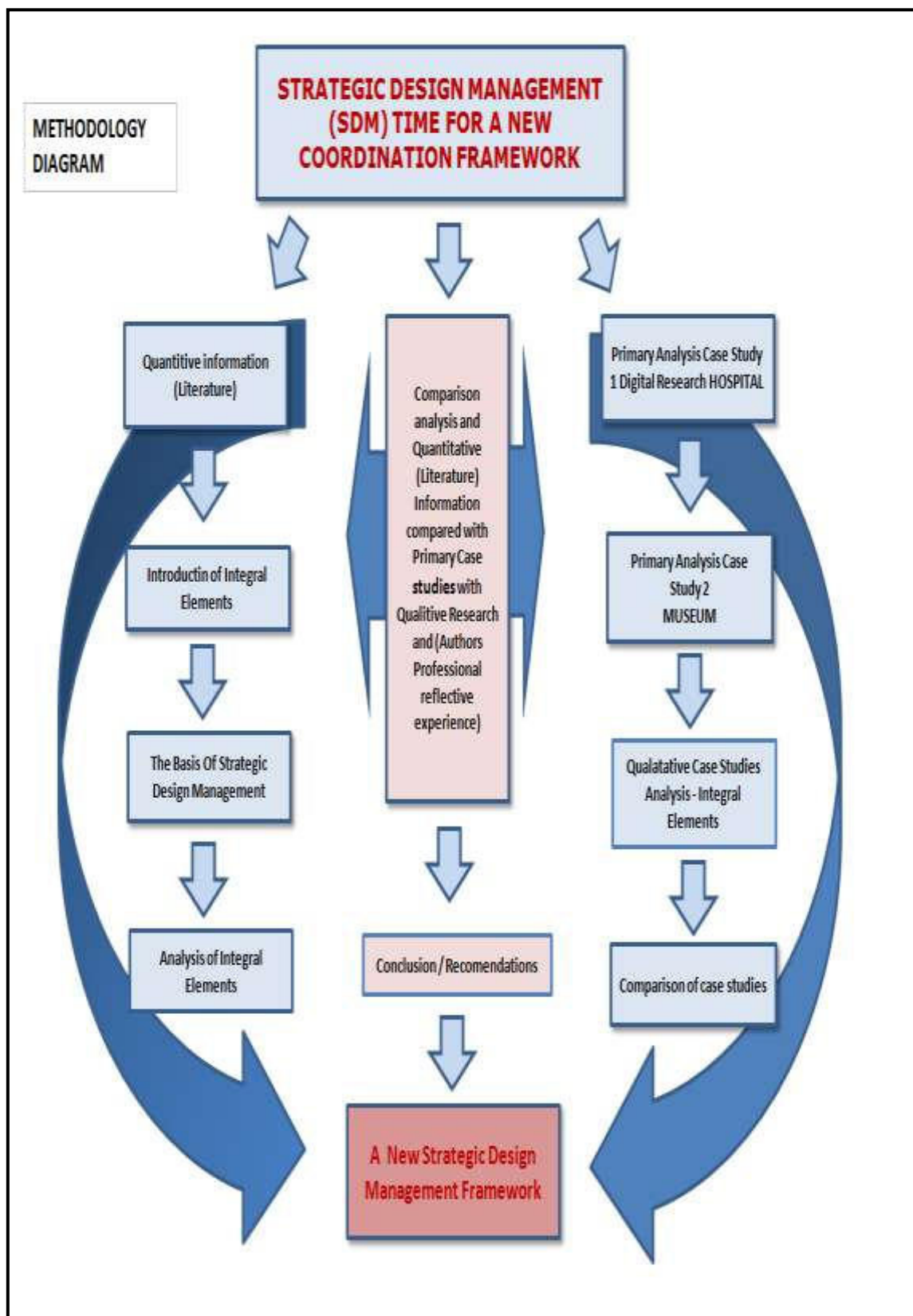


Figure 5.1 Methodology Diagram

4.3 Qualitative research

Naoum (2007) stated that qualitative research is based on gathering people's subjective information such as meanings, experiences, description in subject that to develop theories. Qualitative research is an approach for exploring a principle of a subject which does not have existing theory (Fellows and Liu, 2008). In addition, theory in qualitative research is not very clear in the beginning but will be generated after data collection and analysis.

4.4 Adopted methodology

The principle hypothesis of this dissertation is the need for a Strategic Design Management framework. This will be explored by filtering qualitative research material analysed from associated literature, both design and construction related applicable white papers and web based sources as identified in the references and dissertation analysis along with the author's personal reflective analysis of long managerial experiences within the Built Environment, particularly on large construction projects. (Naoum 2007). This analysis includes 2 case studies both in the MENA Regions (Fellows, 2015) A Women and Children's Digital Research Hospital in the GCC Middle East Region and a Museum project in North Africa as primary research, highlighting key pertinent issues from the principles such as Stakeholder, Program, Risk, Planning, QAQC, BIM management and its interrelations with SDM, Concluding with suggested recommendations and considerations. The research comparisons shall identify a potential Framework capable of guiding the complete design process with better communication and understandings, closing the gap between Client, Design disciplines and Contractors. There are significant objectives such as improved design, budget, programme and quality gains to be made.

4.5 Case Study

According to Yin (2003) a case study can be applied when: (1) the intention of the study is to answer "how" and "why" questions; (2) you cannot influence the behaviour of those involved in the study; (3) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (4) the boundaries are not clear between the phenomenon and context. In essence, Yin (2008) views the goal of case studies as understanding complex social phenomena, and real-life events such as organizational and managerial processes. He explains it well "A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" In a multiple case study, we are examining multiple cases to understand the similarities and differences between the cases. Yin (2003) explains how multiple case studies can be used to either, "(a) predict similar results (a literal replication) or (b) predicts contrasting results but for predictable reasons (a theoretical replication)" It was sought to adopt case studies as the preferred research strategy in this research study reported here. The following were the main factors that influenced preferring case study research over other research strategies, satisfying the criteria for selecting case study strategy. The fact that case study affords the use of explanatory, exploratory methods gives an encompassing idea of real life events (Yin, 2003). The complexity of SDM implementation and its capabilities makes the case studies Whilst SDM research was argued to be project based (Fellows and Lui, 2008), processes in research Thus, case study satisfies the need required of a method in examining a dynamic occurrence in a scenario guided by this study.

The gathered facts give an analysis of the Quantitative information derived in chapters 2 & 3 and comparison of case studies and subsequent pertinent issues in specific sections and goes on to further explain Strategic elements. The case studies cover Generic ground (Baxter and Jack, 2008) and each project explains Management misdemeanours and solutions on common ground when making comparisons to each project. Consideration is to be given that with each and every element from Stakeholder to Construction that design is involved from one or several aspects and that SDM can be administered or utilised to the benefit of improving the elements

4.5.1 Research Methods similarity

To exemplify a methods similarity (Baxter and Jack, 2008) provides a qualitative case study Methodology which describes the chosen justification for this dissertation. They quote; ***'A Qualitative case study methodology provides tools for researchers to study complex phenomena within their contexts. When the approach is applied correctly, it becomes a valuable method'*** Extractions from Baxter and Jack (2008) as follows;-

The purpose of the paper is to identify the key elements for designing and implementing qualitative case study research projects.

i.) Binding the Case

Once the case is determined they consider what the case will NOT be. Baxter and Jack highlight that one of the common pitfalls associated with case study is that there is a tendency for researchers to attempt to answer a question that is too broad or a topic that has too many objectives for one study. In order to avoid this problem they suggest that placing boundaries on a case can prevent this explosion from occurring. Binding the case ensures that the study remains reasonable in scope.

ii.) Determining the Type of Case Study

Once determined that the research question is best answered using a qualitative case study and the case and its boundaries have been determined, then you must consider what type of case study will be conducted. The selection of a specific type of case study design will be guided by the overall study purpose. Are you looking to describe a case, explore a case, or compare between cases? There is also a differential between single and holistic case studies and multiple-case studies. If a study contains more than a single case then a multiple-case study is required. A multiple case study will allow the researcher to analyse within each setting and across settings. While a holistic case study with embedded units only allows the researcher to understand one unique/extreme/critical case. In a multiple case study, you are examining several cases to understand the similarities and differences between the cases. Overall, the evidence created from this type of study is considered robust and reliable.

iii.) Reporting a Case Study

Reporting a case study can be a difficult task for any researcher due to the complex nature of this approach. It is difficult to report the findings in a concise manner, and yet it is the researcher's responsibility to convert a complex phenomenon into a format that is readily understood by the reader. The goal of the report is to describe the study in such a comprehensive manner as to enable the reader to feel as if they had been an active participant in the research and can determine whether or not the study findings could be applied to their own situation. It is important that the researcher describes the context within which the phenomenon is occurring as well as the phenomenon itself. There is no one correct way to report a case

study. However, some suggested ways are by telling the reader a story, by providing a chronological report, or by addressing each proposition. Addressing the propositions ensures that the report remains focused and deals with the research question. In order to fully understand the findings they are compared and contrasted to what can be found in published literature in order to situate the new data into pre-existing data.

iv.) Conclusion

Case study research is more than simply conducting research on a single Individual situation. This approach has the potential to deal with simple through to complex situations. It enables the researcher to answer “how” and “why” type questions, while taking into consideration how a phenomenon is influenced by the context within which it is situated. For the novice research a case study is an excellent opportunity to gain tremendous insight into a case. It enables the researcher to gather data from a variety of sources and to converge the data to illuminate the case.

4.6 Evaluation of Professional experience reflective analysis

Reflective analysis is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2008) It can be used to construct a framework in which either literal replication predicts similar results across multiple cases or it aims at theoretical replication whereby different results are likely for theoretical reasons. Consideration for the design of this dissertation was given after taking into account the Authors reflective Management experiences and research methodology to be adopted. Similar research techniques have been considered and adopted (Fellows and Liu, 2008)

Saunders et al (2009) presented the overall research methodology in the form of an “onion”, in which the thoughts with regard to the research problem lie in the centre and thus several layers have to be “peeled away” before coming to this central position. These layers are the important aspects to be considered in determining the research methodology for a particular research study. With regard to the Case studies the core of the Onion is Strategic Design Management and the several layers are the Integral Elements. Each of the Integral Elements has many objectives as a subject and hence each section of research is focused but not broad to prevent an explosive tendency (Baxter and Jack, 2008) Reflective analysis integrates the theory and potential practice of Strategic Design Management by example. It identifies important aspects of the Authors reflections which are written in the appropriate theory and academic content. It identifies the outcomes of the Authors professional experience and concludes with new understandings and values. The Authors professional experience spans over Thirty five years in Architectural Design and Construction which has been predominantly involved with Design Management. Having worked on a number of Iconic Buildings the Two case studies are robust examples of projects that encapsulate analysis of the critical elements required for Strategic Design Management Practice.

4.7 Limitations

The main constraint of this dissertation was the limited literature associated pertinently and directly toward Design Management from a strategic approach. Research precludes SDM and only provides a plethora of associated topics on Strategic Management and tended to stray from the topic. Further, that the Author has the advantage of working on Mega Projects (Case studies) and confirms that most Consultancies and Contractors have a level of Strategy that

only caresses the status quo without forward thinking innovation toward supporting Design Management. Hence research on holistic Design Management strategy was limited and the reason for this dissertation.

CHAPTER 5

CASE STUDIES - HOSPITAL AND MUSEUM PROJECTS

Acknowledgment: Both Project studies exist within the Middle East and North Africa (MENA) GCC Regions. For purposes of confidentiality and sensitivity with various companies and being live projects (2016) names and precise locations have been omitted. Any projects born in mind with similarity are purely speculative and of no significance.

5.0 Introduction.

The case studies presented here are of two highly Technical projects with a variety of Management portrayal. Their scope and level of detail partially differ due to their mode of Building use. Demonstrating the Integral Elements of SDM explored in Chapters 2 and 3 and the theory of how SDM can rectify the Misdemeanours' that occurred on both projects. Due to timing of this dissertation consideration of 'In depth detail' that matched the Aims and Objectives was the primary reason as to the reason for choosing the 2 case studies even though the primary elements are minimised to prevent an explosive tendency (Baxter and Jack, 2008) The case studies have been chosen as a good exemplar with a view toward drawing vignettes of what is happening now.

It has been the intention to present the Integral Elements in a structured manner to allow cross-referencing and comparisons where possible. Key points to be covered and analysed later are navigated toward the SDM Elements such as Stakeholder Management, Design, Procurement, Processes and Protocols',

Planning, et al. Both projects are incredibly technical and the developments have been designed with 'state of the art' in mind clearly shown to provide Iconic landmarks. Both have endured many challenging aspects and have been met with ferocious claims in terms of programme and budget and not unlike the majority of Mega projects across the Region unfortunately. Fraught with challenges, the projects have been met with the best and experienced professional management from across the Globe to include author as Senior Design Manager (Client Representative)

PROJECT 1: Women and Children's Digital Research Hospital Middle East, GCC Region

5.1. Hospital Design Coordination

Hospital Design Coordination is the Key to success or the consequences are an alternative protracted period of discontent by all stakeholders if managed incorrectly (Kemmer *et al* 2011) Hospital Developments surmount to high levels of Mechanical, Electrical and Plumbing MEP Installations all co-ordinated by the Lead Designer and Design Managers. It is therefore critical to perfect the design coordination (Whole Building Design Guide) prior to site installation. The links of design co-ordination, production and manufacturing should be understood and further focus is needed to assist Contractors and Specialist Contractors to gain advantage in reducing waste production and planning information and can be achieved through the coordination process (Riley and Horman,2001) along with the active use of BIM. The essential benefactors to emerge initially are from a series of processes and protocols that should be instigated during the SDM stage of the Development. Common SDM commodities must be agreed for key elements of the Hospital other than MEP integration and to include areas such as Operating Rooms (ORs) Intensive

Care Units (ICU) Post Anaesthetic Care Units (PACU) and Medical Gases integration. These are all common denominators amongst many.

5.2. Hospital Introduction

The research Hospital is an ultramodern, all-digital research medical center which will set new standards in patient care for Women and Children in the Gulf region (GCC) and internationally. It encompasses three essential missions: World-Class Patient Care, Medical Education and Biomedical Research. The Hospital consists of over 200,000 square Meters of Acute facilities, 360 Beds with a total capacity of 600 beds (subject to future extension) The Hospital includes Sixteen Digital Operating Rooms (Figure 6) and extensive Laboratories over Two floors. Three large Ground level Atriums and Three upper level Healing Garden Atriums all linked with multiple Panoramic Lifts. A 40,000 M² out Patients' wing with all interiors to the development



Figure 6 Example Operating Room

finished to a Six Star Hotel standard (Equivalent Burj Khalifa Dubai) A 'State of the Art' large underground Car park and an Over Ground Multi storey Car Park facility. All Buildings are supported by a Central Services Building containing major Plant and Equipment and to include an Underground water tanks structure. Extensive external works of access Roads, Hard and Soft Landscaping. The Programme, Pre-Management discussion, concept, Brief and contract was in 2006. The Contract was awarded in 2008 with a 3 year allocation to complete (2011). The present target completion is 2016. The development is still under construction due to many exemplar reasons of contractual management misdemeanour. The Brief was compiled based on an 'Offshore Engineering document' and although 'Onshore' is similar to 'Offshore' there are subsequent clauses that do not correlate to the works intent and reduces the structure of the Brief. A more detailed and definitive Brief provided along with early advice from the Design disciplines would have improved the performance of the Contract. The contract was also developed directly by the Client and did not utilise the more favourable International Federation of Consulting Engineers, known by its French acronym Contract FIDIC generally used in the MENA Region. The use of the contract would have lead to a more detailed effective and legally protective Design and Construction document. Utilising the Lead Architect more effectively would have also provided additional due diligence in finalising both Brief and Contract. Due to intense disputes involving all aspects of the project the JVC was terminated and took 6 months to balance a status of progress, tender and appoint a new JVC.

5.3. Integral Management Elements.

5.3.1 Stakeholder.

The commencement of the project was driven with problems of a Brief that was radically changed and a contract misunderstood in many areas. Further, managed by the JVC inappropriately and subsequent monthly reports painted with a different picture of events. The development in general is colossal and of a huge challenge to any Contractor. Due to its digital complexity and multiple private Patient Rooms the equivalent European-UK Hospital would equate to approximately 1000 beds. Hence the Construction programme of 3 years in the MENA GCC Region is achievable however if in Europe unachievable. The Stakeholder in many instances appeared to be stringent and firm but relatively unsure over many issues and indecisive but extremely lenient leading to a plethora of slow instruction.

5.3.2 Design

The Design programme was allocated a total of two years from 2007- 2009. The Design protracted beyond the design deliverables schedule creating a hiatus of delays. The Client changed the Brief substantially in 2008 which became incredibly complicated. The Acute Hospital was re-allocated as a Women and Children's Hospital and the layouts and levels 'Re-stacked' (additional departments and departments relocated to other floors in alternative blocks originally numbered 1-4) to add to the tumultuous changes, the JVCs Architect was terminated and a new practice commissioned. The absence of a Lead Designer after the second year was due to the JVC's adamancy of withheld finances due to poor design, late information and inherent lack of providing a dynamic fully co-ordinated design programme along with withheld payments to the JVC by the Client. The Architects lack of

co-ordination, advice on Package Management and JVC subsequent late Procurement also added to the frustration. Façade design engineering commenced early based on a well known American Architects design and supported by British Façade Engineering Design disciplines. During the critical design one of the design disciplines dissolved its partnerships and a new practice set up which involved further design delays.

The inherent JVC interruptions could have been avoided had the JVC visualised the project holistically prior to tender submission and allowed more provision for SDM and an increase in the number of DM's within the team. The appointed Architects scope of work and responsibilities should have been better communicated and agreed with a presence of Lead Design throughout the project.

