Conceptual design supporting tool between architectural design office and its client

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Conceptual design supporting tool between Architectural design office and its client

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The process of writing this report is unpredictable difficult. There are many people, that I need to express my sincere gratitude. Without the help, instructions and encouragement from them, this paper will never be accomplished.

From the middle to the end of 2008, it took Mr. Bert Willemsen and Dr. Ad den Otter great efforts on helping me to get the opportunity for my ICA (In-Company Assignment, an educational program required by ADMS for ending the training) in a Dutch based Shanghai office. We would have nearly made it, if it was not affected by the severe global economic crisis, whose influence had lasted to present since the end of 2008. Anyhow, Mr. Bert Willemsen and Dr. Ad den Otter, many thanks to both of you on the arrangement.

I would like to thank Mr. Ning Zhang, director of Tianye Shanghai office. After having a thorough talk on the plan of the ICA with him, he offered me a work opportunity and granted that I may take the management reform of Tianye Shanghai office as a study case for the research of my ICA. Again, I shall thank Dr. Ad den Otter, he showed flexibility on helping me to set up this ICA. Then, being a researcher for the ICA, in the mean time I work for Tianye office. However, I must spend my spare time on the research. I must thank all my colleagues in Tianye Shanghai office, they joined the interviews and workshops, which was planned by my research process. It was them who spent their precious time to offer me useful information and suggestions on my research. When the time came to the beginning of 2010, due to the macro-policy control on real estate development in China, Mr. Ning Zhang have to switch the major business of Tianye Shanghai office from conceptual design into construction design. And the implementation on establishing an office automation system (OAS) for the conceptual design phase is hence suspended.

By the beginning of Feb. 2011, my employee contract with Tianye office was expired. Not only because I couldn’t fulfill the implementation phase of the research in Tianye office any more, but also because I shall support the life of my family, I have to find a new job. While I was worrying about how to continue this research, Dr. Ad den Otter and Dr. Henk Jan pels instructed and suggested me to take my new office as a scenario to continue the research. I shall also thank Prof. Harrie Timmermans. When I met him and reported to him on the ICA in Aug. 2011, he fully understood my situation, and encouraged me to overcome difficulties and focus on creating values of what I am planning to design based on current study materials. Surely, I shall thank Mr. Henry Zeng, my current boss, associate principal of Steinberg Architects Shanghai office. He shared his opinions with me on the management of architectural conceptual design phase.

Looking back on the past period, it would be the most unforgettable memories of having a Skype meeting with Dr. Ad den Otter and Dr. Henk Jan pels every Monday night throughout the process that I was writing this paper. I must appreciate again to both of you. Many thanks for your helpful comments, instructions and the detailed English-grammar check on the paper. I shall also thank Mr. Hong Chen, chief architect of Steinberg Architects Shanghai office. He spends his personal precious time helping me on the English writing for this paper.

Last but not least, I shall thank to my wife and my parents. They were constant inspirations to me. I would like to dedicate this paper to them.
Summary

Accompanied with the continuation of rapid Chinese economic growth through the past decades, I have experienced great changes happened in the architectural design industry. Computer science and various architectural design theories had been widely applied; traditional design institutes, which based on planned economic system, are no longer the only choice for clients; new style small professional offices are mushrooming to meet the increasing demands of the expanding building market… However, study on the management of architectural design process has not gained enough attention, especially on the management of architectural conceptual design process for those small professional offices.

Opportunities of booming development also bring sever competition among the mushrooming architectural design offices. Those who possess more competitive advantages will be more likely to survive. Doubtlessly, to work in an effective and quality-control manner will be one of the most important components of those competitive advantages. Architectural conceptual design process is an effort-consuming, intelligent-intensive, and an iterative process. How shall a design office response the request of its client, exchange the right information in time, and deliver the quality controlled design result in accordance with the mutual agreed schedule, greatly influences the evaluation from the client on its work performance.

This paper aims to develop a management tool — CDST (Conceptual Design Supporting Tool) for those architectural design offices to improve their work performance on the architectural conceptual design process. Purpose of this tool implies the following aspects:

1) Helps the architectural design office to work in an effective and quality-control manner.
2) Guide the office to plan an OAS (office automation system) specifically for the management on the project design process.

Inspired by the method of “learning or reflective cycle” (Van Aken 2004), the management reform of Tianye office is chosen as a study case for the research. And later, another architectural design office—Steinberg Architects Shanghai office will be taken as a comparison and scenario to further explain on the result of the research—CDST.

Through the research, CDST is designed into two parts. One is the CMT (Core management tool), the other is the information system guidance. Regarding the CMT, it contains the OMF (Overall management framework) part and the DSM (Detail supporting manual) part. The OMF part illustrates an overall insight on the business process of architectural conceptual design phase. The DSM part explains the influenced parameters and relevant principals on refining the work flow and data flow, which represent the business process of the architectural conceptual design phase. The information system guidance suggests the architectural design office to adopt an office automation system (OAS) on coping with its complex and knowledge-intensive daily work. Relevant types of OAS are introduced and suggestions on establishing a specific OAS, which is based on the specific circumstances of the office, are given.

Since the CDST suggests involving employees into the management reform procedures, the possibility of successfully realizing the standardized and informatized system within the design office enjoys strong Mass Basis.
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1. Introduction

1.1 Motive

(Introduce my personal experience in the architectural design industry. Explain how and why I choose the topic related with conceptual design phase as my research direction for the In-Company Assignment (ICA)

Before I was selected as an ADMS trainee, I had been engaged in architectural design industry for around 10 years. Either start from an assistant architect’s point of view or later from a manager’s point of view, I concerned very much on the performance of teamwork between architects and client during the conceptual design phase. It is the key phase that a project reveals its appearance from empty to a desired vision. Both Architects and client play crucial roles during this phase.

With the booming of economy in China, and also with respect to the influence of Chinese building law (to form a conceptual-oriented design office is much easier than a Local-design-institute style office.), lots of conceptual-oriented small offices are mushrooming. Comparing traditional local design institutes, which are under the Socialist Planed Economy, the conceptual-oriented offices represent the new demands of building market. They are sensitive in the judgment of real estate market and obsessive about the architectural artistic pursuit. In short, these offices are mainly interested in developing architectural conceptual design for the project developing process.

Someone may argue that conceptual design phase means most on offering client a creative design solution, it shall not bother too much on the management issue. However, considering current background of building design industry. This argument tends to be too single-faced. As we all know, prosperity of building industry offers great opportunities to those architectural conceptual design offices, meanwhile, it also brings challenges to them. From the management perspective, for instance, the small offices shall always handle a project with much more complex functionalities and higher expectations from client. A surviving or developing design office often deals with the conflict between the shortage of human resource and the overloaded work( Employees usually carry more than one project at the same time). Furthermore, turnover of staff becomes a popular phenomenon. A design team can seldom corporate for the second project without changing its team member. Fast-pace project developing rhythm also requires a fast delivering on the conceptual design submission. So, how to balance those side effects and effectively offer client a high quality design solution becomes a very practical and significant problem.

Although the manager of an architectural design office pays more and more attention on improving management performance for the conceptual design process, they seldom know how to systematically fulfill it. Nowadays, with a lot of propaganda on office automation system(OAS), some offices are eager to adopt it and push to implement it throughout the whole organization without adjusting it according to the reality of the current organizational situation. Due to less management knowledge and no technician who understands the OAS from software side in an architectural design office, also due to the so-called artistic temperament of an architect (an
architect usually pays high attention on technical aspects of a project design, and less attention or even ignore the management aspects), it is easy to imagine that this kind of management reform rarely successes.

Under such context of the building design market, to investigate how to improve the management performance of the conceptual design process shall not only bring practical value to those architectural design offices, but to its’ clients as well. Thanks to the ADMS ICA (In-Company-Assignment), I finally have the opportunity to study this field for a practical solution after I got more insights on the management theory and techniques through 15-month learning and training courses in ADMS. My ICA starts in the beginning of 2009, in Shanghai, within a Chinese local design office, named Tianye international architectural design office (here after referred as Tianye office).

Inspired by the learning or reflective cycle that Van Aken (2004) presents, (see figure 1.1), the topic on Effective management of Tianye architectural design office for its conceptual design process is chosen for the ICA. Tianye office is taken as a study case for the research, although I have left the office and nowadays worked for another architectural office—Steinberg Architects Shanghai office. The later one will be used at the end of the research to reflect differences in work of Tianye office. Before expanding detail statement on the research, the background of architectural design process, Chinese architectural design business and Tianye office will be introduced in the next paragraphs.

![Figure 1.1 learning or reflective cycle](image)

### 1.2 Introduction of architectural design process and its phases

From a macro point of view, an architectural project (either a building or a plan) delivery process is shown in figure 1.2.

![Figure 1.2](image)

According to the diagram, we can see that architectural design is only a part of this timeline (yellow...
filled part). However, it plays a crucial role for defining how the project looks like, how much it shall cost, and how it functions during the whole process. Generally, it is known that an architectural design office offers its service on architectural design regarding a project for its client. The product submitted by the architectural design office is usually a set of document that could technically describe a project by drawings, specifications and models, etc. It contains the information on how to develop or construct the project.

The Architectural design process evolves through several phases and will last a certain time based on the project scope and deadline for completion. Usually, the process is divided into phases according to the role that each phase plays. Figure 1.2 shows Chinese style of the process, and figure 1.3 shows Dutch style of the process:

**Figure 1.2. (Architectural design process of Chinese style)**

**Figure 1.3. (Architectural design process of Dutch style)**

The difference between the two processes is mainly as follows:

- The Dutch style emphasize more on the node of the client's brief (formulated by both a consultant and the client in a mutual agreed manner) (The architect usually is not involved or hired in defining the brief)
- The Chinese style specially mentions the process of “bidding” phase. An architect shall prepare relevant document for bidding and support its client as a consultant.
- Comparing the Chinese style with the Dutch style, Dutch style develops more gradual from pre-design phase to detailed design phase.

Considering the execution of the case study is in Shanghai, the Chinese style is further explained as follows:

- **Conceptual design (also known as schematic design)**

  Based on the demands and functions formulated in the client's brief, the conceptual design synthesizes the building from words and mental images into a defined, feasible design in drawings and 3d-models. The architect works with his client to transform the relatively vague concepts and the formulated functions in the feasibility study into the actual conceptual space arrangement of a constructible building. The design will be shown in the form of Schematic Drawings, and in some cases a study model. The conceptual design will address all significant areas of the design and will be reviewed with the client before proceeding with more detailed drawings. Preliminary cost estimation is therefore provided at this stage. Such estimation is used to define the total budget necessary and to finance the project.

  The conceptual design phase is an iterative process in which the architect's proposed approach is
critiqued by the client and governmental bureau until a consensus is reached. The period of time necessary to finalize this phase is therefore difficult to appoint.

- **Design Development**
  Architect starts by creating basic concept diagrams and rough sketches. Conceptual brainstorming and exploration define this portion of the design process. The architect creates the initial design of building systems, but then expands the approved conceptual design studies to develop a more detailed drawing illustrating other aspects of the proposed design with help of consulting engineers.

- **Construction design**
  Based on the approved Design Development documents by both client and government, construction drawings and written specifications are developed which describe in detail on all the construction work to be executed. These are the documents upon which the construction contract will be based, and which the contractor will use to build the project. If a building permit is required, the application is usually made at the end of Construction Documentation by client.

- **Bidding**
  Preparing construction documents to its client, architectural design office may support its client on the project bidding process. A contractor is selected, and a construction contract is drawn up between the contractor and the client.

- **Administration of construction**
  On-site observation and conscientious administration of paperwork by the architectural design office throughout construction process is necessary to assure that: a) the design is realized according to the drawings and documents, b) communication flows smoothly, c) that high standards are maintained, to assure that the client gets the building he asked for and that is worth the money.

### 1.3 Business background of Chinese architectural design industry (conceptual design phase)

The booming market of China gives more choices for clients to select a trustful and capable architectural design office. Nowadays, Chinese clients tend to choose different architectural design office in accordance with different design phases. Usually, a conceptual-oriented design office will be selected specifically for the conceptual design phase; and another service-oriented or delivery-oriented design office will be selected specially for the construction design phase.