5.3.3 Absence of Building Information Modelling (BIM)

BIM was not applicable to industry contracts at the time of design inception in the MENA Region. The design of the project would have vastly improved from a coordination aspect and further, essentially useful for design clash detection bearing in mind the intense MEP installation requirements for a Hospital. The transfer of the model to another designer would have also been possible but delays in ramification would also have lead to possible dispute. The model would also be useful for future Facilities. With regard to Management and extensions to the development; Improvement could have been gained on many aspects of the project using BIM at that time and there will be many more improvements to the Built environment with BIM in the future.

5.3.4 Procurement and specialist packages.

The Procurement Schedule

The schedule was introduced by the Project management Consultant (PMC) because the true status of the JVCs procurement status and progress was poorly defined and uninformative. By creating the schedule and arranging bi-weekly meetings the JVC had to report to the Client in detail the status of all procurement packages. The flow of information covered design status, tender status, orders placed, Manufacturers design agreed and signed off, fabrication period and status of component completion, date of delivery to site, and site commencement. It also included for advising the JVC on any outstanding designs required and or any meetings required in resolving contentious issues. Each bi-weekly meeting would include but not be limited to;-

Week 1 Architectural / Interiors

Steel Structure for Atriums and Façade works, different types of stone for interiors, Vertical transportation (Lifts) panoramic lifts, Passenger and Goods lifts, Escalators, Doors and Frames, Ceilings, Balustrades, Block-Work, Plasterboard partitions, Screeds, Kitchen Equipment, Glasing, Roof finishes, Building Maintenance Units (BMU-Cleaning cradles/apparatus) Water Features, All floor finishes-Vinyl, Carpets, Timber, Epoxy painted floors, Painting and Decorating, Nurse call stations, External Hard and Soft Landscaping. Bespoke Joinery

Week 2 MEP

The Mechanical Services Plant and Equipment - Chillers, Condensers, Boilers, Pumps, Water Tanks, Pipe-work, Drainage systems, LNG Tanks, Water Piping, Gas, Hot & Cold water installations. The Electrical Services High and Low

Voltage Plant, Transformers, Generators, electrical containment and services to Kitchen equipment.

ICT - with provision for, Fire alarm cause and effect, Back Ground Music, Automatic Guidance Vehicle service systems (AGV) Building Management Systems (BMS) Vertical transportation (Lifts) Management systems, Nurse Call systems, Voice activation alarms.

Specialist Packages

The main specialist packages consisted of Furniture Fixtures and Equipment (FF&E) and Medical Equipment.

Magnetic Resonance Imaging (MRI)

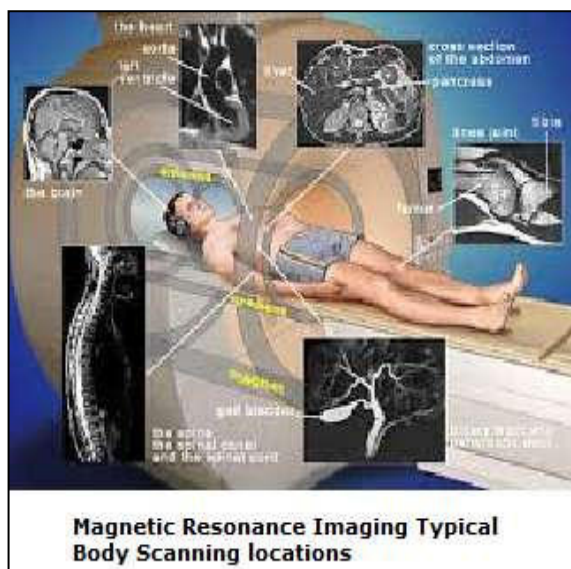


Figure 6.1 Magnetic Resonance Imaging

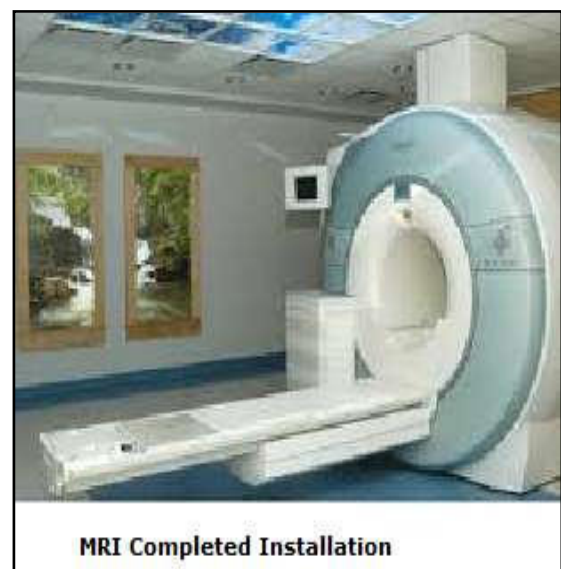


Figure 6.2 MRI Completed Installation



Figure 6.3 Specialist Logistics for Installation Control of MRI Unit

The installation of the MRI (Figure 6.1 and 6.2) is a key example of Design and Construction coordination. The essential coordination encompasses the design layouts, positioning of the Equipment and all MEP and structural entities as well as the Architectural finishes. Design and build-ability focuses on the Equipment considering logistics (Figure 6.3) walls identified to be built later after installation due to delivery and movement of very large components; and include a proviso that small elements of the equipment can be dismantled and maintained without removal of all the Equipment. Lead lining to walls is also a major consideration. All of the above is very much part of the 'DNA' that involves guidance and protocols from SDM.

5.3.5 Commercial

The Buildings Budget was increased by Major design changes and lack of procurement control and incomplete design (Note; Budget management discussed at meetings remains confidential) The JVCs Contractors proposal included a Design Base Memorandum - DBM (Refer appendix A.5) It contained a protracted list of actions that would occur within a specific time and included finalised designs for medical equipment along with clearly defined deliverables such as the final dates for sketch drawings, design development and shop drawings – Architectural, Structural, Interior Design and Façade Engineering. These design deliverables were considered for the monthly evaluations and became debatable and ultimately disputed. Regular commercial meetings occurred and attendees included Client as well as Managers from various departments.

5.3.6 Planning

The Programme of complete works was technically flawed during tender and award to a JVC that stated completion of the contract would be within 3 years.

Other tenders consisted of between 4 and 6 years of work however, insistency of the Client of a 3 year programme prevailed. It was therefore widely believed by management that a hard line approach to progress had to be maintained. From an international perspective programme planning differs from the UK. If the hours of work are strictly maintained then there is 5 days work in the UK compared to 6 in the Middle East. Work commences early with no noise abatement act in particular apart from local neighbourly liaison occasionally, hence work can be carried out around the clock with two-three shifts. There is far more labour intensity and an abundance of work resource compared to the UK and it is not unusual to have a workforce of up to an average of 3000 to 5000 labourers. Logistics are interesting and to see many buses and coaches entering the site in the morning is a spectacle to be seen along with work shift changes early evening. On site, during fit out, electrical tools appear to be sparse and the majority of labour use manual hand tools for cutting and fixing materials; the author has even bared witness to the use of a tube water leveller in lieu of a Sprit level. Therefore technically a 3 year project in the UK equates to (3x2) 6 years in the Middle East and subsequently achievable. The programme was used as an oversight for the status of the project in a Program format (Primavera) and used to monitor project level activity, progress, gaps in the works and to ensure the overall program goals (Nichols et al. 2005) were being met by providing a decision-making capacity to the Team (Newton, 2008)

5.3.7 Program Management

Design Information Management (part of Program Management) is by far one of the most important responsibilities and involved all Design disciplines and Stakeholders. Applying Program Management to the Hospital project had the

intention of improving the organisation's performance and was closely related to systems engineering QAQC.

Typically Program Management needs to identify and manage cross-project dependencies and coordination of such especially MEP, it is crucial to success. Often the Project Director did not have sufficient insight of the risk, issues, requirements, design or solutions to be able to usefully manage effective coordination and the DM from time to time is well placed with the design and construction knowledge to provide this insight by actively seeking out such information from various personnel, however when this occurred, there was a need in order to be comfortable that the overall program goals remained achievable. The Goals were from a design and construction deliverables programme and design Information that was further required on site or amendments to suit 'Build ability' Program Management involved all departments of the team and processes and protocols was the vertebrae of Program Management and given oversight by both QAQC and Design Manager. The P&Ps are part of the complete Quality plan.

5.3.8 Process and Protocols (P&Ps)

The P&Ps often changed to suit site activity. Accepted at tender and then challenged to try and gain additional time by the JVC. The P&Ps had an oversight by the Design and Quality Managers and all P&Ps were part of the Project Management Plan (PMP) and subsequent Quality plan.

5.3.9 Quality

QAQC was constantly challenged. The JVC constantly undermined Materials, workmanship and site inspections. The Inadequate qualities during pre-construction prototyping, Mock ups and Benchmarking created delays in getting the Client to agree and sign off agreed works to move forward. The

strategic approach was to break down the problems and ensure that the JVC rectified specific areas that had been inspected and arrange re-inspection and sign off agreement.

5.3.10 Construction

Mobilisation took considerable time and foundation Rafters commenced late due to protracted Ground works and drainage. This was one of many oversights that the JVC had to later defend. The offices of the Clients project team were built in around Six months followed by commencing a Hospital Prototype Building containing all samples of Interior which was also completed late. The rapid rate of pouring the concrete structure to the Hospital in high temperatures later lead to much repair work before any Screeds could be laid. Much of the site works during Fit Out were delayed either due to late procurement, design or failed Quality procedures. Due to design and quality in construction the programme became substantially protracted and resources became reduced to a point where there was such limited work on site and the JVC became more and more dispute orientated. The Client terminated the JVC paving the way for arbitration in a European Court. It took 6 months to review progress status and appoint a new JVC.

5.4. Analysis and pertinent issues

Having given a broad but not exhaustive description to the complexities of the Project, the site team were faced with Management challenges in assisting the Client through Design, Procurement and Construction, and to target an acceptable Project Handover. To enlighten, the following Design Management functions achieved a better delivery and suggested improvements are also given below; this follows with the same order of above Headings.

5.4.1 Introduction

The Brief, Contract and inclusion of Programme should have been more closely scrutinised and the relevant Management Representatives should have given better advice. An 'Onshore' brief and scope of work would have been more beneficial and less industrial orientated, but the Client Project Manager did not have sufficient experience to consult on such matters and relied heavily upon further appointed consultants only after completion of the Brief and Contract. Working closely with a Health Architect that has an abundance of Health Project experience would have advised on most of the issues that did become apparent and explained in this case study. The Key to avoiding most of the major issues would involve a much more lucrative Strategy. The emphasis is on communication failure.

5.4.2 The Stakeholders

Consisting of the owner (and primary commercial sponsor) Professional Medical personnel to include Specialists, Surgeons, Doctors, Nurses and auxiliary staff all took part in reviews of floor plans, specific departments and all of their contents to include medical equipment, FF&E and MEP. A programme period of more than Nine months was insufficient to sanction all of the Development. The resultant factor required more coordination meetings and further changes to the design during the working design by the JVC. An earlier Strategic assessment with Key personnel setting clear processes and protocols was not only needed but would have eliminated further design, programme and budget protraction.

Meetings took place with the Hospital Owner/CEO every Six months. These meetings were only on progress, the 'forward planner' events over the next Six months and Budget. A strategic report on the analytics and mechanisms of

construction would have eliminated any doubts or concerns brought about by the CEO. Enhanced communication ensuring a rigid understanding of requirements should have been enforced (Weaver, 2010)

5.4.3 Design

The design at concept was extremely robust and integrated into the Clients requirements of a 'Design and Construction' contract. The breakdown and subsequent partial failures occurred during the working design. Evidence by case study shows that more time, analytics and strategic processes defined and written into the contract would have eradicated many misdemeanours. With or without BIM the iterative design process is the same 'From Cradle to Grave' The First Architect contracted by the JVC was found at the commencement of construction contract to be inadequate for such a Mega project and terminated early. The Lead Designer (Architect) left the project after a Two year contract and the remainder of the working Design was completed by the JVC and 'In House' Design Managers controlled by Construction personnel including Project Directors. This is a fundamental mistake and lead to a cataclysmic set of events based on the theory that the JVC would contractually focus on the Brief and Contract and change the design by immense value engineering which then lead to quality issues on site. The Clients representative Design and Construction team eradicated challenges laid down by the JVC and in many instances acted as Lead Architect not designing but managing the design. The complete design programme and essential deliverables was analysed and completely revised under Planning management and Key performance Indicators (KPIs) identified such as specific design information (Riley and Horman,2001) required for immediate on site works and package information for essential procurement. Many Task Force

Design meetings were arranged to include focus on not only Planning (Newton, 2008) but other deliverables such as integrated Design with Construction, Procurement, Commercial Budget, and Specialist Contractor suppliers and Manufacturers. The Clients Management and Design Management team created strategic targets to progress the project.

5.4.4 Absence of BIM

At the time of contract meant more management focus on coordination (Jack, 2013) and subsequent 'retrofit' on site where the design failed to identify major clashes. This was certainly identified with services during a Benchmark and sign off period in specific locations of the Hospital. Hence BIM can eliminate many problematic tendencies and reduce effective wasted Management time.

5.4.5 Procurement and specialist Packages

It is essential to Integrate design with procurement and construction and a successful strategy is gaining all agreements to a Master programme (Refer Strategic Planning Appendix A4) with all procurement package deliverables clearly set out and defined. Delays to major packages cause disruption to their associated dependencies; hence a holistic SDM approach defends further protracted coordination. Examples of this with regard to the Hospital were the procurement of the Medical Equipment and Furniture fittings and equipment (FF&E) Both Major packages are essential to successfully coordinate required MEP services. Both were over nine months late due to indecisive commercial decisions and dispute between Client and JVC over tender reviews and integration with their MEP Contractor. Due to late site installation many services entailed retrofit because services had been installed but without the consensus of the Medical Equipment specialist contractor. When the tender

was awarded the services design and installation had to be amended. Strategically, a process and agreed protocol minimised amendment to the services installation and was brought about by regular design and construction Task Force meetings. The same events occurred with the FF&E.

5.4.6 Commercial

Meetings with regard to design and subsequent effects on construction were held on a weekly basis, and through making the Client aware of many factors cited in this case study, surmounted to regular agreements to the total monthly payments requested by the JVC (These meetings are of a sensitive nature and hence cannot be disclosed in totality) This became more analytical as the JVC progressed and diminished its site works and perpetuated dispute claims. Commercial decisions toward JVC procurement tendering supported by explaining the analytical design within the packages to the Client slowed momentum due to indecisiveness and further challenges of design change. The inevitable delay in procurement outweighed the cost savings as a result of attempted value engineering. A SDM perspective advising the Client on Major procurement packages, enabling confident decisions with Design Management advice, and stringently adhering to a Master programme would have enlightened the Client, stimulated the process and avoided construction implications and payment delays.

5.4.7 Program Management

An essential part of the Management policy explained to the Client before award of the Management contract. The Program Management is a large encyclopaedia file representing the Project Management Plan (PMP) Effecting the responsibilities and actions of every department. Acknowledging that the design in some way or rather involved everyone, the DM and QAQC Manager

was given the responsibility for overview and updating the file. Although the file existed, from an ISO 9001 perspective the file should have been updated on a reasonably regular basis, however, the Clients file had not been updated and without it was difficult to integrate between Client, Client representative and JVC. Strategically this should have been instigated more clearly within the contract and avoided areas of dispute born by inadequate agreements of each PMP. Newly agreed processes and protocols and revision to the PMP along with assisting the Client in revising their PMP brought about a seamless way forward to the project. The Client had begun to misunderstand each department and the personnel's scope of work and responsibilities.

5.4.8 Process and Protocols (P&Ps)

P&Ps were very much part of not only the PMP but the Quality Management Plan (ISO 9000, 9001; 2015) P&Ps were either updated on the Project or a new format identified to suit the Managerial aspects in any of the essential construction processes to include but not limited to all departments of the Project Team but external entities such as Planning, Civil Defence (Fire Department) Municipality (Local Authority) and Statutory Companies such as local Electric and Water supply. Other examples of P&Ps are such as the process of installation for the Façade, Screed, Partitioning and Block Work, all MEP services and the approval of Design Drawings, Material approvals and Method statements of installation [British Standards (BS) 7000 Part 4; 2013]

5.4.9 Quality Assurance, Quality Control (QAQC)

The Management by the JVC after the First year became the initial commencement of the contractual disputes. Its growth entwined around the design process, the approval procedure and category status of all working design drawings that followed. The QAQC of the JVCs design broke down and

the due diligence with regard to content of drawing design information along with coordination began to fail. Following Design meetings along with Construction, QAQC, Design disciplines and JVC a new process and protocol was discussed and implemented reducing the amount of drawing reproduction and improving design deliverables. These types of Managerial principles should have been clearly explained in the Design section of the brief and the strategic principle understood by all JVC Construction Tender's and clearly understood prior to award of contract.

5.4.10 Planning

The construction Master Plan should have been reviewed more holistically, and the Main Hospital and support buildings could have been built, commissioned and handed over within a better planned programme (Refer SDM and JVC Programmes – Appendix A4) Analysing the JVC protracted programme due to many reasons listed above; essentially a Strategic programme of events and greater Holistic review and approach sets out a more beneficial programme of events (Newton, 2008) as shown in the SDM programme. In reality the development is Five years late. Weekly reviews of the programme by every department with a progress report was given to the Planning Manager which followed with a well compiled report to the Client. An overall report for the month was also compiled. Further on into the Contract the report changed and a dash board of information was compiled along with pertinent issues which became more informative and of a better understanding to the Client. Strategically, content of such a report should have been discussed understood and agreed and submitted as a P&P from the first week of the contract onward.

5.4.11 Epilogue

This Case study for the Digital Research Hospital only exemplifies a flavour of the project from a management perspective, the challenges that were faced and solutions to the main pertinent issues. The study provides primary research to evaluate and analytically compare to the second case study which then allows comparison to qualitative literature.

There is a well known statement within the industry which summarises many aspects of this study, 'Fail to plan, plan to fail' The project at its construction end and beginning to an incredible Women and Children's Six Star Hospital will not be seen in this light. Instead it will be seen as an Iconic landmark with its environment that saves Thousands of lives and brings new faces into the world. The success and happy faces will be seen in lieu of the Heartache, sweat and tears along with many happy events that occurred from all the professional staff that made the project possible.