When it comes to the conceptual design phase, some clients will set up an design office selecting standard and offer a certain amount of bidding fee for holding a public conceptual design competition; others prefers to operate it in a private manner, they invite the offices that they are familiar and have an individual negotiation on the right and duties of the design task with each party. For the first mode, a competition program defines the right and liabilities clearly over the task. A design office can get a clear vision on the risk and the benefit of whether join the competition. For the second mode, sometimes clients will ask the invited office to show a round of preliminary conceptual design before they have the intention of contracting an office. In this case,
the risk shall be carried by the design office.

As the second mode is good for clients to keep its commercial secret, and has few risks on selecting a suitable design office. More and more clients tend to choose this mode. So, in this thesis, the second mode will be chosen as the research background.

1.4 Introduction of Tianye architectural design office
(Introduce the background of Tianye office: location, history and scale of the organization; business types that it involves in; vision of the organization; operation status comparing to peers in current architectural design industry; personnel status of the organization…etc.)

The headquarter of Tianye international architectural design office (Tianye office) is located in Shanghai, with around 22 employees (Due to fluctuation of Chinese construction market, high employee turn-over is a popular phenomenon regarding such a small scale architectural design office in Shanghai). However, it has a big branch in Shandong province, with around 75 employees. Around 60% staff comprises of middle and senior titles and registered expertise qualification.

Business range of Tianye office contains urban design, architecture design and landscape design. According to director of Tianye office, the business orientation for Shanghai office, is mainly involved in conceptual design phase. Conversely, Shandong office is mainly involved in construction design phase. Capability on residential community design and commercial estate design is Tianye Shanghai office's advantage.

The business vision of Tianye office is aiming to be a forerunner and leader of the design industry. Tianye office insists on outperforming the customer's anticipation and aspiring to be efficient and high quality performed in both aspects of project design and office management.

1.5 Dissertation structure
(Explain how the paper is structured, number of chapters and the Intention of each chapter)
This report is aiming at developing a supporting tool for architectural design office to structure and manage the conceptual design process to make it more efficient and effective. Following a scientific research procedure, this report is structured into 7 chapters. The sequence of the chapters is: first describing the analysis of the firm, the main problems or bottlenecks concerning the design process, and based on the diagnosis, finally the development of the tool is explained and its functionality is described. Once some criteria based on the analysis of the current situation and on literature are generated, these criteria are synthesized and used to design the tool.

Chapter 1: Introduction
This chapter describes the background of the research topic for the ICA. Explains the reason why this research topic is chosen. Introduce the basic knowledge of architectural design industry and the organizational situation of Tianye office, whose management is taken as the case study example.

Chapter 2: Problem definition
Taking the management of Tianye office as a case study, problems occurred during the conceptual
design phase are discovered and structured. Expectations of Tianye office on improving current management performance are collected. In accordance with all these data, research scope and research goal are defined. In order to reach the goal, theoretical research methods and techniques are introduced.

Chapter 3: Literature review  
To start analyze or during analysis phase, key factors that influenced the research goal are investigated through literature review.

Chapter 4: Analysis  
Current management situation is analysed. Organizational structure and role of related actors are studied. Current design process is illustrated. It’s work flow and data flow diagram is described. Bottlenecks are identified and positioned in accordance with above mentioned flow diagram. In the end of this chapter, analysing results are concluded.

Chapter 5: Synthesis and design  
Based on literature review and current management situation analysis, a set of criteria is synthesized for developing a Conceptual Design Supporting Tool (CDST). Parameters and functions of the tool--CDST are defined. The relationship between CDST and OAS is discussed.

Chapter 6: Implementation  
Suggestions are provided for Tianye office according to the implementation and use of CDST. Another scenario taken for Steinberg Architects is also introduced.

Chapter 7: Conclusion and discussion  
The Value of CDST for the firm and the client is concluded and discussed in depth..
2. Problem definition

2.1 Problem definition

To investigate the topic of improving management performance for the conceptual design process, the management of Tianye office is taken as a case study for the research. Since I was hired by Tianye office as a chief architect, the role I played as, regarding this research, on one hand is a professional researcher and on the other hand is a professional, an architect executing various projects. Relevant data is collected not only by interviews with Tianye office’s employees and the firm’s director, but by personal observation through on-going daily work in the office investigating the current design process and its difficulties in daily work. This is a research situation as Gummesson (1999) describes in which the researcher is an actor in the case studied.

The points shown below are the main problems encountered in Tianye office during conceptual design process.

✧ External and internal communication

The communication flows between clients and Tianye, are ill-structured. During the conceptual design phase, the project architect or project manager communicates with the client mainly according to his/her personal experiences using various media like …meetings / telephone, email messages, etc… “Quite a lot of repeating efforts happened just because of the missing information, which is failed to be collected by the project architect / project manager in the early design stage with the client.” This is stated as complaint by several assistant architects.

Regarding the internal communication, it happens that, while architects are still working based on the original program, the updated idea from client has not been timely or clearly transferred to them by the architect’s contact with the client. Hence great efforts are wasted. Although an instant communication software package has been installed to each employee’s computer, the information exchanged by it, is not structured and can hardly be retrieved. There is not a person appointed to be responsible for this communication and the database information described below, for keeping the information up-to-date.

✧ Database

There is a special hard disk arranged in the LAN(Local Area Network) for data storage. However, there is no rule for document categorizing and backup. Only accomplished design achievements(digital drawings, presentations and virtual models, etc..) are required to have a backup into this disk. Employees are used to solely dealing all the on-processing document by his/her own computer. No sharing project folder is created for a design team in the server. People use the instant communication software to transfer the file that they demand from each other. There is no knowledge sharing folders within the LAN. Employees usually search relevant reference resources by books or internet. Even a similar project done before, can only be traced by somebody who once joined the project design team and had the memorization on it.