PROJECT 2

Museum Project – Middle East, North Africa

5.5. Introduction

The Mega Museum in North Africa Project is one of several other similar public developments in the MENA Region currently underway. With an allocated area of over 400,000 m², the Museum is within close proximity to Iconic landmarks and its resilience to these assists in setting out the Museum from a geometric perspective. The facility will offer an exhibition area of over 30,000 m² and house exhibits with a value of over One Billion US Dollars.

5.5.1 Key facts must be taken into consideration

The project was designed in 2002/3 but due to substantial country issues and

funding the project did not commence until 2008. By this time the majority of working Design had been completed and the winning Construction Tender (JVC) commenced work with Groundwork's preparation already completed.

The PMC provided direct communication with Client Senior Management and Consultants, Integrated Design and Construction departments and ensured that all planning and design complied with the highest standards. The PMC Guided and managed all of the design review team disciplines, coordinated technical documentation and submissions, ensuring conformance with the design intent, managing the Contractors technical design to include conformity with contract documents, Building Information Modelling (BIM) Liaising and integrating with Site Construction Management to include procurement, build-ability and site inspection QAQC.

5.6 Integral Management Elements.

5.6.1 Stakeholder

The Client is essentially Country Government lead with Managerial staff reporting to a Ministry on a regular basis. From a Client Representative point of view and in Harmony with managerial duties the 'Client is always right' or, 'Yes, now what would you like' was adopted, however, this can only be stretched so far before potential approaches to a Client can collapse; condemned if you do and condemned if you do not. Management tends to build on the basis of Clients requirements, however, when the Client changes its approach or even changes its Leader and department then the whole Management approach could potentially change or in the worst case scenario collapse completely. In this particular Case study consideration must be given that the Project Management Consultant (PMC) had its Project Director/Leader changed over Four times to include staff teams. The Client was particularly

difficult and had a tendency to change the design and then refute instruction; hence everything was instigated only after confirmation in writing. Regular Project Management Consultant (PMC) reports were completed by each department and collated into one document and presented and discussed each month. The JVC also prepared weekly and fortnightly reports which were presented to the Client and PMC every Two weeks. Further reading of this case study will also reveal the Clients tendency to change or slow the rate of decision making responsibility.

5.6.2 Design

The Design was carried out in European Offices with sub-Design Consultants in the MENA Region. The Design Contract was written by the Client and Lead Designer – Architect along with fee scales for specific design functions and integrated into a FIDIC Design and Build contract. An agreed lump sum was accepted by the Consultant Design Team for all working drawings which also included the BIM at concept only. The Design Team only visited site each time after agreeing fees and gaining an instruction from the Client. Liaison with Statutory authorities and Civil Defence (Fire department) had begun but ceased in 2007. All of the remaining working design to include BIM became in accordance with the Construction contract the responsibility of the JVC. Many of the design questions raised by the JVC were resolved by Design Management arranging telephone discussions by appointment with the European Design Team. Confirmation of the agreed design information was followed up by email. It became more and more difficult to arrange these meetings due to the Clients delay in fee payments. More and more design queries were resolved by the Design Managers with confirmation of action copied to the design disciplines.

5.6.3 Building Information modelling (BIM)

The contract requirement for BIM on the project for its time of design inception must be considered as 'state of the art' because at commencement no other Mega project within the MENA Region included or had BIM or at least was unheard of. The resultant factor lead to the Clients misinterpretation of the BIM contract which later resulted in dispute and consequential claims for additional budgets and extensions of time. This case study will not go into finite BIM events and detail but only provide an analysis based on the design and construction challenges and misdemeanours.

The Design Team did not provide a complete BIM design model at tender. BIM Protocol (CIC/ BIM 2013) would have prevailed. The Model was to be assembled entirely by the JVC. The only information provided by the Design Team was the Geometry. It was the responsibility of the JVC to provide a complete model managed by a Model Manager encapsulating all levels of design to include agreement on model access, security, transmission, and archiving. The more important aspect was a software matrix that clearly defines the totality of the model. The legal and contractual issues and responsibility lead to a dispute board. The Client should have taken the lead on these issues, however in the 'Design and Build' contract it was disputed that it should be the JVC. The powers and responsibilities of the BIM Model Manager should have been set out in the process and protocols within the Contract and both PMC and JVC Managers scopes and responsibilities clearly defined. The roles of other parties and stakeholders in the BIM process should also have been clearly outlined.

5.6.4 Procurement

The packages devised by the Design Team were substantial. The JVC had initially created a procurement programme which amalgamated packages together lowering the risk of gaining materials in a 'Just in time' aspect and reducing further risks of price increases. Major packages such as Chillers, Escalators and Passenger Lifts were given an accelerated purchase programme often to the disliking of the Client and PMC. Quality control was therefore compromised and follow up documentation was unsatisfactory. Subsequent payment was held back and irrespective of the incorrect processes the JVC initiated claims and disputes.

5.6.5 Specialist Packages

The specialist packages consisted of all highly technical Facades, a complicated Geometrical Concrete Roof, Glazing, Building Management Units (Cleaning Cradles - BMU) Exhibition Furniture Cabinets and an Exhibition Design Specialist. All specialist packages were of a Provisional sum. Timing in placing orders in accordance with the JVC programme was important especially when coordinating with other packages of dependency to avoid delays. The appointment of the Provisional sums became an issue and subsequent dispute which surmounted from Both JVC and Client prolonging the procurement process, to include changes to the process of procurement and review of the clauses and sub-clauses to the contracts.

5.6.6 Commercial

Due to issues with the Client over financing all of the works within the contract was Micro scrutinised. From payments to works completed outstanding payments due to the design team and advanced payment percentages to the provisional sum packages. The process of agreeing payments and scheduling

the Budget became very difficult with the Client. Commercial 'In House' meetings were scheduled regularly with all departments of the PMC and Design was a common denominator.

5.6.7 Planning

The Design, procurement and construction deliverables were reviewed on a weekly basis. The PMC Design Review Team analysed the critical path of the design deliverables. The overall programme was complicated and until analytically reviewed by the planning department the majority of the team only partially understood its content. A specialist Planning Consultant was commissioned to report on the content of the programme and after one month provided a report which was fully explained at a meeting with the Client. There were many aspects of the programme and comparisons to the works on site, procurement and design that highlighted JVC failure to comply. The JVC then agreed to amend the programme. Weekly design deliverable programmes were only issued toward close of business the day before a weekly review meeting which nearly always highlighted many design drawings, method statements, Material approvals and site inspections as late or beyond a 21 day review period. Reports of the BIM programme were reported in the same manner. Many of the reasons for PMC programme overrun was due to the lack of JVC due diligence regarding contents of all design drawings issued and relevant information such as specifications and quality control documentation all of which were reissued in some occasions several times which in turn delayed the design review and construction departments. The 'Knock on' effect caused by the JVC was eventually highlighted at a dispute board. Many other aspects of construction misdemeanours became apparent within the review of the programme to include the continuance of the late design deliverables.

5.6.8 Program Management - Process and Protocols (P&Ps)

Program Management was controlled initially by the Construction department and then passed to the QAQC department. The reason for this was due to under resourcing and Client failure to agree additional staff. Each department leader was responsible for maintaining and updating their P&Ps for inclusion into the Quality Plan. This was then referred within the Project Management Plan (PMP) Most of the emphasis of Program Management was focused on Design, Planning, Construction, QAQC and Risk Management. The Design P&Ps reviewed by the PMC were changed not only as an updated record of review methods but to improve methods of review with the JVC which had declined over a period of time. Express design reviews were introduced. The proposed shared BIM review sessions improved relationships with the JVC and by advising to the appointment of a BIM specialist as well as BIM Managing and upgrading computer hardware revitalised the design processes with the JVC more efficiently.

5.6.9 Quality Assurance, Quality Control (QAQC)

Unfortunately again, due to under resourcing, Management allocated the responsibility of the Document Control (DC) department to Quality Control. Records and general documentation for Material samples and site inspections as an example were kept and shared with DC and hence why QAQC were allocated the responsibility. However, this did exhaust QAQC Management. P&Ps were devised and arranged by QAQC with the Design Managers for Site Inspection of Prototype works, Mock ups, and permanent Benchmark works which could be compared to remaining site works installation of any description. The Inspections focused on Concrete works, Steel (Structural Design Discipline) Façade Engineering, Stone Floors and Walls, Block-Work

(Architectural Design Discipline) Plant and equipment, Duct work, Pipe work, drainage and fire fighting installations (MEP Design Discipline) External works (Landscaping Design)

5.6.10 Construction

The Construction department was equally challenged by the JVC along with the Design department and the constant requests from the Client for design changes. From a PMC perspective it is essential to maintain communication between both departments. There were not only design changes that affected the programme but site issues created by the JVC. Some of the design submissions were reviewed by Design and Construction and immediate on site design was expedited by arranging meetings between all disciplines necessary and the Client by advance request. Works Method statements were also actioned in the same way, often being reviewed several times if the construction method required substantial description to the works and could potentially compromise the design.

5.7. Analysis and pertinent issues

Having given a broad but not exhaustive description to the complexities of the Second Case Study, the PMC and site team were again faced with Management challenges in assisting the Client through Design, Procurement and Construction and to target an acceptable Project Handover along with all disputes overseen by a dispute board in line with the FIDIC contract. The Design Management functions achieving delivery and suggested improvements are also given below; this follows with the same order of above Headings.

5.7.1 The Stakeholder

When challenged with financial implications it is not easy for the Stakeholders to manage effectively and a grave mistake to cause constant dispute,

interruptions to programme and disparity in the ranks together with unreasonable changes to staff personnel throughout the project including Stakeholder. There has to be clear direction and priorities given. Budget has to be very carefully controlled. Design at working and shop drawing stage in an ideal world should be frozen. The Brief and Contract for the project should cover every aspect. A logical and well analysed holistic and strategic approach and a better defined group of P&Ps along with precise BIM itemisation would lead the project more effectively and avoid any digression and misunderstandings, with provision for better coordination cohesion and clear communication. SDM guidance assists the Stakeholder in analysing the project and provides Brief and Contract mechanics that suit his requirements more efficiently and provides a better management approach to programme, procurement and construction.

5.7.2 Design

The Stakeholder instructed the PMC early in the contract to review all of the Design teams design Information and when provided with a report used assumptions of poor design to reduce design fees. Had the Stakeholder paid what was fair for design services and arranged regular on site monthly meetings in accordance with design contract agreements, any design queries from any discipline on the project JVC included could have been resolved. The events that followed the design ignited a dispute board in accordance with the FIDIC contract and resulted in long term accumulated legal fees, and protracted loss of department management staff time in preparing for defence and offense documentation. SDM approach to dispute would be to control disputes through organised documentation and an Executive Board of Representatives written in the contract to meet on a monthly basis and agree

solutions to any problematic factors. The Design team like wise represented by its Lead Designer would be part of the Board. In effect the Board is a Task Force for moving the project forward. Strategically it should be imperative that the contract stipulates 'on site' attendance by the Design Team or its representative irrespective of fees which were agreed prior initiating the design.

5.7.3 BIM

The Clients full requirements for the BIM should be discussed and clearly defined within the Brief and cross referenced and referred in detail within the Contract (CIC/BIM Pro Appendix 1; 2013) There should be no disparity about any of the BIM P&Ps to include BIM Leader and team organisation. A Matrix of content and agreed Method statement - execution Plan for the Model from Inception to completion should be clearly defined. 'As Built' and Facilities Management for the Museum should have also been clearly defined. The Visual Design, and follow up iterative design process, level of design must be clearly defined and where each design discipline adopts in sequence. The BIM could have also utilised 4D Programme planning and 5D commercial Budget reviews. Part of the BIM was used for cost analysis but only for area totals and number of components.

5.7.4 Procurement

The JVC overall programme detailed procurement deliverables, however the reality of the process did not coincide, hence Material components were either ordered too late or too early with a resultant reactive rather than proactive management tendency. Strategically the Programme must integrate clearly between Design, Procurement and Construction. Weekly procurement meetings would also highlight progress and status of all packages.

5.7.5 Specialist Packages

Due to the size, technicality and design integration factors these packages, Facades by example, should have been expedited more efficiently at the commencement of the project. SDM looks at innovative ways in which Façade Engineering can be detail designed early and integrated with BIM. Major packages should not prevent any form of design progression. The earlier such packages are appointed the less coordination problems occur.

5.7.6 Commercial

Regular meetings to inform and or update commercial Managers with regard to design and factors related to design allows for the budget to be accurately defined without any future hidden surprises. Maintaining design changes (or not having any) under control and guiding the Client through the potential JVC changes regulates and assists controlling Budget. Delays in decision making often creates ambiguity and subsequent claims and disputes.

5.7.7 Planning

Planning is a focal communicative and measurable tool that is a primary function of SDM. The planning review by a specialist could have followed up with a series of meetings focusing on a forward planner type approach reviewing works on a Two, Four and Six week look ahead on Design, procurement and Construction. The programme provided by the JVC was too complicated and tended to camouflage outstanding items of work. Micro programmes focusing on specific construction areas of work simplifies and communicates a clearer picture of proposed works and communicates to various departments items that require further attention or that can be measured or expedited (Newton, 2008)

5.7.8 Program Management - Process and Protocols (P&Ps)

Passing the responsibilities from one department to another creates Confusion and later continued responsibility creates management challenges by original personnel responsible. The tendency is to allocate P&Ps to QAQC and Program Management to the Operations Manager. This should be shown within the Personnel organisation chart and documented within the PMP. P&Ps should be updated to reflect how the works are being managed and expedited at least by review on a Quarterly basis with new P&Ps to suit changes within the project showing how P&Ps improve efficiency.

5.7.9 Quality Assurance, Quality Control (QAQC)

QAQC and Quality Design Management tend to work closely with one another. Strategically it is essential to monitor the key components of construction and control repeat works by comparing Benchmark signed off works. Without the Benchmarking of specific work qualities only allows quality stray and ultimately design compromise. The Components born from design should have good examples and collective documentation for sign off by the design team and Client. Strategically, specific specialist design packages should be listed for ultimate scrutinisation within the Brief and advised by the DM even prior to tender. A list of P&Ps should also be agreed and understood by the Client who ultimately has the control of agreeing any component quality. Façade Engineering is a prime example of Quality protocols.

5.7.10 Construction

Design and Construction departments must ensure regular dialogue with each other and in many cases resolve problematic issues together with other departments such as Commercial and Planning. Design, Construction, Planning, Quality and Budget must be remembered as the Main items that any Client will be interested in and question on a regular basis. The 'Key stone' is

Design. SDM holistically reviews all but from a Design perspective. Therefore design communication with Construction is essential. Projects must alienate against the 'Them and us' situation which has occurred on many projects throughout the world. The communication on the Museum project was very good and design and construction worked together very well. The challenges at times by the JVC were frustrating and Client changes did not improve the situation. Enforcing Management administration and correct use of P&Ps and stringently insisting JVC conformance along with many on and off site meetings progressed construction. Insistency with design QAQC at commencement of constructing specific areas on site ensured design compliance.

5.8 Epilogue.

This Case study for the Mega Museum again only exemplifies a flavour of the project from a management perspective, the challenges that were faced and solutions to the main pertinent issues. The study provides primary research to evaluate and analytically compare to the First case study which then allows comparison to quantitative literature. The success of the Museum is heavily reliant on financing which will inevitably occur during a protracted contract and final completion date. The Architectural Design will indeed make another Iconic Building and will be recognised as much as other Museums such as The Great Court British Museum, The Guggenheim in Bilbao and the Louvre in Paris.

5.9 CASE STUDY ANALYSIS AND FINDINGS

Table (Figure 7) is an aid memoir to the Hospital and Museum Case studies, coordinating Quantitative and Qualitative analysis along with a referral to each chapter item reference of SDM Integral elements.