✧ Document management
Neither for material documents nor digital documents, there is no relevant standard for showing version or status. Employees named the digital file by their personal habit. Only archived documents on the above mentioned hard disk can be retrieved. The daily on-processing documents can only be transferred by the instant communication software; otherwise, using an U-disk to transfer them. Even the printed submittal presenting to client has no record. They are just stored in a particular cupboard. When someone wants to browse a certain document, he/she shall check all of the stored documents until get the one he/she is intended to read.

✧ Workflow

According to interviews, only a few employees have a clear vision on the work flow for project design process. Usually, a schedule for a new task is appointed to a project architect by director's oral notice only. Milestones of the design process are appointed by the experience of a project architect only; and there is no further plan for different detailed design tasks rather than in the mind of the director or project architect. Due to lack of overview on task arrangement, it not only causes working conflict, but causes unsatisfied feelings among employees.

✧ Quality control

There is no formal quality standard for design documents except following a compulsive regulation issued by the government (The depth of architectural and engineering design documentation requirements) in this office. An interesting thing is that, through interviews in this respect, most architects mentioned that the firm's director emphasized the most in an informal manner is that the product submittal (final design achievements presented to client) shall meet the satisfaction of its client. The reality is that design documents (sketches, design images, drawings, specifications, etc...) made by different project architect show great discrepancies. And it could hardly be traced that they are designed by the same company.

Above mentioned problems greatly influenced the design efficiency and the quality of output. And could cause project delays or lower quality of submittal output and therefore lead up to less profit for both architectural design firm and its client.

2.2 Requirement and expectation of Tianye office

By interviews with the firm's director, the long term ambition of Tianye office aims at building an international brand to raise the influence of the organization in architectural design industry and hence to reach a advantageous place in future's competition. Currently, the director wants the management of the office to use standardized methods in an effective way. And what he emphasizes more is that the effectiveness to have a product submission approved by its client shall be improved. Although he imagines that an Office Automation System (in terms of a software package) may be suitable for fulfilling his expectation, he is also worrying about the following issues:

1) Too many packages existing in current market to decide which one shall be selected
2) The payment for acquiring the OAS is not clear in the market.
3) Regarding the specific situation of Tianye office, an adaptive adjustment on the existing OAS is needed. But how to do it?
He hopes that the ADMS trainee is capable to develop a management tool to support the project design management regarding the conceptual design process in an effective and quality control manner, hence to improve the business performance between Tianye office and its client. And furthermore, the tool may be linked to plan and adjust an existing OAS specifically for Tianye office.

2.3 Research scope

Based on above defined problems and expectations of Tianye office, the research scope is restricted within the project management aspect for the conceptual design process. The research is defined from the office manager’s point of view. The analysis of the current situation of Tianye office and Steinberg Architects, plus investigation of relevant literature and exploration on current existing OAS are all served for improving the management performance of conceptual design process.

2.4 Research goal

Based on above mentioned aspects, the research goal of the ICA is defined as follows:

1) Develop a management tool to help an architectural design office work in an effective and quality-control manner for its client within the architectural conceptual design process.
2) Furthermore, this tool can guide an architectural design office to plan an OAS specifically for the management on the project design process.

2.5 Main research question and sub-questions to reach the goal

2.5.1 Main research questions

According to the defined research goal, the following main research questions can be raised:

1) How can a management tool help an architectural design office to support the project management aspect regarding the conceptual design phase in an effective and quality control manner?
2) And how can the tool guide an architectural design office to select and adopt an OAS to enhance its project management performance in the conceptual design phase?
2.5.2 Sub research questions
To have a better understanding of the main question, sub-questions showing below are catalogued into two ranges: one is related with background knowledge of this field; the other is strictly related with the study case. These sub-questions represent the analysis and design phase in the regulative cycle.

Range 1.—questions on terminology related with conceptual design phase
1) What is the conceptual design phase? (Consisting of activities, tasks, client support, etc.)
2) What is the context of project management in the conceptual design phase?

Range 2.—questions on the study case
1) What bottle necks does Tianye office face regarding the management in the conceptual design phase that affects the working efficiency and the quality of the output?
2) How can a management tool support Tianye office to solve bottle necks and have the output met or exceeded client's expectations?
3) How to divide the conceptual design process into several describable and controllable stages?
4) How can the management tool support managing each stage in an effective and quality control manner?

2.6 Methodology and technique
2.6.1 Research methodology
A research, which is based on the paradigm of the design science, and aimed at developing prescriptive knowledge in the form of technological rules or solution concept, follows the learning or reflective cycle of Van Aken (2004). (see figure 1.1)

According to design-focused and theory-based business problem solving method, this research takes the regulative cycle of Van Strien (1997) (see figure 2.1) as an instrument for developing the management tool specifically for Tianye office.

![The Regulative cycle for business problem solving (Van Strien 1997)](image)

2.6.2 Delineation of the research
This research is aiming at designing a management tool for supporting the architectural conceptual design process with common sense. The management situation of Tianye office is taken as a study case for starting the research. Following the regulative cycle, a specific tool is developed for Tianye office. After that, another scenario for checking the tool, taken in Steinberg Architects will be reflected.
the phase of “developing technological rules”, case-specific elements of Tianye office and Steinberg Architects will be removed from the developed tool. Finally, to reach the research goal, the tool will be refined and redesigned in an universal significant manner.

Regarding the regulative cycle, the qualitative research method is adopted on data analysis. Particular ideas are discussed and identified with a relatively small research population. The following procedures are taken during the research process:

1) determining the area:
Along with the analysis of the current management situation for the conceptual design process of Tianye office, the research scope is defined. At the reflection phase, the analysis for Steinberg Architects is used for checking the performance of the designed tool. Comparing different situations, to see how the tool works within the defined research scope, and to improve the tool in accordance with the performance changing in Steinberg Architects.

2) Taking in-depth interviews:
Interviews with individuals from Tianye office, Steinberg Architects and several clients they are serving for, are held. Appendix lists these interviews.

3) Analyzing specialist literature:
Regarding the research scope, relevant research topics are selected. Investigation on those topics through literature review plays crucial role for designing the desired management tool.

4) Investigating current existing software packages of the OAS (Office automation system).
As the goal is to develop an OAS for the architectural design office, current existing software packages will be studied. That is to say, the aiming OAS will be selected and redesigned based on current software packages.
3. Literature study

Regarding the research topic, the following knowledge or theories will be investigated:

1) Knowledge on architectural conceptual design phase.
2) Theory on organizational analysis—McKinsey’s 7S framework.
3) Theory on organizational change.
4) Method on establishing an information system—SSADM (Structural system analysis and design manual)
5) Theory on BPR (Business process reengineering)
6) Theory on project management
7) Theory on “quality” of architecture design and “quality control” on the design process.
8) Knowledge on work flow and data flow
9) Knowledge on BPMN (business process modeling notation)

3.1 Knowledge on architectural conceptual design phase.
As the research goal is limited within the architectural conceptual design phase, the knowledge of design process, design tasks and design achievement related with this phase will be investigated. Hereafter, the above mentioned knowledge described by AIA (American Institute of Architecture) will be taken as a reference.

3.1.1 Design process and tasks of conceptual design phase
According to AIA, the typical conceptual design process for the design office is separated into several distinct phases: Pre-design phase, site-analysis phase, schematic design phase (See table 3.2).

Pre-design phase is also named as ‘programming’. Architectural programming is “the systematic process of gathering and analyzing information about a building or other setting, and then using that information to create guidelines for the performance of that setting.” (Duerk, 1993). Programming is also defined as “consultation to establish and document the following detailed requirements for a project” (AIA 1993). In general, pre-design is a problem-seeking stage. Site analysis is treated as distinct phase probably because it involves on-site activity in real projects. In contrast to the pre-design stage, schematic design phase is a problem solving stage in this phase. What is called ‘creative part’ usually refers to the schematic design phase where main concepts of form and space are generated.

<table>
<thead>
<tr>
<th>phases</th>
<th>Expected Tasks (partial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>conceptual</td>
<td>- design objectives</td>
</tr>
<tr>
<td>design</td>
<td>- limitations and criteria</td>
</tr>
<tr>
<td>pre-design</td>
<td>- site requirements</td>
</tr>
<tr>
<td></td>
<td>- space relations</td>
</tr>
<tr>
<td></td>
<td>- initial approximate facility areas and space requirements</td>
</tr>
<tr>
<td></td>
<td>- flexibility and expandability, etc.</td>
</tr>
<tr>
<td>site</td>
<td>- site analysis and selection,</td>
</tr>
<tr>
<td>analysis</td>
<td>- site development planning,</td>
</tr>
</tbody>
</table>
Rather than following a sequential order, these activities take place in an iterative manner. Design is an iterative process where schemes are recognized, explored, revised and enhanced until a solution is identified (Sanders 1996).

Besides above technical design tasks, according to the AIA, *The Architect’s Handbook of Professional Practice*, relevant business tasks are also important, for instance:
1) Marketing and public relations
2) Risk management
3) Agreement/contract negotiation
4) Management on design team and design process
5) Communication and presentation

### 3.1.2 Design achievement of the conceptual design phase

Based on the client’s approved design brief, the architectural design office shall prepare design achievement for the client. The achievement comprises a set of design documents, which including drawings and relevant specification: explanation on design concept, a site plan, relevant analysis diagrams, preliminary building plans, sections, elevations, study models, perspective sketches, or digital modeling, an estimation on building cost, etc…

During the conceptual design process, the design office keeps updating the intermediate design results to its client. These intermediate design results carry the role of communicating between the design office and its client. Practically, it concerns better responding to the client’s expectations.

Usually, the design achievements finished within the conceptual design phase, not only shall meet or surpass the expectation from client, but shall get approved by government. Both client and government cares less on the design process but the design submissions. However, they have different concerns on the design submissions. Client cares more on the practicability of the proposed design and the profit that it may generate, while government cares more on the public benefit that the design proposal may bring to the society, at least it shall meet the approved requirements of zoning plan.

With respect to the Chinese building design industry, Chinese government issues a specific code on the requirements and depth of design contents for the conceptual design documentation, which shall be submitted to the government. (See national code: *The Depth of Architectural and Engineering Design Documentation Requirements*). Practically, each local government in China will also issue its local requirements on the design submissions. In short, the contents and depth of the design achievement
shall not only meet the requirements from client, but also the above mentioned code or regulations.

### 3.1.3 Stakeholders within the conceptual design phase

Stakeholders can be defined as groups or individuals who have stake in or expectation of a projects performance (Newcombe, 2003). There are mainly five groups of stakeholders related with the conceptual design phase:

1) **Designer—Architectural design office**
   All employees served for the project can be categorized into this group. They are the key actors that decide the working performance on the project design. Narrowly speaking, the working performance mainly depends on capability of the specific design team. For instance: the experience and knowledge of the design team, the management performance of the design team, etc… Interest of this group is mainly about obtaining the business and artistic value, reputations among peers by proposing a satisfied conceptual design achievement for client, users and government.

2) **Consultant—Supporting offices**
   As the architectural conceptual design office mainly formed by architects, the knowledge on structure, mechanic system and other fields shall be supported by relevant consultants—other professional offices. Generally speaking, regarding to conceptual design phase, the involvements of the consultant are rather low. Furthermore, in China, the consultants are usually hired directly by the client. Interest of this group is about obtaining its business value by technique supporting for Designer and client.

3) **Client—Building developer**
   Client offers business to designer, and consultant provides space commodities to users. Its interest is about gaining profit by developing the project and delivering it to users as soon as possible. Regarding the real estate developing project, to a great extent, client represents the most interests of users, to whom they are willing to sell the developed project.

4) **User—Inhabitant of the building**
   Users are the final inhabitant of the project; they stay and take the usage of the space offered by the developed building. Target group of the user is depended on the requirements of zoning plan and the market orientation planned by client. Interest of users is about the value of utility, beauty and durability, when they look at or stay in the building.

5) **Supervisor—Government**
   Government acts as a supervisor on overall controlling the requirements regulated by zoning plan with respect on the developing project. The project is usually supervised by local government, unless the design proposal surpasses the regulated code. If so, the design proposal shall be checked and approved by the government of national level. Interest of the government mainly lays on creating and balancing the public benefit of the society.