Hospital Stakeholder Management	Enhance communication with Stakeholders and ensure of a rigid understanding of requirements (Weaver, 2010)	Offshore Contract inadequate. Brief Changed significantly	Required a better Brief and robust interrelated contract and a frozen design.	5-9-1
Museum Stakeholder Management	BIM should be utilised throughout the complete iterative design process from 'Cradle to Grave' (Kouider et al 2009) Company Leaders tend to not understand the process and protocols of BIM and fail to create a robust strategic policy.	A Matrix of content, execution plan and agreed Method statement (BSI, PAS 1162-2, 2013) for the Model from Inception to completion should be clearly defined.	Stakeholder collaboration, Communication essential and understanding from all management. BIM to be clearly defined.	5-9-1
Hospital Design	Design requires a more holistic approach 'of greater understanding'	The breakdown and subsequent partial failures occurred during the working design.	More time, analytics and strategic processes defined and written into the contract. (use of FIDIC)	5-9-2
Museum Design	The management of Architectural design as well as Architectural management is still not marginally understood and defined. Controlling the design process requires more rigorous Design Management for project success (Bibby 2003)	Difficult to arrange design meetings due to the Clients delay in fee payments. More and more design queries resolved by the Design Managers	Control through organised documentation Executive Board of Representatives to meet on a monthly basis and agree solutions to problematic factors. Maintain Lead Designer	5-9-2

Hospital Procurement	Identify all significant work elements, assess their interdependencies and dependencies and organise the work so that orderly progress can be achieved' (BS7000 Part 4 2013;Project Planning)	Delays to major packages cause disruption to their associated dependencies; hence a holistic SDM approach defends further protracted coordination.	It is essential to Integrate design with procurement and construction and a successful strategy is gaining all agreements to a Master programme	5-9-4
Museum Procurement	The Process of Design; Pre-Construction, Procurement, Construction and Post Construction requires Change Management and a new strategy integrating the Design DNA generically.	Material components were either ordered too late or too early with a resultant reactive rather than proactive management tendency	Facades by example, should be expedited more efficiently at the commencement of the project	5-9-4
Hospital Commercial	The continuing Design Iterative process and its associated mechanics will only continue to create problematic tendencies leading to programme and budget breakdowns unless a new SDM framework is introduced.	Design deliverables were considered for the monthly evaluations and became debatable and ultimately disputed. Regular commercial meetings occurred and attendees included Client as well as Managers from various departments.	A SDM perspective advising the Client on Major procurement packages, enabling confident decisions with Design Management advice, and stringently adhering to a Master programme enlightens the Client, stimulates the process and avoids construction implications and payment delays.	5-9-5
Museum Commercial	Regular meetings to inform and or update commercial Managers with regard to design and factors related to design allows for the budget to be accurately defined without any future hidden surprises	Outstanding payments due to the design team and advanced payment percentages to the provisional sum packages and agreeing payments and scheduling the Budget became very difficult with the Client.	Keeping any design changes (or not having any) under control as well as guiding the Client through potential JVC change regulates and assists controlling Budget.	5-9-5
Hospital planning	An effective and workable design programme is essential	The construction Master Plan should have been reviewed more	Strategic programme of events and	5-9-6

	to improve co-ordination (Riley and Horman 2001)	holistically	greater Holistic review and approach sets out a more beneficial programme of events (Refer Figure 6)	
Museum Planning	Integration and coordination of activities utilising specific resources to meet present day to day objectives partly resulting from strategic planning along with other management tools (Newton 2008)	The programme provided by the JVC was too complicated and tended to camouflage outstanding items of work.	Planning information can be achieved through the coordination process (Riley, <i>et al</i> ; 2001.) The DM with lead disciplines must create a fully integrated design Programme configured devised and agreed with all other Design Consultants, Construction and Client Management to enable a better pattern of 'forward planning' the design works.	5-9-6
Hospital Program Management	Applying Program Management can instigate managing several related projects, often with the intention of improving the organization's performance.	The Program Management is a large encyclopaedia file representing the Project Management Plan (PMP) Effecting the responsibilities and actions of every department.	Typically Program Management needs to identify and manage cross-project dependencies	5-9-7
Museum Program Management	Applying Program Management can instigate managing several related projects, often with the intention of improving the organization's performance.	Each department leader was responsible for maintaining and updating their P&Ps for inclusion into the Quality Plan. This was then referred within the Project Management Plan (PMP) Most of the emphasis of Program Management was focused on Design, Planning, Construction, QAQC and Risk Management.	SDM journeys one step further and visualises the design and or its requirements holistically and enables DM's through discussion and Macro analysis to create a guidance design programme that can be discussed further with all	5-9-7

			stakeholders and Clientele at the offset.	
Hospital P&Ps	British Standards (BS) 7000 Part 4; 2013 gives reasonable guidance on DM within the Built Environment and selects divisions of responsibility common to all methods	The P&Ps often changed to suit site activity. Accepted at tender and then challenged to try and gain additional time by the JVC.	P&Ps updated on the Project or a new format identified to suit the Managerial aspects in any of the essential construction processes. All department process' of installation i.e. Façade, Screed, Partitioning, Block Work, all MEP services Design Drawings, Material and Method Statements	5-9-8
Museum P&Ps	It is the Brief along with the agreed contracts that can be the success or failure of a project.	Due to under resourcing and Client failure to agree additional staff each department leader was responsible for maintaining and updating their P&Ps for inclusion into the Quality Plan.	P&Ps should be updated to reflect how the works are being managed and expedited at least by review on a Quarterly basis with new P&Ps to suit changes within the project showing how P&Ps improve efficiency.	5-9-8
Hospital QAQC	From a strategic stance the Design Manager should be given the ability to warrant decisions and agreements with the same authority as the Project Director	The JVC constantly undermined Materials, workmanship and site inspections. The Inadequate qualities during pre-construction prototyping, Mock ups and Benchmarking created delays in getting the Client to agree and sign off agreed works to move forward.	Types of Managerial principles must be clearly explained in the design section of the brief and the strategic principle understood by all JVC Construction Tender's and clearly understood prior to award of contract.	5-9-9

Museum QAQC	Design quality management principles (DQMP) are a fundamental group of rules and values that can be accepted as true and can be used as a basis for quality management (ISO 9000, 9001;2015)	Records and general documentation for Material samples and site inspections were kept and shared with Document Control. QAQC were allocated the responsibility. This exhausted QAQC Management. P&Ps were devised and arranged by QAQC with the Design Managers for Site Inspection of Prototype works, Mock ups, and permanent Benchmark works	The Components born from design should have good examples and collective documentation for sign off by the design team and Client. Strategically, specific specialist design packages should be listed for ultimate scrutinisation within the Brief and advised by the DM even prior to tender.	5-9-9
Hospital Construction	The majority of construction delays surmount to inadequate design and with poor information is more significant than site workmanship and management. This is generally attributed to coordinating and controlling the design process therefore requiring more rigorous Design Management for project success (Bibby 2003)	Fit Out was delayed either due to late procurement, design or failed Quality procedures. Due to design and quality in construction the programme became substantially protracted and resources became reduced due to non payment	A SDM perspective advising the Client on Major procurement packages, enabling confident decisions with Design Management advice, and stringently adhering to a Master programme would have enlightened the Client, stimulated the process and avoided construction implications and payment delays.	5-9-10
Museum Construction	One of the many uncoordinated processes involves the Design disciplines QAQC processes and protocols and it is not until the Construction phase that these processes have to be faced and a common agreement met between all stakeholders.	The Construction department was equally challenged by the JVC along with the Design department and the constant requests from the Client for design changes.	Design and Construction departments must ensure regular dialogue with each other and in many cases resolve problematic issues together with other departments	5-9-10

Figure 7 Pertinent issues from analysis and primary research

5.9.1 Stakeholder Management.

Stakeholder management is essential for mega-project success. It takes the lead over every aspect of management and includes every department inclusive of Client (Section 3.6) Managers and Contractors. The outcome of a project can be seen in a positive or negative way. The project team must identify and understand their Key Stakeholders and communicate effectively.

The Heathrow Airport Terminal 5 (Weaver 2010) typifies what can be a great success and failure. T5's contract with Contractor and specialist contractor was well thought out and agreeable to all a 'No blame every gain' hence everyone worked as a team. The opposite occurred at the Wembley Football stadium complex in London (Daily Mail web site, No date) whereby all matters of the contract were flawed disputed and delays were regularly reported by the Media. All of which could have been avoided with a better strategy and communicative approach.

The Stakeholder Management within both case studies made fundamental mistakes prior to award of contracts to the Contractors. Both projects required a more definitive brief (Section 3.6) and comfortably interrelated with the contract (Oracle white Paper, 2011) The Hospital was based on an offshore contract and the Museum had a confusing misinterpreted contract consisting of many volumes. Both could have been compiled with an SDM approach. Both projects should have had a robust Brief to include a fully understood and coordinated BIM document and matrix in the case of the Museum. The Client must be fully understood and supported (Gillespie, 2002) to compile the correct documents and for example understand the complete design iterative process and all associated elements involved with design along with the business understanding (Bredemeyer et al 2006)

5.9.2 Design

Both case studies reveal that the Design requires a more holistic approach (Section 2.2) of greater understanding. In both cases the management of Architectural design as well as Architectural management were not marginally understood and defined and lead to a multitude of indecisiveness and subsequent disputes. Controlling the design process requires more rigorous Design Management for project success (Bibby, 2003) the common difficulties of managing the design of both projects was the breakdown and subsequent failures that occurred during the working design. The absence of the Lead Designer and difficulty in arranging design meetings due to the Clients delay in fee payments ultimately lead the projects into vast disparity. More and more design queries were resolved by the Design Managers. Strategically, design must be controlled through organised documentation and any disparity should be raised through the hierarchy of the organisation up to the Executive Board of Representatives who generally meet on a monthly basis and agree ultimate solutions to problematic factors. The Design should be represented by the Lead Designer, however, changes this decade such as BIM warrant Design Managers to also be Project Directors and facilitate same as the Lead Designer at Board level. This is because BIM includes design and other entities such as programme and budget. More time, analytics, and strategic processes should be defined and written into the contracts such as the use of a FIDIC contract.

5.9.3 BIM

Within the case studies; BIM was not utilised on the Hospital. It was too early for its use in the MENA Region; however, its use would have been overwhelmingly set as a huge success (Section 2.3) and would have overcome many aspects described earlier as programme delays and budget dispute.

Coordination would have been easier and huge amounts of time and money saved over 'Clash detection'. The Model also traces history of any design changes and the major changes and restacking of floors and departments would have given the Client Stakeholders a better understanding with 3D walkthroughs and prevented many meetings. One of the strategies to avoid as in the case of the Museum is problematic situations which require reworking. An example of this would be of the Lead Architect giving away minimal BIM (concept) information at tender stage and then for the Contractor to finalise all information at Design and Construction; then the Client Changes significant areas of the design. The threat of additional cost enters the equation and potential programme delays only to be resolved via a dispute board. Agreeing and implementing a BIM execution plan (PAS 1162-2; 2013) overcomes the particular problem (Section 3.3).

5.9.4 Procurement

Both projects were given a list of packages provided by the Design Disciplines which was reviewed and re-collated by the JVC's. Each Package, Major and Minor was agreed and significant work elements identified assessing their interdependencies and dependencies and organised the work so that orderly progress could be achieved in accordance with the programme. (British standards, BS7000 Part 4 2013) The primary and generic mistake was that all Stakeholders were indecisive and the JVC's failed to adhere to the procurement period allocated within the programme.

The procurement process of Design at Pre-Construction, Procurement, Construction and Post-Construction requires Change Management and a new strategy. It can be suggested by example of not improving the existing process be it Design and Build, Construction Management or Traditional type

contracts but rather that the design contents can be integrated using BIM (2D and 3D) and generically use design component information from a library of specialist contractors (Section 2.4) interrelated with the designs provided by the Design Disciplines. Delays to major packages on both projects caused disruption to their associated dependencies; hence a holistic SDM approach of maintaining programme and placing orders on time defends further protracted coordination.

Material components were either ordered too late (Hospital) or too early (Museum) with a resultant reactive rather than proactive management tendency.

It is essential to Integrate design with procurement and construction and a successful strategy is gaining all agreements to a Master programme. SDM can look at a dynamic fully coordinated programme that gives support to Design, Procurement and Construction prior to Contractor award of tender. BIM now provides potential for coordination of the design (Section 2.3) 2D, 3D, Programme 4D and commercial Budget 5D (Song *et al* 2014)

Facades by example should continue to be expedited more efficiently at the commencement of the project and before the procurement process. This is well known, infiltrated by the Architect and has been successful on many projects. Both the Museum and Hospital reviewed the Façade Packages directly after the Concrete Structural component design by the JVC's. MEP is an example of another Major Package reviewed prior to other procurement packages.

5.9.5 Commercial

The Museum project had regular meetings to inform and or update Commercial Managers with regard to design and factors related to design to

allow for the budget to be accurately defined without any future hidden surprises (These meetings remain confidential) The Quantum problem was financial and Stakeholders tended to often Value Engineer the design, and absence of the Lead Designer due to payments did not eradicate the requirement for resolving design issues on and off site or review major packages such as Facades. The Hospital also had similar circumstances.

Design deliverables were considered for the monthly evaluations on both projects and became debatable and ultimately disputed. Regular commercial meetings occurred and attendees included Client as well as Managers from various departments. The Client for the Hospital was informed of every forthcoming meeting and in most cases attended the majority. This was useful and the Client was very much part of the team. The Client at Museum however tended to only attend monthly meetings often misunderstanding historic actions and questioning or requesting unnecessary follow ups. This confused the JVC and in some cases lead to dispute, the majority being financial. Outstanding invoices due to the design team, advanced payment percentages involving the provisional sum packages and agreeing payments and scheduling the Budget became very difficult with the Client. The Hospital ongoing absence of a Lead Designer and subsequent protracted design issues and resolution by the Design Managers resulted in regular monthly payment disputes.

The Design Iterative process and its associated mechanics will only continue to create problematic tendencies leading to programme and budget breakdowns unless a new SDM framework is introduced. A SDM support to the Client on Major procurement packages, enabling confident decisions with Design Management advice and stringently adhering to a Master programme enlightens the Client, stimulates the process and avoids construction

implications and payment delays (Section 2.2). Stakeholders must agree to maintain the Design Team by local representation throughout the Project on and off site. The flow of design information and resolution of any queries makes the Client more comfortable and understood and a clearer approach to agreeing monthly payments. Keeping any of the design changes (or not having any) under control, as well as guiding the Client through potential JVC change regulates and assists controlling Budget. (Jack, 2013)

5.9.6 Planning

The Hospital Construction Master Programme should have been reviewed more holistically. Many early events and Key Performance Indicators (KPIs) were never met. Design Deliverables due to changes in the Design Team and its design and subsequent absence paved the way for failure. Unlike the Hospital programme the Museum programme provided by the JVC was too complicated and tended to camouflage outstanding items of work. In both cases the integrated Design Deliverables and transition of deliverables into procurement was not met and eventually caused payment and programme dispute. An effective and workable design programme is essential to improve co-ordination. It is essential to Integrate and coordinate activities utilising specific resources to meet present day to day objectives partly resulting from Strategic (Section 2.2) Planning along with other management tools (Newton, 2008) A strategic programme of events and greater Holistic review and approach sets out a more beneficial programme of events that can be understood by all Stakeholders. Planning information can be achieved through the coordination process (Riley and Horman, 2001.) The DM with lead disciplines must create a fully integrated design Programme configured devised and agreed with all

other Design Consultants, Construction and Client Management to enable a better pattern of 'forward planning' the design works.

The emphasis is therefore predominant for SDM to discuss in an analytical format with Client Stakeholders before any form of tendering. The programme can also be coordinated with the assistance of the Design Disciplines and include potential Major specialist packages such as Façade and MEP.

5.9.7 Program Management

Program Management is consequential actions arisen due to adhering or not adhering to the processes and protocols (Martinelli *et al* 2014) both projects had their processes written and administered into the contracts. The effective program management was only as good as following a procedure that for the majority was taken for granted as a procedure that everyone had worked to on previous projects, revised to suit the status quo and actioned to resolve anything to get the job done. The Hospital Program Management is a large encyclopaedia file representing the Project Management Plan (PMP) effecting the responsibilities and actions of every department. Apart from adding processes every department tended to work to their P&Ps. The Client collaboration was also met, whereas with the Museum much of the teams P&Ps were partly utilised, changed or withdrawn altogether due to lack of resource. The common factor for both projects was that the Clients Stakeholders did not have a PMP or a QMP and never coordinated with the key players.

Both project department leaders were responsible for maintaining and updating their P&Ps for inclusion into the Quality Plan. This was then referred within the Project Management Plan (PMP) Most of the emphasis of Program Management was focused on Design, Planning (Section 2.5.1) Construction, QAQC and Risk Management (Section 3.4)

Applying Program Management can instigate managing several related departments or projects, often with the intention of improving the organization's performance hence SDM Program Management is an essential management tool that should be discussed and implemented at the Client stakeholders first meeting.

5.9.8 Process' and Protocols

The common denominators with both projects were that the P&Ps changed to suit site activity. With the P&P, QMP and PMP accepted at tender they were then challenged by the JVC's to try and gain additional time and cost. The British Standards (BS 7000 Part 4; 2013) gives reasonable guidance on Design Management within the Built Environment and selects divisions of responsibility common to all methods.

It is the Brief along with the agreed contracts that can be the success or failure of a project and the Brief and Contract sets out the P&Ps (Section 2.5). The Hospital was for a time reasonably resourced however with the Museum due to under resourcing and Client failure to agree additional staff each department leader was responsible for maintaining and updating their P&Ps for inclusion into the Quality Plan. P&Ps for the projects were updated or a new format identified to suit the Managerial aspects in any of the essential construction processes. All department process' of installation i.e. Façade, Screed, Partitioning, Block Work, all MEP services Design Drawings, Material and Method Statements generally complied and often lead to protracted design and construction drawings and documents resubmissions brought about by lack of due diligence. Site protocols often became the discussion of dispute. P&Ps should be updated to reflect how the works are being managed and expedited at least by review on a Quarterly basis. New P&Ps can be introduced

to suit changes within the project showing how P&Ps improve efficiency. Compliance with regular use of the Quality Management plan assists with this required process. Quality Management system, Design; (ISO 9001; 2015)

5.9.9 Quality Assurance, Quality Control.

Design Management and QAQC work closely with one another. QA assists the process of design and QC in maintaining that the design is not compromised. Many site Inspection processes documentation (Appendix A3) and overall conformance control assists Manager and Architect (Section 3.5). From a strategic stance the Design Manager should be given the ability to warrant decisions and agreements with the same authority as the Project Director

Design quality management principles (DQMP) are a fundamental group of rules and values that can be accepted as true and can be used as a basis for quality management (ISO 9001;2015)

The Hospital JVC constantly undermined Materials, workmanship and site inspections. The Inadequate qualities during pre-construction prototyping, Mock ups and Benchmarking created delays in getting the Client to agree and sign off agreed works to move forward. Similarities occur on many other projects in the MENA region and the Museum inclusive. The Museum records and general documentation for Material samples and site inspections were kept and shared with Document Control. P&Ps were devised and arranged by QAQC with the Design Managers for Site Inspection of Prototype works, Mock ups, and permanent Benchmark works.

The Hospital contract Managerial principles should have been compiled more clearly to explain the design sections of the brief and the strategic principle understood by all JVC Construction Tender's and clearly understood prior to

award of contract. For the Museum the same principle applies to include BIM in more definitive detail.

The Components born from design should have good examples and collective documentation for sign off by the design team and Client. Strategically, specific specialist design packages should be listed for ultimate scrutinisation within the Brief and advised by the DM even prior to tender.

5.9.10 Construction

The majority of the Hospital construction delays surmounted to JVC's inadequate timing of design and poor quality of information along with inadequate site quality control and failure to meet programme. This was generally attributed to coordinating and controlling the design process therefore requiring more rigorous JVC Design Management for project acceptance which was only acceptable with the assistance of the Client PMC Team (Bibby, 2003) whereas the Museum was mainly plagued with design changes before and during construction and continuous financial implications. Fit Out was delayed either due to late procurement, design or failed Quality procedures. One of the many uncoordinated processes that occurred on both projects involved the Design disciplines QAQC processes and protocols (Section 2.5 and 3.5) and it is not until the Construction phase that these processes have to be faced and a common agreement met between all stakeholders.