Link above mentioned stakeholder groups with the specific market background in China, the consultant and the uncertainty user are less relevant with the research goal. The other way round, designer, client and supervisor shall be laid more concerns.
3.2 McKinsey’s 7S framework

Theory on organizational analysis

This is a management model developed by well-known business consultants Robert H. Waterman, Jr. and Tom Peters (1980). It describes an organization by 7 elements, each of which begins with letter—s: Strategy, Structure, System, Shared value, Skill, Staff, Style. Among them, Strategy, system, Structure are considered as “Hard” elements. They are easier to define or identify and management can directly influence them. Others are regarded as “Soft” elements, they are more difficult to describe, and are less tangible and more influenced by culture.

Figure 3.2 McKinsey’s 7S framework

1) **Strategy**: the plan devised to maintain and build competitive advantages over the competition of current architectural conceptual design industry.

2) **Structure**: the basic organization of the company, its departments, reporting lines, areas of expertise, responsibility and how they inter-relate.

3) **Systems**: the daily activities and procedures that staff members engage in to get the job done. the procedures, processes and routines that characterize how the work should be done. It includes financial system; recruiting, promotion and performance appraisal systems, information system, etc…

4) **Shared Values**: called "superordinate goals" The values and beliefs of the company. Ultimately they guide employees towards 'valued' behavior. These are the core values of the company that are evidenced in the corporate culture and the general work ethic.

5) **Skills**: the capabilities and competences that exist within the company.

6) **Staff**: the company's people resources and how they are developed, trained, and motivated.

7) **Style**: the leadership approach of top management and the company's overall operating approach.

This model is based on the theory that, for an organization to perform well, these seven elements need to be aligned and mutually reinforcing. So, the model can be used to help identify what needs to be realigned to improve performance, or to maintain alignment (and performance) during other types of change, for example to help an organization:

- Improve the performance of a company.
- Examine the likely effects of future changes within a company.
- Align departments and processes during a merger or acquisition.
- Determine how best to implement a proposed strategy.

3.3 Theory on organizational change

Many different theories/models of organizational change exist throughout the multidisciplinary literature base. Summarized by Adrianna J. Kezar (2001), there are mainly 6 categories: (1) evolutionary, (2) teleological, (3) life cycle, (4) dialectical, (5) social cognition, and (6) cultural. Each category encompasses many different individual models. Regarding the research goal setting in this paper, the theory of “teleological” is studied.
Based on the necessity of change discovered by leaders, change agents or others, teleological approach is motivated by internal organizational features rather than the external environment. The leader of the organization is the center of the changing process; the goal on the change is set up; sets expectations, models, communicates, engages, and rewards. Strategic choices and human creativity are highlighted. Using rational scientific management tools, its process for change is rational and linear, individual managers are much more instrumental to the process (Carnall, 1995; Carr, Hard, and Tranant, 1996). The outcome of the change is new systems, structures or organizational principals.

Following with the model of teleology on organizational change, theory of project management, method on establishing an information system—(SSADM), theory on business process reengineering, etc... are need to be investigated.

3.4 Method on establishing an information system—SSADM (Structural system analysis and design manual)

Structured systems analysis and design method (SSADM) is a systems approach to the analysis and design of information systems. SSADM was produced for the Central Computer and Telecommunications Agency (now Office of Government Commerce), a UK government office concerned with the use of technology in government, from 1980 onwards.

SSADM takes establishing the information system as a project. The following diagram describes the steps of how the information System is realized:
3.5 Theory on BPR (Business Process Reengineering)

Business process re-engineering is the analysis and design of workflows and processes within an organization. It was raised by Michael Hammer in an article, which is published in Harvard Business Review in 1990. Afterwards, BPR was improved and propagated by Champy. According to Hammer, the work being done does not add any value for customers, and this work should be removed. Companies should reconsider their processes in order to maximize customer value, while minimizing the consumption of resources required for delivering their product or service.

Reengineering starts with a high-level assessment of the organization's mission, strategic goals, and customer needs. Basic questions are asked, such as "Does our mission need to be redefined? Are our strategic goals aligned with our mission? Who are our customers?" An organization may find that it is operating on questionable assumptions, particularly in terms of the wants and needs of its customers. Only after the organization rethink what it should be doing, does it go on to decide how best to do it. Within the framework of this basic assessment of mission and goals, re-engineering focuses on the organization's business processes—the steps and procedures that govern how resources are used to create products and services that meet the needs of particular customers or markets. As a structured ordering of work steps across time and place, a business process can be decomposed into specific activities, measured, modeled, and improved.

A key stimulus for re-engineering has been the continuing development and deployment of sophisticated information systems and networks. This information technology is considered by some as a major enabler for new forms of working and collaborating within an organization and across organizational borders.

In the early application stage, BPR is basically the fundamental re-thinking and radical re-design, made to an organization's existing resources. It is more than just business improvising. It is an approach for redesigning the way work is done to better support the organization's mission and reduce costs. Since 1995, considering business processes as a starting point for business analysis and redesign has become a widely accepted approach and is a standard part of the change methodology portfolio, but is typically performed in a less radical way as originally proposed.

3.6 Theory on project management

Project management is the discipline of planning, organizing, securing, and managing resources to achieve specific goals. The design task can also be regarded as a project. The goal is to deliver the design results to its client, which meets the requirements and expectations of client and can be approved by government. How to organize the design team, arrange the design tasks, plan the design process, secure the design schedule, produce the design result with its quality controlled, minimize the cost and maximize the profit for the design office, are the key issues related with the project management.

3.6.1 History of the theory development on project management

Y.C. Chiu (2010) has an investigation on the history of the project management by the book of ‘An introduction to the History of Project Management’ from the earliest time to AD 1900. Project management has evolved over the ages in step with the evolution of the cultural and knowledge
environments of a particular historical period. General management skills, project tools, and techniques have also evolved, along with the tradition of master builders and project activities in construction. Considering the research field of this paper, the tools and core elements of knowledge for contemporary project management, which developed by Gantt and Fayol, the forerunner to modern project management, will be taken as a start to explain the theory of project management. Gantt is well known by the planning and control techniques, while Fayol contributes on creation of the 5 management functions: planning, organizing, commanding, coordinating, and controlling, which form the foundation of the body of knowledge associated with project and program management.