A SDM perspective advising the Client on Major procurement packages, enabling confident decisions with Design Management advice and stringently adhering to a Master programme (Riley and Horman, 2001) would have enlightened the Clients, stimulated the process' and avoided construction implications and payment delays (Section 3.7.1).

Design and Construction departments must ensure regular dialogue with each other and in many cases resolve problematic issues together with other departments. Both projects consisted of good in house communication and subsequent management and advice and assisting the JVCs with the design process prevailed but quality issues, site Inspections followed with disputes, budget and programme claims delayed both projects significantly.

CHAPTER 6

OVERALL ANALYSIS - CONCLUSION AND RECOMMENDATIONS

This chapter's conclusion and recommendations are based from the Qualitative and primary research analysis. Further recommendations are initially perpetrated in Chapter 5; however, future further research into the protracted requirements of SDM will reveal additional values to support the new framework. The majority of Construction personnel at any level still seem to steer the Design Manager toward an alliance with the design disciplines giving excuses of why the Architect was late in providing information that was needed on a specific packages to allow procurement of components. Timing and planning only seem to frequent around suppliers and manufacturers and not the source that is needed to correctly implement and construct what was originally design intended. The knowledge of Managing the design process is shallow. The DM is constantly challenged by hierarchy often to the point where programme and budget compromise design. Construction projects still remain one of the most ignored areas with regard to design and project management techniques still show incapacity for solving design management problems on complex and mega projects (Kemmer et al 2011) Strategically this trait must change and more value must be seen with the DM in the very early Pre-

contract stages. This has tended to occur on contracts such as Public Funded Initiative (PFI) projects

6.1 The Design Manager

The Design Manager has evolved in the last three decades from Document Control to potential Boardroom status. The DM now becomes very much involved in all aspects of a project development business; hence strategic alliance is extremely important. Prior to different forms of contract, looking at traditional construction, the Architect was the pinnacle of any development.

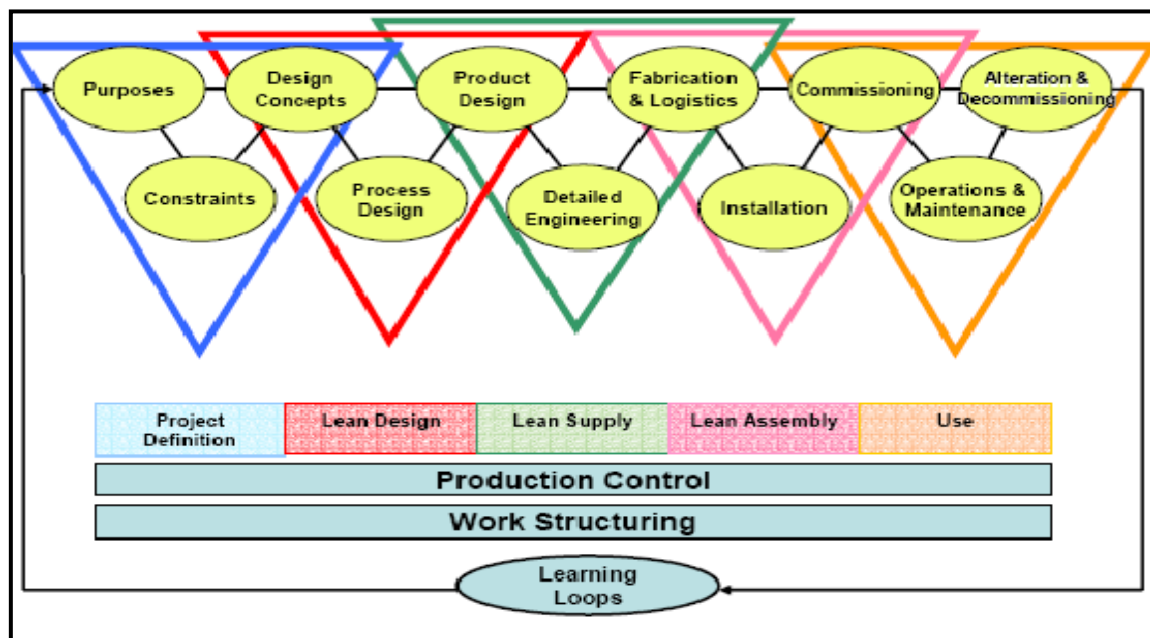


Figure 8 Lean Project Delivery System (Ballard, 2008) (Kemmer et al 2011)

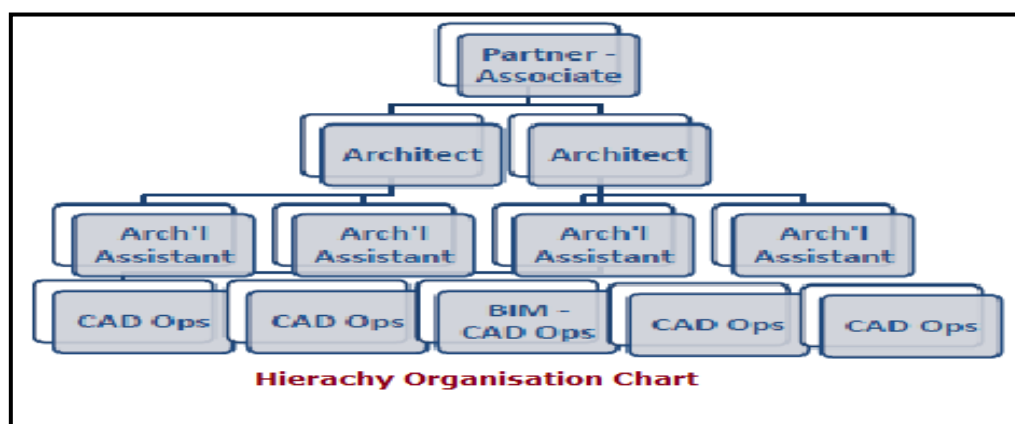


Figure 9 Typical Architectural Personnel, Standard Project

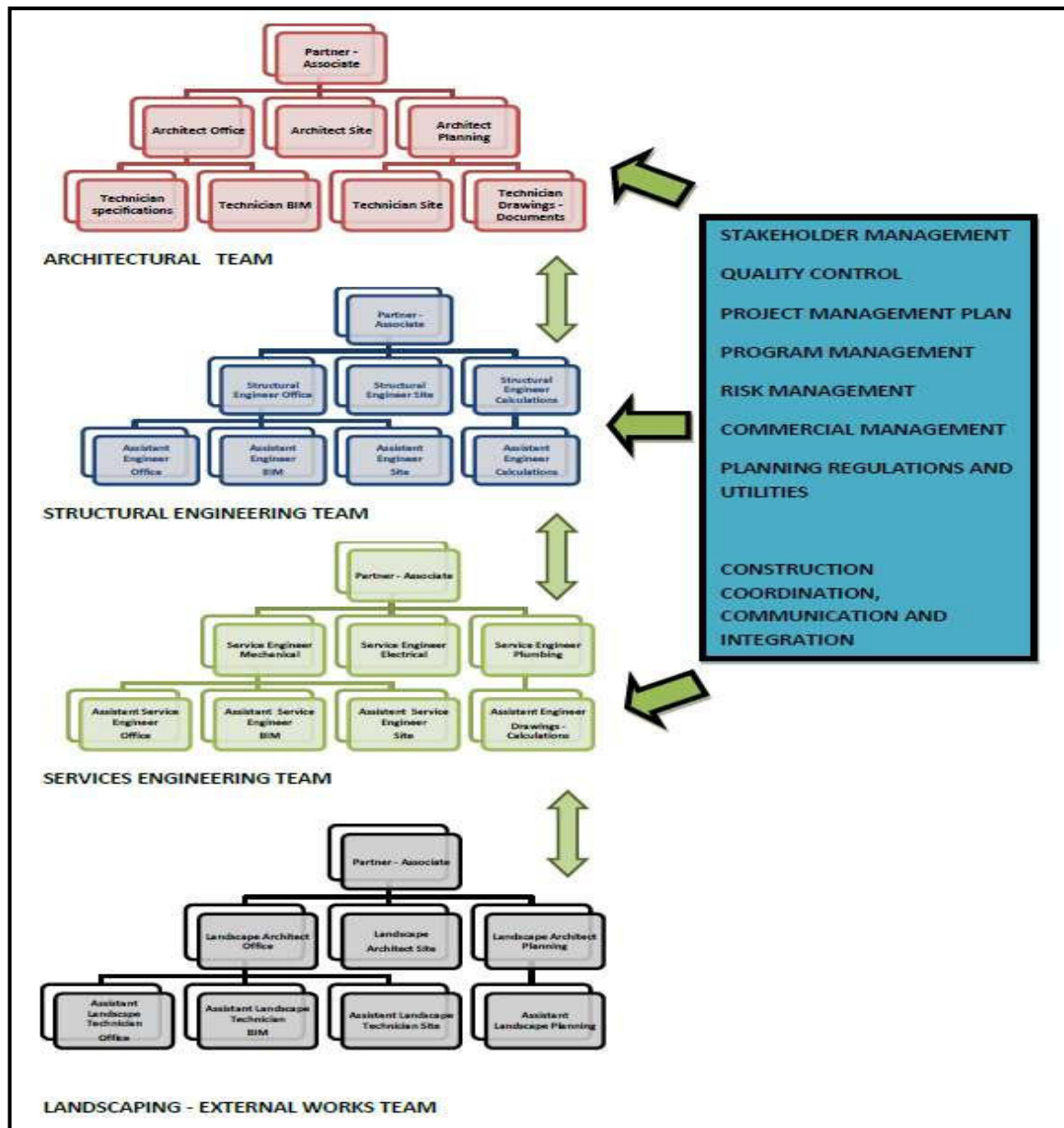


Figure 10 Mega Project Personnel

He has lost part of that position by the Built Environment creating specialist trade contractors who include overall working design today. The majority of working design 'fit for purpose' has transpired to the responsibility of the specialist trade contractor. This leaves the Architect with the guide of basic concept and sketch design only.

BIM has further shadowed this once endless scope of responsibility by piecing the specialist contractors working design together with other trades. The

Architect only paints the picture. (Figure 8) Blue and Red triangles. Control of the working design in its risk, commercialism, build-ability, co-ordination, programme, QAQC, Project and Construction Management has become the responsibility indirectly of the DM. Green – Yellow triangles. The Organisation Chart for Architectural Personnel (Figure 9) has changed considerably and expanded (Figure 10) Design Practices have become more cautious with their Insurances and caveats of the contract that have become overcomplicated often resulting in delaying commencement with Clientele until contractual obligations are resolved. A presence on site has diminished considerably too often with an agreed 'On site Lead Architect' period which tends to dissolve rapidly without any presence after the agreed period perhaps due to Client disagreement or arbitration potential amongst other reasons. This is particularly exemplarily in the MENA region and Lead Architect includes all other Design Disciplines. Often the Design Manager (a combination of PMC DM and Contractor DM) heavily supports all site operatives in resolving construction activity misdemeanours and are a true ally to Clientele and Stakeholders; however, this is only through managing the design effectively and not designing. Other QAQC diminished responsibilities seen more by the DM include;

- **Prototype Construction.** A learning curve of building the design and applying design amendments mainly to suit build ability.
- **Mock-ups.** Example of Materials proposed and quality of workmanship.
- **Bench-marking.** Installation of Material and workmanship that will be part of the permanent development and further used as an example of comparison to the remainder of all the installation. A good representation to all of the above is Façade Engineering. The new age calls for an overall review by the

Royal Institute of British Architects (RIBA) along with other Institutes such as the Chartered Institute of Building (CIOB) and further review from a Global aspect. The question asks per se if yesterdays working Architect (Technical) is today's Design Manager. The example of the personnel organisation chart (Figure 9) can increase tenfold on Major and Mega projects but often surmounts to programme design deliverable requirements and timing of the procurement route. With these in mind team disciplines require extensive management. SDM is the pinnacle of controlling all overall but the strategy must be clear, understood and rigidly implemented. In early October (2015) the media presented the new Boeing 797 passenger aircraft and went on to make a sweeping statement that the Terminal docking facility had been

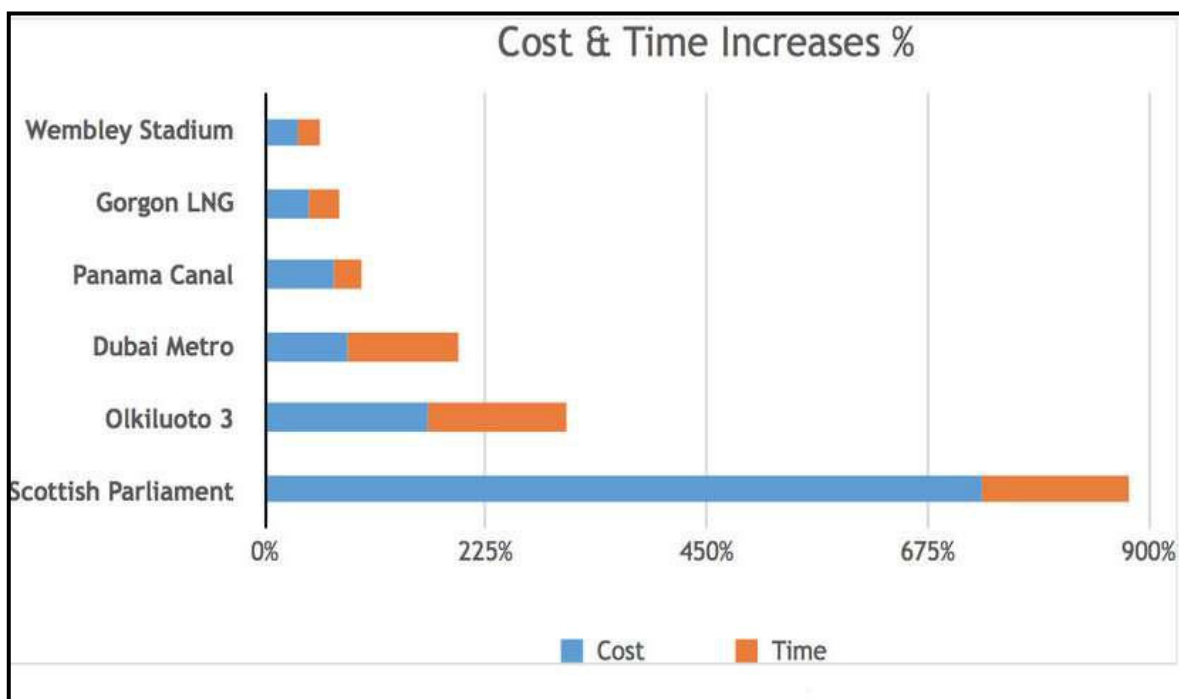


Figure 11 Iconic World Projects Listed

designed to match the Airbus A380. This is acknowledged but does the facilities allow for 1000 passengers to disembark into the terminal at any one time, and what if two or three of the same aircraft arrived at similar times? Looking at the factor from a SDM perspective, 1000 passengers equates to; additional toilets, a review of space planning, passport control, Baggage claim,

in fact the whole trajectory of design increases the requirement for Terminal facilities and subsequent long term expansion. Airbus then announced the possibility of future aircraft designed to carry Pods of Passengers which would allow them to board within the terminal dismissing the process of embark and disembark (Airbus, 2015) this sole proposal entices an airport terminal complete redesign. Reviewing holistically, the question arises as to whether the Design Scope and Brief included for expansion over a short space of time (4 years) and whether any Airport Terminal ultimately has the facilities for accepting the 797 yet alone the new Airbuses. The same P&Ps must apply. The same SDM must apply. Then SDM must also look at dependencies such as Civil defence means of escape, Mechanical Electrical and Plumbing requirements. The list of dependencies tends to grow very fast and when macro focusing and applying SDM analytics it becomes predominantly obvious that designing the 797 docking facility is not the solution to facilitating the Giant aircrafts birth into Airports, merely that another generation of aircraft needs to satisfy the skies of industry and will congest Airports even more. It would seem that Infrastructure has not taken into consideration Aviation Technology and merely continues to Master Plan only to suit present day requirements and not encapsulate the 'What if' of the future. Clientele such as BAA and BA seem to have only grasped the outer perimeters of SDM and require further guidance. London Heathrow Airport is a good example of this statement. Not long after Terminal 5 was complete that the thought of a new runway enters the equation. The same principles of SDM apply to any form of design and Design Management. The Case studies refer to Operating Rooms within a Hospital. To finalise the design, the layout has a programme allocation of around six months. This allows a design concept to grow and agree the correct number of

ORs to efficiently run the Hospital, hence many meetings with huge numbers of staff is required. But apply SDM is difficult when Change Management becomes part of the equation.

This management is less tolerable to the specialists groups that tend to cushion the status Quo. The time factor of Operations is the Key to the number of ORs required, however, applying design analytics and 'design based evidence' it is likely that the number of ORs required would decrease but interdependencies in this case similar to the Airport Terminal would increase. SDM Analytics again applies. By applying the SDM components a more holistic design consideration would become apparent. CIOB Global Construction Review (CIOB, 2015) reported that there has been an influx of Major and Mega projects around the World in the last Century that had been subject to programme delays and increases. Figure 11 provides a list of such Iconic projects. To resolve such cataclysmic disputes require expensive Arbitration routes and can run into millions of pounds due in many cases from misunderstanding documentation after aligning with Clientele Management or Construction Contractor orientations. Projects at present in Europe and the MENA Region continue in this way with a definitive upward trend to fail in budget and programme, all of which have been caused through design changes being the major denominator. Support advice and education are required to avoid the Iron triangle of Programme, budget and Quality disturbance especially Contracts, Records / Documentation, Technology and the overall approach to a project.

Any form of Contract must be clear and it's content to be the engine of collating and viably instructing and administrating all the works of the project

correctly without any doubt or misdemeanour. The Brief must encapsulate how the Clientele guides and requires the contract to be carried out. Therefore the understanding and management is critical. Allocating time to allow SDM analytics would bear a distinct advantage in preventing many failures that have resulted in Arbitration and prevent modifications that can potentially enhance risk.