Since 1950', the modern Project Management era begins. Currently, two groups are active on the field of project management. One is the International Project Management Association (IPMA), another is Project Management Institute (PMI). IPMA was founded in Europe in 1967. PMI was formed in the USA in 1969. Both of them systematically contribute great on the modern project management field.

3.6.2 Approaches
There are a number of approaches to managing project activities including agile, interactive, incremental, and phased approaches. Hereafter, the traditional approach and process-based management approach will be investigated.
- The traditional approach
  A traditional phased approach identifies a sequence of steps to be completed. In the "traditional approach", five developmental components of a project can be distinguished (four stages plus control):
  1) initiation;
  2) planning and design;
  3) execution and construction;
  4) monitoring and controlling systems;
  5) completion
- Process-based management
  Process-based management is a management approach that governs the mindset and actions in an organization. It is a philosophy of how an organization manages its operations, aligned with and supported by the vision, mission and values of the organization. The process is the basis on which decisions are made and actions are taken. The general process is that the vision determines the necessary strategy, structure and human resource requirements for the organization. It can also be used on the project management level in that a clear vision of a project defines the strategy, structure and resources required to achieve success. The project process continues with the implementation of the tasks and activities required to achieve the vision.

3.6.3 Project constraints
Regardless of the methodology employed, careful consideration must be given to the overall project objectives, timeline, and cost, as well as the roles.
and responsibilities of all participants and stakeholders. Traditionally, these constraints have been listed as "scope," "schedule," and "cost." These are also referred to as the "project management triangle", where each side represents a constraint. One side of the triangle cannot be changed without affecting the others. See Figure 3.6.3 Project management triangle.

The time constraint refers to the amount of time available to complete a project. The cost constraint refers to the budgeted amount available for the project. The scope constraint refers to what must be done to produce the project's end result. These three constraints are often competing constraints: increased scope typically means increased time and increased cost, a tight time constraint could mean increased costs and reduced scope, and a tight budget could mean increased time and reduced scope. The discipline of project management is about providing the tools and techniques that enable the project team to organize their work to meet these constraints.

3.7 Theory on “quality” of the architecture design and “quality control” of the design process.

3.7.1 Quality of architecture design

Talking about the quality of the architecture design, the quality of the building that represented by the architecture design shall be investigated. The earliest surviving written work on this topic is De architectura, by the Roman architect Vitruvius in the early 1st century CE. According to Vitruvius, a good building should satisfy the following three principles:
1) Durability – it should stand up robustly and remain in good condition.
2) Utility – it should be useful and function well for the people using it
3) Beauty – it should delight people and raise their spirits.

In the late 20th century a new concept was added--the consideration of sustainability, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship, the responsible management of resource use.

Regarding the quality of architecture design, it encompasses all the aspects by which a building is judged. One of the representative perspectives is the Design Quality Indicator (DQI), which is developed to measure the design quality of buildings. Following the description of Vitruvius, DQI interprets the connotation of architecture design quality in a modern style:
- Functionality (utilitas) - the arrangement, quality and interrelationship of spaces and how the building is designed to be useful to all.
- Build Quality (firmitas) - the engineering performance of the building, which includes structural stability and the integration, safety and robustness of the systems, finishes and fittings.
- Impact (venustas) - the building’s ability to create a sense of place and have a positive effect on the local community and environment.
According to Leentje Volker (2010), Figure 3.7.1 describes how design quality is commonly discussed by using the classification of the DQI for the Vitruvian trilogy.

1) Technical, physical, hard, functional, objective or tangible qualities, in this research referred to as ‘tangible characteristics’;
2) Perceptual, soft, subjective, judgmental or intangible values, in this research referred to as ‘intangible characteristics’.

Tangible characteristics can most easily be measured and quantified by an assessment system which is generally acknowledged. Intangible characteristics refer to a personal response to built form, people’s perception of space, texture, colour and light, the meanings and associations attached by people to places or the way by which people assign aesthetic qualities to their surroundings (Bârtolo, 2002; Vitruvius & Morgan, 1960).

3.7.2 Assessment on the quality of architecture design

Besides the above professional discussion on the quality of architecture design, according to Leentje Volker, three other perspectives shall also be emphasized in parallel:

1) Design perception and affect (cognitive approach)
2) Product experience and emotion (interaction approach)
3) Value systems in design (process approach)

Design quality therefore can be defined as an overall value judgment by an individual person based on the interaction between this person and an object in the built environment. The assessment systems for design quality need to take into account that affective responses occur in the interaction between a product and an individual.
product qualities according to the Kano principles (based on Walden, 2003) offers some insight into the product attributes which are perceived to be important to customers. This model focuses on differentiating product features, as opposed to focusing initially on customer needs. Thomson (2003) states that the distinction between quality and value lies in the objective or subjective character of its judgment. Value assessments can be subjective when framed against an individual’s values, while quality assessments can be considered objective when the relationship between benefit and expense is compared on a level of fulfillment of requirements. Leentje Volker concludes: a value judgment always includes an experience that is accompanied with an affective response. this affective response consists of three components: aesthetic experience, experience of meaning, and emotional experience. Four general levels are taken for assessing the architecture design quality:

1) Under-performance,
2) Basic performance,
3) Added value
4) Excellence.

3.7.3 Quality control on the design process

Quality control is a process by which entities review the quality of all factors involved in production. In the 1980s, the quality control of peers review and quality control circle, were developed.

- Quality control circles
  The idea of the quality control circle, which originated in Japan in the 1960s, has been successfully applied in many industries. A quality control circle is a group of employees that regularly meet to identify, analyse, and solve problems related to their work. The premise is that employees are valuable resources and may know, better than management, their immediate quality control problems and how to solve them. Benefits from this process include increased motivation, improved communication, teamwork, more involvement by employees, and higher productivity. The circles should meet once a week for an hour and be flexible enough to accommodate everyone’s schedules. Membership should be voluntary.