Recording of all documentation is also critical and the day to day administration although often tedious and time consuming is an important entity. Such actions assist in the event of a project going to arbitration and or litigation. In some cases discussing and compromising over the meeting table does not work although many Pre-arranged coordination meetings tend to take the chill off any design ambiguity. Another such P&P that is effective and generally organised by the DM are Technical meetings which also now include BIM. This is the Key to future success but its recognition of BIM as just a 3D machine must be dismissed. BIM identifies many aspects of construction but it will not coordinate on its own and requires input. The commencement of BIM being crucial and to be fully understood by Clientele, hence SDM can pave the way forward for the Clientele.

There are several routes to resolving disputes and differing forums in different countries such as the MENA region have differing Jurisdictions often compromising one another. By example Egypt has their regulations as well as International. It is important to learn from those involved and how the P&Ps work. The question that remains is did any of the listed internationally flawed projects allow for a period of SDM?

Although the majority of companies be it, Consultancy, Contractor and design disciplines do have a strategy at executive level it is a reproduction of previous events without any innovation that tends to follow the status quo shaping a great deal of information to satisfy tenders throughout the year. Selection and decisions are only made to suit individual tenders. In general there is a genuine absence of SDM. Management tends to apply little process or protocols and 'shoe horns' design to make proposals attractive. An adjunct of this failure to achieve consistent selection is lack of leadership. The lack of unit leaders and decision-makers is apparent, and in support of this inconsistency fundamental mistakes have and are occurring within the Built Environment.

Some, though few leaders are naturals; the rest get there by mastery of their role, achieved only by familiarity. Familiarity is only achieved if repeated or if the designers come from a genuine design discipline background and not construction. Strategic Management gives a wider vision and holistic approach to employees of an organization and they can more appropriately understand how their project and position fits into the entire organisational plan and how it is co-related to other organisational members.

Client Leadership involves Design Management and SDM framework agreements that serve as a very important purpose within the Built Environment to develop longer-term relationships between customers and their suppliers. They can enhance and improve project deliverables in terms of programme, budget and quality; however, many public sector clients are not creating or managing their Strategic Frameworks rigorously enough to achieve benefit. One of the functions of CEOs in conjunction with the various departments of a company should be to ensure wider use and more effective

management of frameworks, where they are appropriate at every level of the company. The built environment requires a Strategic Design Management Framework that is agreed generically across the industry that can be adapted to suit competitiveness and improve construction. Acknowledging the strategies and management tools that exist within the Built Environment, further analysis across the industry is required predominantly to explain and provide new strategies to include Strategic Design Management. Construction projects are getting larger, and on the increase, many are mega, Iconic and highly technical, and involve very specialist designers and manufacturers. Towers that exceed the skyline, digital Hospitals, Shopping and Entertainment Centres, Sports Centres, Stadiums and new Rail Networks but to name a few. Clientele expect a faster project programme and a lower budget margin, all of which is being manipulated by companies within an industry that has been through financial turmoil and world disturbances. With many projects across the Globe involving Tender Bids from countries such as China the market is becoming more and more competitive. With regard to the 'Mega' projects, a focused strategy guiding and improving the DM should be adopted to include inventive innovation. The vertebrae of this strategy can immensely reduce confusion in the ranks and stimulate a more decisive way in creating more innovative solutions and gain rapid agreeable conclusions; a form of 'Lean' SDM. (Kemmer *et al* 2011) The coordination aspect of Mechanical, Electrical and Plumbing (MEP) by example in design and construction has been immensely improved following general consensus by UK Government rule and across the Globe to utilise BIM. Many other coordination aspects of working design have created vast improvement and in years to come the industry will wonder how construction was instigated without BIM. However, there are

other overwhelming items that continue to be evaded_and uncoordinated. These items can only be coordinated by Management and the design can only be lead coordinated by the Architect and resolved further by the DM. SDM should be integrated within all departments of construction. The DM works alongside the Senior Project Manager on most projects because design is part of the heart to any building. This transpires to account for everyone on any project and to include the Architectural Technician as a member of the team. Further integrated processes with key players such as the Technician and DM are required to provide more of a macro understanding of the detailed design which in turn provides better communication, enhancing and motivating the positions such as the Technician. Maintaining and understanding these processes produces a better work satisfaction and inevitably sends signals to the hierarchal Management. Better work satisfaction tends to result in better work output and consequently better results within the market place. Companies like Google promote this, but does this exist in Construction Teams? Creating a strategic process' and communication elements provide a better understanding of objectives and ultimate responsibilities. All players can be allowed to express new innovative methods and applications along with the rest of the team. This will enhance and improve both Information and performance highways utilising lessons learnt for example from previous projects and adhering to the guidance from SDM. The SDM processes can be applied to all Project Management Plans (PMP) and hosted by QAQC (QMP). It is the essence to the success of a project and prevents management of the design from straying or being compromised. Program Management is an important part of SDM and is the glue that binds PMP, QMP and construction together.

6.2. Strategic Design Management; Design and shared entities with Construction

Communication across the complete team spectrum is one of the most important aspects not just for SDM, however, in assisting and guiding the DM(s) the importance of design and its integration that follows into construction is a transitional process and highlights that the DM responsibilities occur from design inception to project completion. Figure 12 depicts the communication and involvement from design, associated entities and Construction integration. The processes must be agreed and included in the quality management plan and audited, reviewed and updated on a regular basis. The principles of the design quality plan clearly explained in the International Standards organisation and apply; Clientele focus, Leadership, engagement of people, process approach, improvement, evidence based decision making and relationship management (ISO 9000; ISO 9001) The design must integrate with all fellow design disciplines guided by the 'Lead

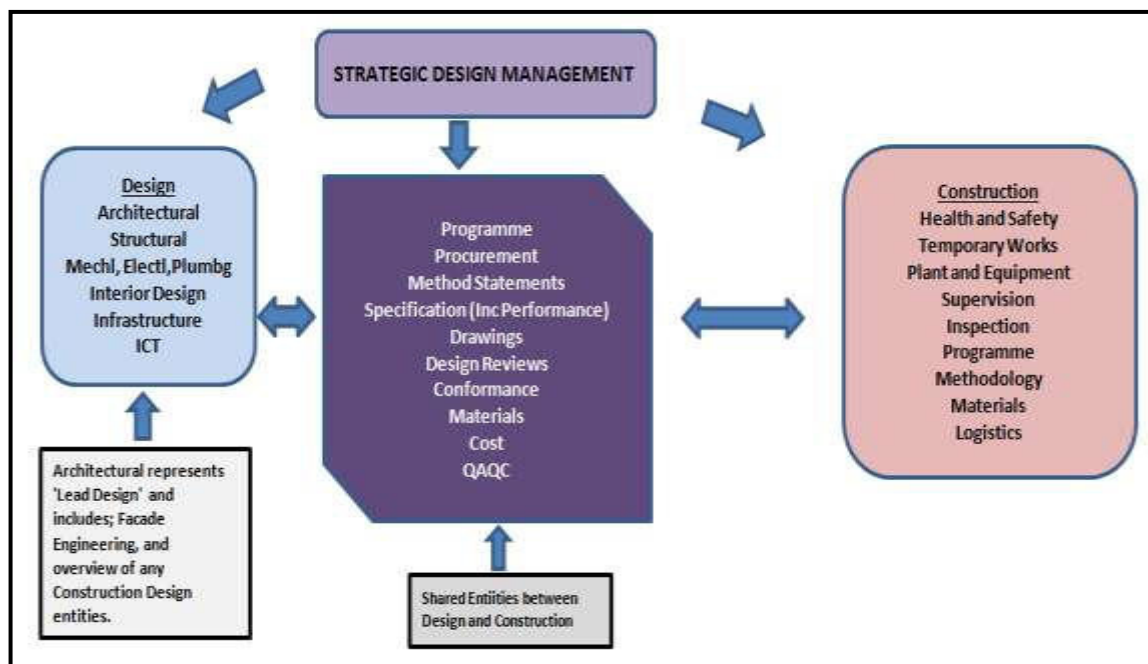


Figure 12 SDM Design and Shared entities with Construction

design' Architect. Progression of the design shall also be agreed by the Clientele, and depending on departments, Stakeholders to be inclusive. Sanction of this process enables the BIM to move onto the next stage level of design. Once design development is achieved then all design information can be brought together to form packages of information for tender (Procurement stage) The Pre-Construction and construction team must also review the design from a Build ability perspective. These processes require regular vigilance and an understanding by the team and not just Design. SDM must retain an acceptable dominance managed with perseverance, people management and a good understanding of change management; however, change management must be kept to an absolute minimum so that in the overall design process the design is not compromised. A robust example of change management abuse can be seen from the architectural decade of the 1980s where building design was stripped of its signature due to vast amounts of value engineering and design changes inevitably to suit budget with the resultant observation that most of the buildings looked similar. It was only by the part traditional build method or Construction Management that buildings gained the original Architects signature; Icons in London such as the Lloyds Building by Richard Rogers is an example. By introduction of SDM, design and budget are agreed and frozen by the Clientele even before contract tender award. The key is to retain robust design information that is technically sanctioned by construction and specialist contractors before the final route of the overall design process.

6.3. Strategic Design Management Program Planning

Theoretical Planning refers to the direction, coordination and integration to meet daily objectives. Further SDM focuses on more analytics within the

Design programme and its transition into Procurement and Construction. Activities need to follow a suit parallel to construction by using 'S' curves and critical path activities and Key performance Indicators (KPI's) for monitoring and auditing progress which in turn assists in advice to amend or revise areas that either will or have compromised the programme, and in turn increasing additional resources to realign works. BIM now has the capability of providing programme planning (4D)

The typical planning role is effective for monitoring, auditing, reporting and maintaining progress. Unless fully coordinated with the Design Team and with a macro dynamic design interrelated procurement programme the complete construction programme can be fundamentally flawed and inaccurate. Guidance through SDM with the DM and introduction of process and protocol to establish programme requirements can diminish any inaccuracies and achieve a realistic time framed series of deliverables. With working realism the BIM will provide a more accurate working overall programme (Elson, 2012) it is essential that any concept of design programming should be provided and implemented the day the Clientele is introduced. And Clientele must have achievable programmes. This can be achieved with SDM visualising the complete developments holistically. This process factor is vastly underestimated and Clientele must go through a new programme framework of programme understanding.

With traditional planning, if the Contractor was to produce an achievable programme at tender stage would they be engaged? It is well known that durations are rarely ever met all be it either Contractor or Client with their changes, design inclusive.

There is no reason why SDM could not produce a fully detailed programme to be novated at Tender; BIM can provide this. Non compliance and subsequent default in the programme tends to lead to damages and delay claims. There has to be 'a line in the sand' and the Built Environment has to change. Detailed programmes from tender stage should continue and there are many projects that complete on Time to Budget and exceed Quality. The improvement and assurance ally stems from holistic design planning from SDM. There is no reason why a Planner with process and protocol SDM could not produce a workable programme or workable programme by a consultant with BIM before tender. Traditional Contractors design programmes are inaccurate and most are not correctly coordinated due to poor Design Management. Implementing time within the BIM would correct this as long as it is by the Designer and not the Contractor and guided and agreed by the DM and SDM.

Good effective Planning is now being seen and implemented with the BIM. Planners are able to see design in a much improved dimension rather than the traditional drawing details and are more integration with Design Management. The Planners role is changing and integration with the DM (directed by SDM) due to BIM is occurring; The challenge ahead is going to be the BIM Control by the Architect who has the lead design throughout the life of the BIM project and because he fundamentally has the Key to the Whole Model. If it changes without Architectural approval the Building Changes, and differences across the project occur to include, Cost, Programme, Quality and the potential to compromise the design. Aligning SDM with the BIM, planning (4D)_model reporting can be improved with the visual aspect as long as it reflects what is actually happening. It is known that many reports during construction for the

Client are never read unless necessary. BIM along with SDM reduces all the endless notes and tends to make the report more realistic and appealing.

6.4. Strategic Design Management Leadership qualities

Leadership should not be about who is right, but it should be about what is right.

It must be accepted or at least acknowledged that there are many Managers within the Built Environment that do not understand the timing and process of design and tend to create a Leadership of demand, subsequently 'fire fighting' poor performance as the norm and value being politically correct more than being incorrect. Leadership is not a position or a title. It is not a job reserved only for a precious few presiding over their team structures. SDM is not to keep people from leadership, but to create leadership. It is found that the most successful businesses are ones in which everyone is considered a leader, Yahoo and Virgin as examples. Leadership that isn't transferrable, repeatable, scalable, and sustainable isn't really leadership at all. Design Management requires enhancing within an agreeable, lean, competitive strategic framework. SDM requires creativity built with teamwork and encapsulates members across a project team rather than status within an organisation chart.

Best Practices - Value engineering, change management, forward planning, weekly team meetings ,group cost analysis and Task force meetings.

There is nothing greater than solving problems no matter how technical and greater than an example of group analysis 'Many hands make lighter work' That is not stating that the conclusion is given by all but the ramifications and final précis is collated and finalised in SDM terms by the DM. Following best practices, QAQC, and various protocols protects the status quo and provides

innovation by ensuring that the teams follow the same process and protocols and methodologies. To differentiate and create competitiveness you have to steer away from sameness, and prevent reinvention of the wheel. SDM must innovate DM's beyond best practice and seek out new methods as old ones tend to fade after a period of time. This is purely from a management tendency and not with the design, for inheriting the technique in design leads to possible design compromise.

Value Engineering - Cost cutting is a risk and providing cheaper tenders only leads to client analysis and eventual loss of finance. The key is to invest smarter. Companies who prosper focus on management opportunities rather than risk. Hence estimation and procurement departments inevitably get given the upper hand over Design Management and it is not until manufacturers products are on site where claims of misunderstanding the design are shrouded in delays and claims. It is far greater to be less concerned with expenditure and more concerned with finding new ways to create greater return on investment. Laing O Rourke's Off Site Manufacturing (OSM) is an example of zero profit on the first use in projects – establishment, followed by future profit when using OSM on many other projects. Design was at the helm and critical decisions had to be made with the hierarchy inevitably guided by a form of SDM, but the resultant use of OSM will provide future profiting.

Change management- hosts many activities in construction and carries small medium and large risks. Planning, cost, design and site construction are the main entities. But with unwillingness to change outpaces most leaders and their ability to learn and leaders must not remain in the past; 'on the last project we did it like this' is yesterdays time warp. Only new creative tendencies will lead to a greater destination. Leaders who do not broaden or

allow broadening of new creative ways will ultimately be replaced by those who want effective change.

Forward planning – Does not mean berating the Contractors because works are behind programme. Forward planning is the ability to look at ways in improving performance and or checking the construction requirements for the next 2, 4 and 6 weeks ahead (duration can differ) checking final design information, materials, procurement status, resources required and any Coordination issues or ambiguities prior to works on site. It is the DM's responsibility to ensure that design information at hand is correct and has not changed in any way, however, change may be a factor if areas of construction do not have build ability then the design may change to suit which then has a cost and time association, hence forward planning allows time for these factors.

Weekly team meetings – from a Leadership perspective allows dialogue with all of the team on specific problems across the project and in reverse to Political correctness allows the team to discuss and possibly resolute many issues. Design tends to get involved and becomes the DMs responsibility to provide information or assist and become involved in co-related issues. This must be controlled or an outbreak of over capacity can lead to failure. SDM protocols agreed and implemented with the PMP and QMP protects against such events.

Political Correctness – stifles innovation and dilutes potential for enthusiasm and highly charged stimulating ideas rather like being lead by ironic standard day to day existing protocols creating personnel that become afraid to withhold potential resolutions and when asked for their opinions abruptly look

like 'Deer's eyes in headlights'. Motivational leadership free from the latter only brings out the best in a person.

Group cost analysis – Is especially useful for commercial managers and allows the DM to fully explain specific design details, how they came about and the reasons for any potential change. DM's can also assist commercial departments with any budget related issues to design and or any design consultancy. It is useful in averting any potential programme delays and increase in budget and is invariably utilised in reviewing any form of tenders.

Task force meetings – Focus on specific items and areas of a project, analysing one or several problems with various members of the team and seeking to provide an agreed solution or method of moving forward. The task(s) can be generated from any department and involve group leaders and Stakeholders where appropriate. The meetings can be held at management or executive management levels and can be arranged to resolute items that have potentially manifested and become unresolved or unsatisfactory after previous dialogue with parties that disagree or stagnate.

6.5. Strategic Design Management – Stakeholder Management

The Construction Industries Evolution over the last 45 years has rapidly changed. New inventories include Construction Management, Design and Build, Guaranteed Lump Sum, Management Contracting, and the introduction of AutoCAD and BIM along with much different legislation, all put into the Cauldron of confusion. Stakeholder Management is the most important aspect of SDM and its priority focus is to achieve required objective(s) for the Client/Stakeholder and further achieve the organisations goals. Communication and understanding and support is sacrosanct from a management point of perspective and all integral management elements

described within this dissertation such as Design, BIM, Commercial, Programme, Quality, Risk, QAQC, and Construction are important to coherently utilise SDM. The general direction of various components to achieve a desired future status is all about integration and coordination of activities utilising specific resources to meet present day to day objectives resultant from strategic planning, but the most valuable asset is to agree and create a well structured and detailed brief along with an agreeable contract to suit the type of project. The Brief and Contract for the project should cover every aspect and a logical and well analysed holistic and strategic approach and better defined group of P&Ps along with a precise BIM execution plan will lead projects more effectively and avoid digression and misunderstandings. SDM guidance assists the Stakeholder in analysing the project and provides a better management approach to programme, design, procurement and construction. Methods must be agreed to suit the scale of the project, and Clientele irrespective of their construction knowledge must be supported at all times during the complete project process. Key personnel guided by SDM can set clear processes and protocols that eliminate any design, programme and budget potential future protraction. The Integral primary SDM elements can be a major asset to any Clientele and are explained amongst the critical management requirements which are inclusive within this dissertation. The complete detailed duration of a project can also be established with SDM and 4D BIM and to gain a better understanding of the complete project process from concept design to Handover.

6.6 Addressing the Aims and Objectives

1. Provision of Integral Management Elements to support Strategic Design Management (SDM) based on literature research.

The Integral Management Elements are referred within the content of this Chapter and Chapter 5, and concluded as a Universal Structure;-

- Stakeholder Management
- Design
- BIM
- Procurement
- Commercial
- Planning
- Program Management
- Process and Protocols
- Quality Assurance and Quality Control
- Construction

Design and Design Management can be seen to be associated in every part of the Iterative Design process. The Personal Statement and Introduction to this dissertation refers to everyone wanting or being involved with Design. Hence a 'Universal structure' Framework is apparent. SDM focuses and supports these Elements. The factor can also be seen within content of the literature review in Chapters 2 and 3.

Section 2.2 summarises and puts into perspective the SDM Framework from a 'Holistic' Hypothesis which entrenches the Integral Management Elements. The London 2012 Olympic Games Project is a good example of success and a Development delivered ahead of programme, within budget and of High quality Construction.

2. Based on two case studies provides examples of the reflective elements that can use SDM

The two case studies in Chapter 5 have explained the misdemeanours of each project that could have been eradicated with the practice of SDM and examples are given of the elements that can use SDM along with a literature review of real life context.

By referring and applying the designed research methodology within this dissertation has provided sufficient criteria for explaining the Integral Management Elements that are required to support a Strategic Design Management Framework. The précis below concludes the aim and objective listed within the Introduction and provides a foundation for a SDM Framework. The knowledge of Managing the design process is shallow. The DM is constantly challenged by hierarchy often to the point where programme and budget compromise design. Construction projects remain the most ignored areas with regard to design, and project management techniques still show incapacity for solving Design Management problems on complex and mega projects. The DM is involved in all aspects of a project development business, hence strategic alliance is extremely important. It is the transition of design through to Procurement and onto Construction that transpires to be the weakest link. Communication between Construction Procurement Managers, Project Managers and Design disciplines requires stronger communication and understanding, and that communication must extend throughout the structure of all the Management teams including the Stakeholder. This is the quintessential coordination and responsibility of the DM and demands support from SDM.

Any form of Contract must be clear and its content to be the engine of collating and viably instructing and administrating all the works of the project correctly without any doubt. The Brief must encapsulate how the Clientele guides and requires the contract to be carried out, hence the understanding and management is critical. Allocating time to allow SDM analytics would bear a distinct advantage in preventing many failures that have resulted in Arbitration and prevent modifications that can potentially enhance risk.

Communication across the complete team spectrum is one of the most important aspects not just for SDM, however, in assisting and guiding the DM(s) the importance of design and its integration that follows into construction is a transitional process and highlights that the DM responsibilities occur from design inception to project completion. SDM must retain an acceptable dominance managed with perseverance, people management and a good understanding of change management; however, change management must be kept to an absolute minimum so that in the overall design process the design is not compromised.

Although the majority of companies be it, Consultancy, Contractor and Design disciplines do have a strategy at executive level it is a repeat of previous events without any innovation that tends to follow the status quo shaping a great deal of information to satisfy tenders throughout the year. Selection and decisions are only made to suit individual tenders. In general there is a genuine absence of SDM. Management tends to apply little processes or protocols and 'shoe horns' design to make proposals attractive. An adjunct of this failure to achieve consistent selection is lack of leadership.

Strategic Management gives a broader perspective to the employees of an organization and they can better understand how their position fits into the entire organizational plan and how it is co-related to other organisational members. Client Leadership involves Design Management and a SDM Framework set of agreements that serve as a very important purpose within the Built Environment to develop longer term relationships between customers and their suppliers. One of the functions of CEOs in conjunction with the various departments of a company should be to ensure wider use and more effective management of these frameworks, where they are appropriate at every level of the company. With regard to the 'Mega' projects, a focused strategy guiding and improving the DM should be adopted to include inventive innovation to encapsulate Holistic analytics mentioned in this dissertation. The vertebrae of this strategy can immensely reduce confusion in the ranks and stimulate a more decisive way in creating more innovative solutions and gain rapid agreeable conclusions; a form of 'Lean' SDM.

Clientele must have achievable programmes. This can be achieved with SDM visualising the complete developments holistically. This process factor is vastly underestimated and Clientele must go through a new programme Framework of programme understanding. Good effective Planning is now being seen and implemented with the BIM. Planners are able to see design in a much improved dimension rather than the traditional drawing details and are more integrated with the support of Design Management. The Planners role is changing and integration with the DM (directed by SDM) due to BIM is occurring; The challenge ahead is going to be the BIM Control by the Architect who has the lead design throughout the life of the BIM project and because he has the Key to the Whole Model fundamentally.

SDM is not to keep people from leadership, but to create leadership. It is found that the most successful businesses are ones in which everyone is considered a leader. SDM requires creativity built with teamwork and encapsulates members across a project team rather than status within an organisation chart. Stakeholder Management is the most important aspect of SDM and its priority focus is to achieve required objective(s) for the Client/Stakeholder and further achieve the organisations goals. Communication and understanding and support is sacrosanct from a management point of perspective and all integral management elements described within this dissertation such as Design, BIM, Commercial, Programme, Quality, Risk, QAQC, and Construction are important to coherently utilise SDM. SDM guidance assists the Stakeholder in analysing the project and provides a better management approach to programme, design, procurement and construction. Methods must be agreed to suit the scale of the project, and Clientele irrespective of their construction knowledge must be supported at all times during the complete project process. BIM is part of the Key to future success but its recognition of BIM as just a 3D machine must be dismissed. BIM identifies many aspects of construction but it will not coordinate on its own and requires input. The commencement of BIM being crucial and to be fully understood by Clientele, hence SDM can pave the way forward for the Clientele in this manner.

Theoretical Planning refers to the direction, coordination and integration to meet daily objectives. Further SDM focuses on more analytics within the Design programme and its transition into Procurement and Construction. Activities need to follow a suit parallel to construction by using 'S' curves and critical path activities and Key performance Indicators (KPI's) for monitoring

and auditing progress which in turn assists in advice to amend or revise areas that either will or have compromised the programme, and in turn increasing additional resources to realign works. BIM now has the capability of providing programme planning (4D) The working design 'fit for purpose' has transpired to the responsibility of the Specialist Trade Contractor and Major Packages such as MEP and Façade Engineering further warrant the DM to integrate dependency's and Inter-dependency's while also considering programme and ultimate design deliverables. This leaves the Architect with the guide of basic concept and sketch design only. In the majority of contracts it is the Design disciplines design development that creates a hiatus of managing the design process and also involves BIM management through to a resolution not only at manufacturing stage but as late as site installation. By following SDM, and mentioned in the introduction to this dissertation; much of the misdemeanours' would have been resolved at Stakeholder concept prior to Tender and award of the project.

3. How Strategic Design Management can improve Design Management within the Built Environment

Often the Design Manager (a combination of PMC, DM and Contractor DM) heavily supports all site operatives in resolving construction activity design conformance and are a true ally to Clientele and Stakeholders; however, this is only through managing the design strategically and effectively and not designing. As a reminder that CIOB Global Construction Review (10th August 2015) reported that there has been an influx of Major and Mega projects around the World in the last Century that has been subject to programme delays and increases, hence the Egan Report of 1998, however, Construction

worldwide is again falling back into the same problems that occurred pre 1998 but perhaps will be resolved by BIM practice and support from SDM.

SDM should be integrated within all departments of construction. The DM works alongside the Senior Project Manager and Directors on most projects because design is generic to any building. This transpires to account for everyone on any project and to include the Architect and Architectural Technician as members of the team by example. Further integrated processes with key players such as the Technician and DM are required to provide more of a macro understanding of the detailed design which in turn provides better communication, enhancing and motivating the positions such as the Technician. All Personnel can be allowed to express new innovative methods and applications along with the rest of the team. This will enhance and improve both Information and performance highways. By utilising the Integral Elements SDM supports and maintains the DM without cause to stray from the original Brief and intentions. Stakeholder Management (Item 5.9.1) support is essential and SDM supports the DM in providing essential Design Management, targeting the future accomplishments with the intention of project success.

4. Initialisation of a Strategic Design Management Framework.

The information has been collated and a conclusion for a New SDM Framework is exemplified within the contents of this Chapter.

The Strategic Design Management Framework re-invigorates supports and improves the Integral Management Elements (5.9.1 – 5.9.10). The Framework ensures that the Elements 'Stay on track' and do not diversify away from areas such as the Brief, Design conformance and any possible Design compromise. The Framework is a reminder of the agreed processes and

protocols at the onset with the Stakeholders. Programme schedule focus is also important and a regular requirement to monitor and ascertain all deliverables from a design aspect at Design Development and Construction stages. Appendix A2 presents the framework more explicitly and shows the function and coverage of the Framework.

A strategic design management holistic approach supports Design Management; from a Design discipline and Management aspect and to holistically guide the Stakeholders and Lead Management with a new Framework of support principally developed from the Integral Management elements such as BIM, Design, Construction , Risk, Programme, Planning and QAQC Management. It is to ease and define a better understanding and support of Design Management. A business process that incorporates the Framework described within the Dissertation.

5. How Strategic Design Management supports Stakeholder Management

Essentially Strategic Design Management's most important aspect is to Consult and advise Stakeholder Management of the Critical analytics found or known in conjunction with the Design Manager(s) There is a disparate range of Clientele involved; this ranges from Land and or Building ownership, Companies with shares or part ownership to Banks and Development Partners Public Funded Initiative (PFI) Hospitals is a good example of Stakeholder Clientele. (Weaver, 2010) The London Olympic Games Development Strategy (3.1) is an excellent example of successful strategies with a similar Framework to SDM.

It is the Decisions and actions of the Stakeholder that drive a Project Development to success or failure. Leadership qualities (6.4) is essential for

SDM to steer effectively but must be accomplished by correctly utilising 'People Management' and always bear in mind the cultural aspects when applied on an international scale. Agreeing and applying the Integral Management Elements within the Framework is a commencement for success, ever mindful that the elements can change to suit specific Project Developments. To reiterate; leadership that isn't transferrable, repeatable, scalable, and sustainable isn't really leadership at all. Design Management requires enhancing within an agreeable, lean, competitive strategic Framework. SDM requires creativity built with teamwork and encapsulates members across a project team (Chapter 2, Figure 2) rather than status within an organisation chart. 'SDM definition: ***'A business process that incorporates design and its management into the strategy formation process and implemented at every level of the organisation'*** (Gillespie, 2002) Refer 3.1 SDM's objective in supporting the Stakeholders is characteristically to achieve the required objectives and organisations goals (6.5) with emphasis on design and its involvement, commitment, and enthusiasm with the complete iterative design process from inception through to completion and handover.

6.7. Framework Considerations

The following considerations are based on the Authors reflective experience with professional companies of the Built Environment and also reflect synchronisation with this dissertation.

Initialisation of a Strategic Design Management Framework Provision of Integral Management Elements to support Strategic Design Management

1. Regular Design Management (DM) Auditing ensures that projects are utilising the correct and agreed Design Management practices and tools

discussed and agreed for the Project Management Plan (PMP) and agreed by Stakeholders, reiterating that protocol and familiarity should be integrated with Design, Construction, Commercial, Planning, Risk and Stakeholder departments utilising the provision of the Integral Management Elements – The SDM Framework. This prevents the processes getting confused and reminds personnel of the required management practices without straying. It also prevents confusion and incorrect assumptions which otherwise lead to ambiguity and subsequent disagreements and subsequent claims.

2. Improve the Design Quality Management Plan (DQMP) project process and protocols to ensure that the complete Design process is more effective, productive and efficient. All members of the project team should be involved including the Stakeholders. Utilise the Process and Protocols (P&Ps) in a unique way, Innovative but without reinventing the wheel. It is the P&Ps that harness success or failure.

How Strategic Design Management supports Stakeholder Management

3. Ensure that the Clientele are more integrated with Design Management and create a better SDM harmony. Stakeholder Management (Weaver2010) is one of the major critical elements of SDM. Mega-projects create challenges, the greater the project, the more challenging it becomes. Construction management focuses on the Scope, programme, cost and quality. With Technology and highly technical projects this is insufficient across the international market and ignoring the social aspects of a Major project will surmount to failure. Effective Stakeholder SDM is mandatory for Major-project success. If the project

is sufficiently challenged, the protest movement can quickly become an unwanted virus. Examples of effective Stakeholder SDM are;-

- Recognise key stakeholders that lead, who they are and represent and who is the most important. This is more specific with Government.
- Evaluate Stakeholders in order of priority starting with the highest primary position.
- For VIP Stakeholders focus and review their requirements and consider their Expectations and develop strong communication planning.
- Develop Public Relations communication for the wider audience but keep the Communication specific and without trajectory. This works well with
Hospital projects.
- Review the Stakeholders at regular intervals and discuss and gain general feedback on thoughts from the teams. This tends to position the
Stakeholders from a hierarchy perspective.

How Strategic Design Management can improve Design Management within the Built Environment

4. SDM acts as a fulcrum to improve DM performance and supports ongoing DM Task Forces. The task Forces act as a focus on specific element(s) of the development but the DM(s) always involve, Planning, Budget, Construction, Stakeholder.
5. Strategically ensure that the Design Manager aligns other fellow Managers and guides them from a design perspective with and without key design disciplines.

6. Planning schedules should be given a realistic series of design deliverables dates that do not hinder Design disciplines or make them feel uncomfortable and stretched to complete assignments.

6.7.1 Framework Recommendations

1. Management shall integrate and include Contractors and Specialist Contractors where appropriate and Concur and or discuss SDM with various mixes of Client across the Built Environment. This creates good communication and understanding and assists in integrating SDM from the onset. All Developments that involve design; Aviation, Health, Education, Hospitality, High Rise, Landscaping, Infrastructure, Civil, Interior Design, Government and private sectors. This covers a wide selection of the Construction Industry by example, however, SDM can be utilised in almost any part of the Built Environment where design is involved.
2. SDM shall have representation at Board level to improve Design Management Hierarchy across the business supported by all DM's and giving Design Management responsibility as Project Directors. The Strategy shall be directed from President, CEO down the Hierarchal chain and supported in every way to ensure greater business goals and a solid understanding of SDM.
3. Align Design Management with commercial and Procurement processes to improve an effective project. Design can be compromised if the Budget is stretched. By adjusting design of components in the correct format can support cost certainty without design stray. With a better understanding and explanative process and detailed design limits

various questions and misunderstandings by potential specialist contractors during procurement and eliminates any ambiguity.

4. Ensure that Design and Construction communicate effectively and not in a 'Them and us' scenario. This also includes all Design disciplines. Regular dialogue must take place between Design and Construction departments in particular (No design, no construction) Complex Technically designed projects require daily, perhaps early morning short meetings. More detailed meetings can be prior arranged and involve other departments. This is another good communication network.

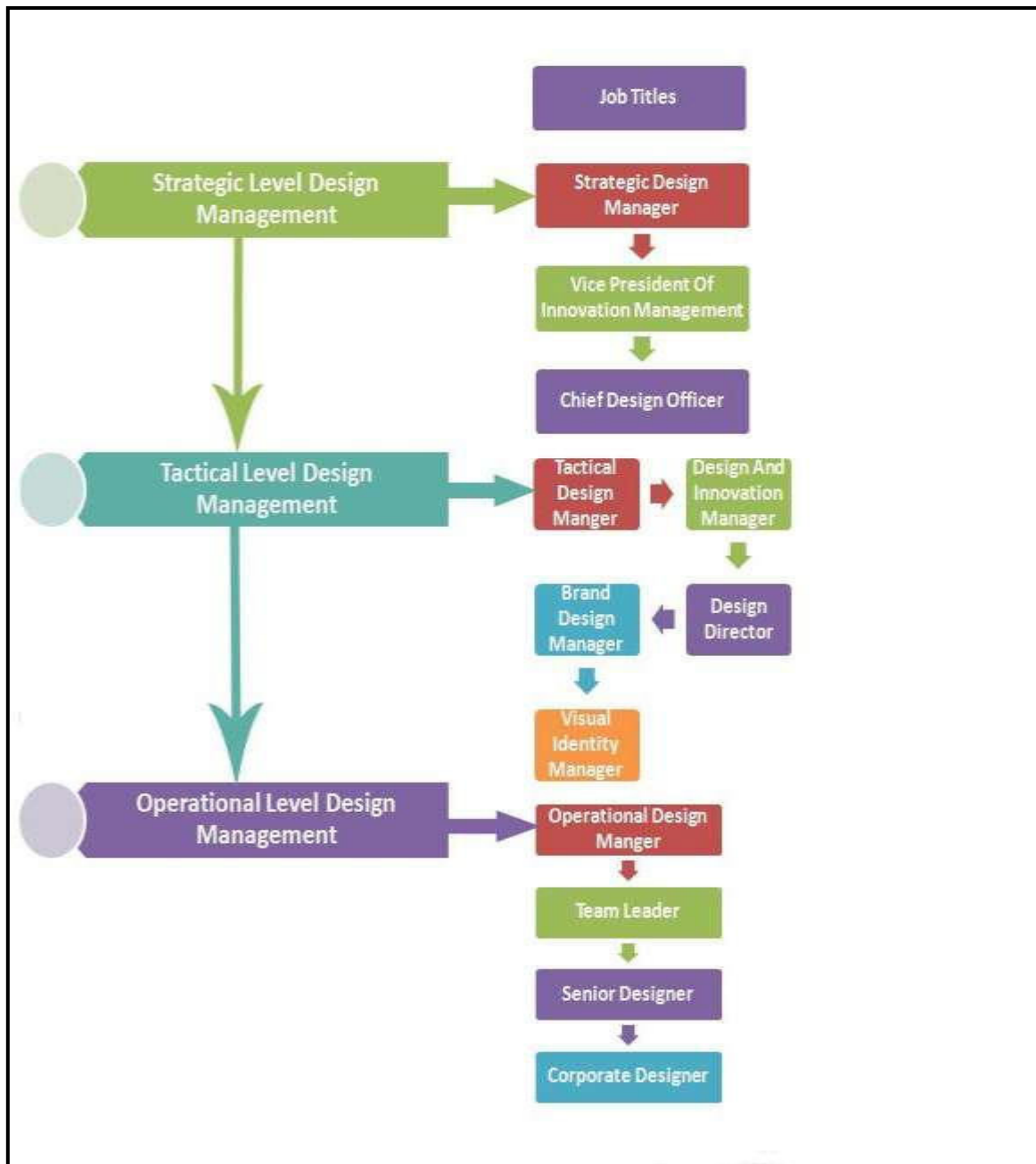
6.8 Future Research

Further research with many disciplines within the Built Environment will lead the way to further analysis of micro information and commodities that can create a substantial improved framework and results to guide SDM into a revised framework that suits the Built Environment and guides Design Management into a new decade. As an example; the Built Environment has been preparing over Two Thousand different specialist trades that will be the central data information for integrating with BIM which will endeavour to make the modelling easier and provide Clientele with more choice in the construction of a building model. Hence BIM will be one of the SDM targets for further research. The research must include National and International companies and personnel which could ultimately create a Global understanding and works of SDM.

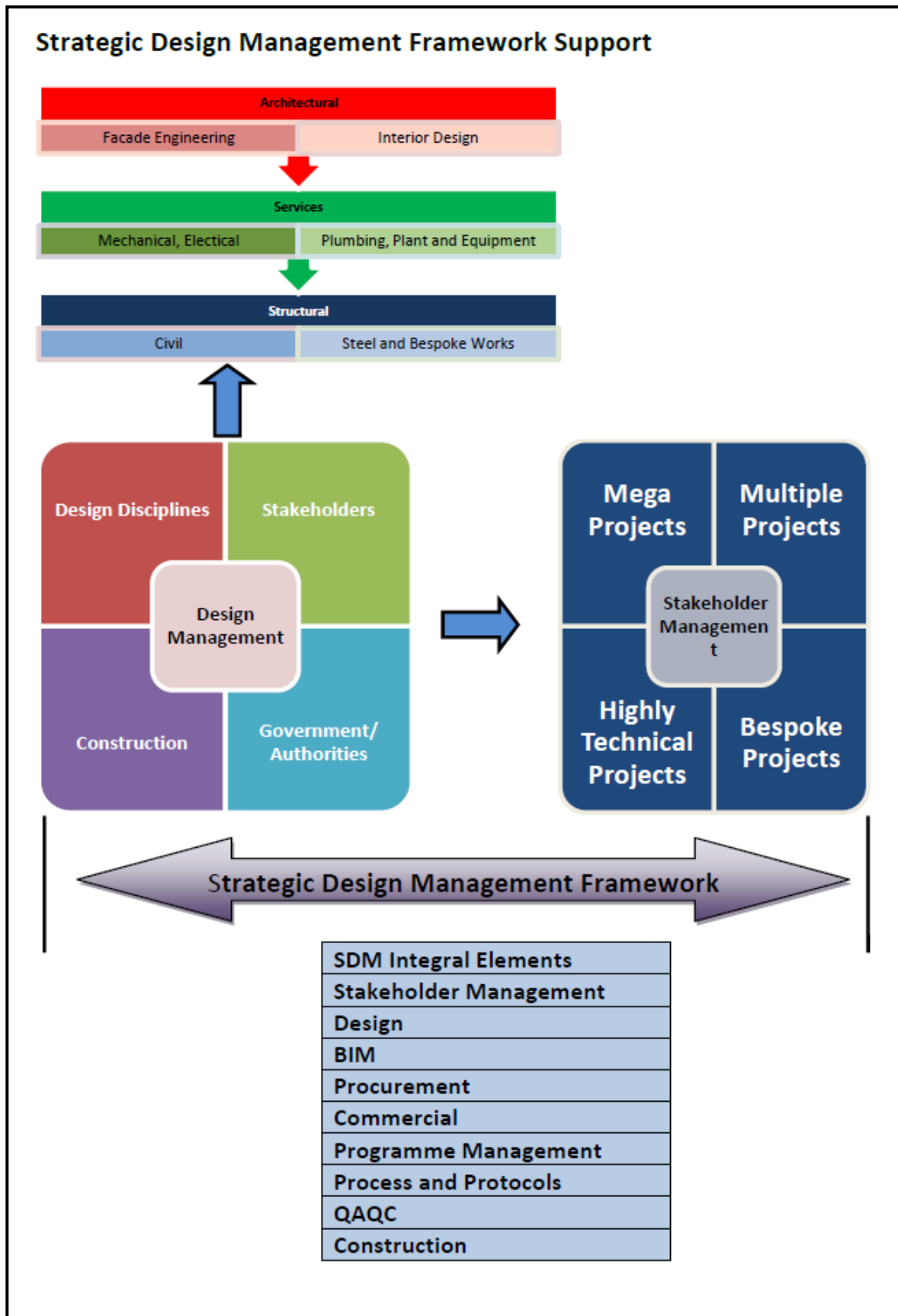
The present dissertation has explained the principles of SDM, fundamental flaws, integration with various elements of the Built Environment and laid new ground to consider and follow.

Future research will focus on further Strategic Design Management and how it is linked and beneficial to all Stakeholders including Management, Clientele and Design disciplines as a new Foundation to the Built Environment.

APPENDICES



A1 Strategic Design Management (SDM) Level within Organisation



A2 Strategic Design Management Framework

A3. Quality Management Plan

A sample of a Project Management Quality Plan; Items listed (Non exhaustive) that are associated with SDM

Table of Contents

Revisions

Acronyms

1.0 Management

- Roles and Responsibilities
- Executive Committee
- Design Quality Assurance Manager
- Sampling and Testing Personnel
- Document Control
- Design Manager
- Structures Design Manager
- Materials approval Engineer
- Design Discipline Lead
- Engineers of record
- Design Checkers
- Design Engineers

2.0 Reporting Responsibilities

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- Communication requirements
- Staffing levels

3.0 Administration

- Personnel training
- Document Control
- Documents revision

4.0 Audits

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- Audit personnel
- Non conformance reports for the quality process
- Documentation procedures
- Design Changes
- As-Built Drawings
- Data gathering procedures
- Quality control checking
- Review and submittal schedule
- Progress Payment Documentation
- Manufacturers Certificates of Compliance
- Quality Documentation
- Contract Price Adjustments

5.0 Documentation

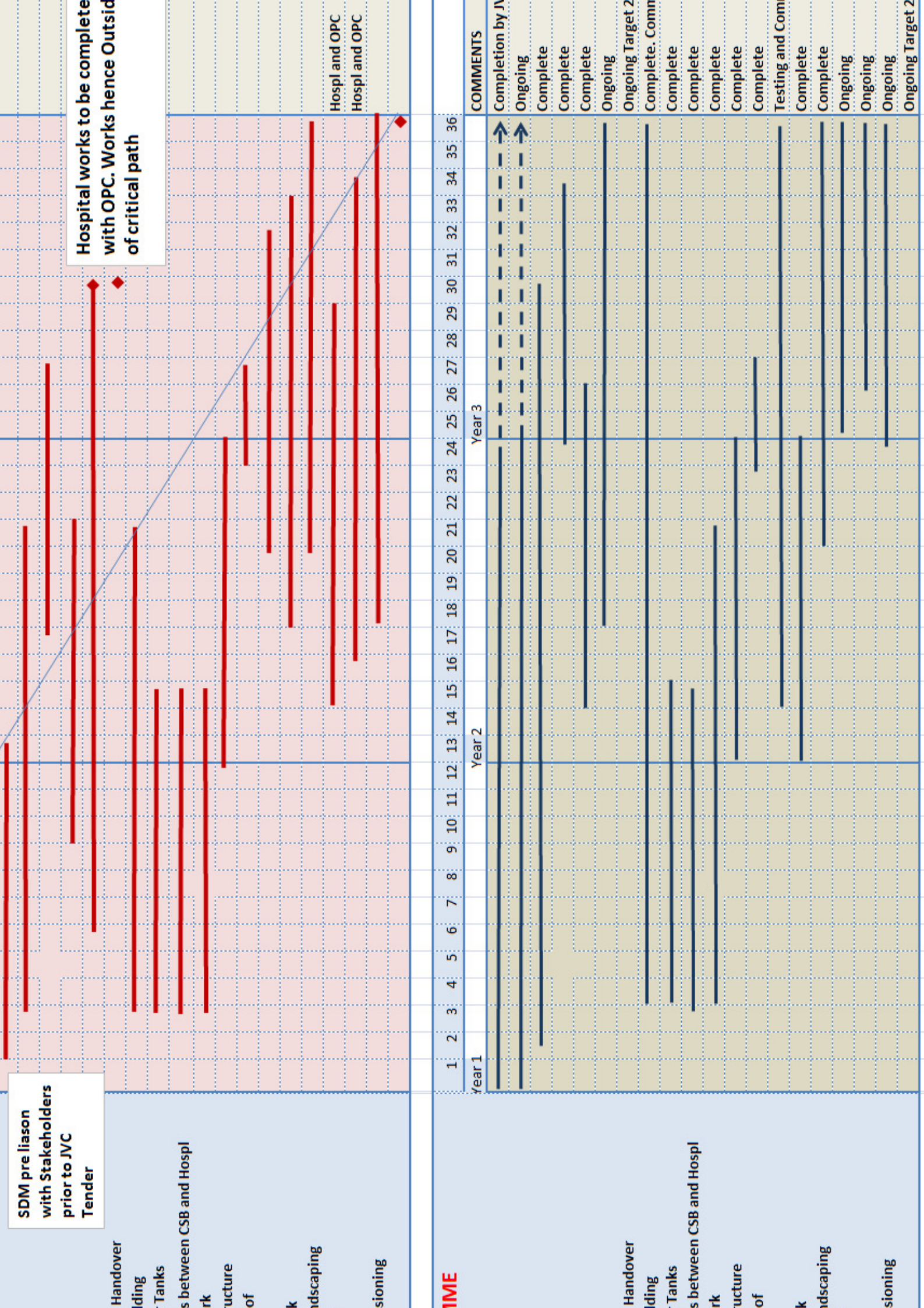
- QC Monthly Certification
- QC Reports
- Substantial Works Completion
- Final Inspections
- Final Certificate of Compliance
- Final Owner Acceptance

6.0 Investigations and Testing

- Procedures to Ensure Consistency and Quality of Material Products supplied by Specialist Trades
- Procedures to Ensure Quality and Documentation of field Investigations
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- Preliminary Design Submittal
- Design Development Submittal
- Design Information For Construction / Shop and Temporary Construction Drawings
- As Built Drawings
- RFI (Request For Information) Submittal
- Design QA Audits and Certification
- Design Reviews
- Formal Design Reviews
- Other Reviews
- RFI Procedure
- Acceptance Of Design
- Design Changes During Construction
- Design Change Initiated by Design Team
- Design Changes Initiated on site
- Schedule Requirements (Planning)
- Forms
- Design Quality Procedure.



	All	Executive Summary (Overall) Project Design Basis Memorandum excluding Appendix B	PTN: 2663 R1/8277 R2	B	PTN: 2663 R1/8277 R2	B	(SP-00-00006) DTN 8334 31-Mar-11
	All	Appendix B - Attachment 2 :		E		E	submitted - to be updated on an ongoing basis
	All	Appendix B - Attachment 2 :		E		E	submitted - to be updated on an ongoing basis
	All	Appendix B - Attachment 2 :		E		E	submitted - to be updated on an ongoing basis
Document 16 Drawings	All	SD drawings		B		B	drawings to be updated on an ongoing basis
	Hospital	Hospital Building General Arrangement Architecture Base Plans "Improved Schematic Design"	PTN: 2256 R0	E	PTN: 2256 R0	E	(RT-01-00040) - status quo
	OPC & CSB	Design Base Memorandum Central Service Building & Outpatient Clinic	PTN: 2361 R0	E	PTN: 2361 R0	E	(RT-01-00043) - status quo
	HealthCare	Design Basis Memorandum for architecture, ID & medical equipment	PTN: 6551 R2	B	PTN: 6551 R2	B	submitted (SP-00-00009)
	Hospital, Clinic & CSB	ARCHITECTURAL (Vert Transport)	PTN: 4777 R3	B	PTN: 4777 R3	B	submitted (RT-01-00002)
	Hospital, Clinic & CSB	ARCHITECTURAL (INTERIORS)/Presentation for ID 9 (Off. Support & conference spaces/Food services & retail deen presentation/furniture workshop	PTN: 3442 R1	E	PTN: 3442 R1	E	(NN-01-00011) - status quo
	Clinic	Design Basis Report for Structural Analysis & Design - Clinic Building	PTN: 6708 R5/6986 R7	D/B	PTN: 6708 R5/6986 R7	D/B	submitted (RT-05-00008)
	CSB	Design Basis Report for Structural Analysis & Design - Central Services Building	PTN: 5000 R4	A	PTN: 5000 R4	A	submitted (RT-05-00009)
	Hospital	Design Basis Report for Structural Analysis & Design - Hospital Building	PTN: 6712 R5/6985 R6	D/B	PTN: 6712 R5/6985 R6	D/B	submitted (RT-05-00011)
	MLSCP	PTN: 3540 R1 – DBM for PT Beams and slabs	PTN: 6869 R2/7834 R3	B	PTN: 6869 R2/7834 R3	B	(SP-00-00011) DTN 7816 28-Feb-11
	UGCP	Design Basis for the Calculation of Post Tensioning Slab & Beam	PTN: 1226 R4	A	PTN: 1226 R4	A	(CS-05-00005)
	Hospital, Clinic & CSB	Exterior Curtain Wall	PTN: 1791 S0	B	PTN: 1791 S0	B	submitted (Drawings SC series)
	Hospital & Clinic	Pixel Wall system Design	PTN: 2544 R0	E	PTN: 2544 R0	E	(RT-05-00067/68) - status quo
	Hospital	Design Basis Report – Atrium Steelwork Calculation (Hospital Building - NTA)	PTN: 3411 R0	E	PTN: 3411 R0	E	(RT-05-00098 R0) - status quo
Para-structural system	Non-Med	Design Basis Memorandum (PARSONS)	PTN:6316R6/7444R7	B/B	PTN:6316R6/7444R7	B/B	(SP-00-00002)
	All	Mechanical, Electrical & Plumbing Design Basis Memorandum	PTN: 0940 R3	B	PTN: 0940 R3	B	submitted (SP-00-00001)
	All	Information Communication Technology (ICT/ELV) Design Basis Memorandum - Siemens	PTN: 5654R2/6605R3/7703 R4	B	PTN: 5654R2/6605R3/7703 R4	B	(SP-11-00001) DTN 8047 27-Feb-11
	Clinic	A Primer: Development and Planning of Research Support Facilities / Report: Research lab	PTN: 1219	B	PTN: 1219	B	submitted (RT-01-00015)
	Hospital, Clinic & CSB	Automated Guided Vehicle System (AGVS) - Material Handling System Report	PTN: 4513 R1	B	PTN: 4513 R1	B	submitted (RT-00-00154)
	Hospital, Clinic & CSB	AGV Material management	PTN: 4513 R1	D	PTN: 4513 R1	D	(RT-00-00154). Status quo
	Hospital	Hospital Building - 2nd Mezzanine CSSD Equipment and Schedule	PTN: 5786 S5	B	PTN: 5786 S5	B	submitted (Drawings SD series)
	Hospital	Report - CSSD	PTN: 4513 R1	B	PTN: 4513 R1	B	submitted (RT-00-00154)
	Hospital	Report - Schematic Design Metabolic Narrative	PTN: 1218 R0	B	PTN: 1218 R0	B	submitted (RT-01-00013)
	Hospital & Clinic	Report - Schematic Design Food Service Narrative	PTN: 1218 R0	B	PTN: 1218 R0	B	submitted (RT-01-00013)
	CSB	Report of Laundry	PTN: 1200 R2	B	PTN: 1200 R2	B	submitted (RT-00-00028)
	Hospital	Briefing Report for the Submission of Pneumatic Tube System	PTN: 4513 R1	B	PTN: 4513 R1	B	submitted (RT-00-00154)
	All	Life Safety & Building Code Narrative for Hospital, Clinic & CSB	PTN: 3250 R1	B	PTN: 3250 R1	B	submitted (RT-01-00001)
	All		PTN: 7490 R3	B	PTN: 7490 R3	B	JV to Submit as part of DC2
	All	(Overall Security Strategy) - Electronic Security System Design Report					(RT-11-00005) DTN 8229 27-Feb-11
	All						JV to submit at DD
	All			E			Specification list submitted - status quo
	Hospital & Clinic	Room Data Sheet - Hospital and Clinic Plaza Level	PTN: 3682 R0	C	PTN: 3682 R0	C	(DS-01-00001) - Status quo
	Clinic	SMRC Clinic Building Plaza Level Room Data Sheet	PTN: 7873 R0	E	PTN: 7873 R0	E	(DS-01-00002) - Status quo
	Prototype	Report - Room Data Sheet - Prototype Building	PTN: 1771 R0	C	PTN: 1771 R0	C	(RT-01-00029) - Status quo
	Hospital	RDS Hospital 2nd level IFC Submission				C	(DS-01-00003)
	Hospital	RDS Hospital 3rd level IFC Submission				C	(DS-01-00004)
	Hospital	RDS Hospital Mall level IFC Submission				C	(DS-01-00006)
	Hospital	RDS Hospital 5th & 6th level IFC Submission				C	(DS-01-00007)
	CSB	RDS CSB Lower and Ground level IFC Submission				C	(DS-01-00008)
	Clinic	Report - Clinic - RDS Mall to 4th level IFC				B	(RT-01-00228)
	All						JV to issue at DD
		Research Lab Design Basis Memorandum	PTN: 4512 R1	B	PTN: 4512 R1	B	submitted (NN-01-00018)
		DBM Design Narrative Medical Gas System	PTN: 6270 R0	E	PTN: 6270 R0	E	(NN-12-00017) status quo

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