- Peer review
  Peer review is a process of self-regulation by a profession or a process of evaluation involving qualified individuals within the relevant field. Peer review methods are employed to maintain standards, improve performance and provide credibility. Peer review improves the quality of the practice by having its policies and procedures examined by a group of professional colleagues. It is difficult for authors and researchers, whether individually or in a team, to spot every mistake or flaw in a complicated piece of work. This is not necessarily a reflection on those concerned, but because with a new and perhaps eclectic subject, an opportunity for improvement may be more obvious to someone with special expertise or who simply looks at it with a fresh eye. Therefore, showing work to others increases the probability that weaknesses will be identified and improved.

- Quality management system and ISO 9000
  A quality management system (QMS) can be expressed as the organizational structure, procedures, processes and resources needed to implement quality management. Of all QMS regimes the ISO 9000 series is probably the most widely implemented worldwide. Steps of developing a QMS are shown as follows:
  • Develop a QMS Development Plan which conforms to ISO 9001 2000 requirements.
• QMS Development Plan should use a process approach.
• Organizations must identify and manage the processes that make up their quality management systems.

The ISO 9000 family of standards relates to quality management systems and is designed to help organizations ensure they meet the needs of customers and other stakeholders (Pokinska et al, 2002). The standards are published by ISO, the International Organization for Standardization, and available through National standards bodies. ISO 9000 deals with the fundamentals of quality management systems, including the eight management principles (Beattie and Sohal, 1999; Tsim et al, 2002) on which the family of standards is based. ISO 9000 is sweeping the world, and rapidly becoming the most important quality standard.

Theoretically speaking, follows the 22 processes listed below, the quality management system may meet all of the ISO 9001 2000 requirements:

1) Quality Management Process
2) Resource Management Process
3) Regulatory Research Process
4) Market Research Process
5) Product Design Process
6) Purchasing Process
7) Production Process
8) Service Provision Process
9) Product Protection Process
10) Customer Needs Assessment
11) Customer Communications Process
12) Internal Communications Process
13) Document Control Process
14) Record Keeping Process
15) Planning Process
16) Training Process
17) Internal Audit Process
18) Management Review Process
19) Monitoring and Measuring Process
20) Nonconformance Management Process
21) Continual Improvement Process
22) General Systemic Process

3.8 Knowledge on work flow and data flow

3.8.1 Work flow and work flow diagram
A workflow consists of a sequence of connected steps. Emphasis is on the flow paradigm, where each step follows the precedent without delay or gap and ends just before the subsequent step may begin. For control purposes, workflow may be a view on real work under a chosen aspect, thus serving as a virtual representation of actual work. The flow being described may refer to a document or product that
The key driver to gain benefit from the understanding of the workflow process in a business context is that the throughput of the work stream path is modeled in such a way as to evaluate the efficiency of the flow route through internal silos with a view to increasing discrete control of uniquely identified business attributes and rules and reducing potential low efficiency drivers. Evaluation of resources, both physical and human is essential to evaluate hand-off points and potential to create smoother transitions between tasks. Several workflow improvement theories have been proposed and implemented in the modern workplace.

A workflow can usually be described using formal or informal flow diagramming techniques, showing directed flows between processing steps. Single processing steps or components of a workflow can basically be defined by three parameters:

1) **Input description**: the information, material and energy required to complete the step
2) **Transformation rules**, algorithms, which may be carried out by associated human roles or machines, or a combination
3) **Output description**: the information, material and energy produced by the step and provided as input to downstream steps.

### 3.8.2 Data flow and data flow diagram

Data flow is a term used in computing, and may have various shades of meaning. It is closely related to message passing. It is the paradigm of communication where messages are sent from a sender to one or more recipients.

A data flow diagram is a graphical representation of the "flow" of data through an information system, modeling its process aspects. Data flow diagrams illustrate how data is processed by a system in terms of inputs and outputs. Often they are a preliminary step used to create an overview of the system which can later be elaborated. Data flow diagrams can also be used for the visualization of data processing. Data flow diagrams were proposed by Larry Constantine, the original developer of structured design, based on Martin and Estrin's "data flow graph" model of computation. The data flow diagram shows what kinds of data will be input to and output from the system, where the data will come from and go to, and where the data will be stored. It does not show information about the timing of processes, or information about whether processes will operate in sequence or in parallel.

Data flow diagrams can be used to provide the end user with a physical idea of where the data they input ultimately has an effect upon the structure of the whole system from order to dispatch to report. In the course of developing a set of leveled data flow diagrams the analyst/designers is forced to address how the system may be decomposed into component sub-systems, and to identify the transaction data in the data model.

### 3.9 Knowledge on BPMN (Business Process Model and Notation)

Business Process Model and Notation (BPMN) is a standard for business process modeling that provides a graphical notation for specifying business processes in a Business Process Diagram, based
on a flowcharting technique very similar to activity diagrams from Unified Modeling Language (UML). The objective of BPMN is to support business process management, for both technical users and business users, by providing a notation that is intuitive to business users, yet able to represent complex process semantics.

Currently there are several competing standards for business process modeling languages used by modeling tools and processes. Widespread adoption of the BPMN will help unify the expression of basic business process concepts.

Business process modeling is used to communicate a wide variety of information to a wide variety of audiences. BPMN is designed to cover many types of modeling and allows the creation of end-to-end business processes. The structural elements of BPMN allow the viewer to be able to easily differentiate between sections of a BPMN Diagram. There are three basic types of sub-models within an end-to-end BPMN model:

1) Processes (Orchestration), including:
   ✴ Private (internal) business processes
   ✴ Abstract (public) processes
2) Choreographies
3) Collaborations, which may include Processes and/or Choreographies
   ✴ A view of Conversations
4. Analysis

4.1 Organizational analysis on Tianye office

Mckinsey's 7S organizational model is taken as a tool on analyzing Tianye office. Hereafter, the “Shared value, Structure, Strategy, System, Style, Staff, Skill” of the office will be investigated by interviews and personal observation. Since I have to be engaged in daily work in the office, it took me nearly half a year on finding and defining the current management situation. Surely, it also offered me the closest and the most directive means on analyzing the situation.

4.1.1 Shared Value:
The shared value of Shanghai office is not specifically described by employee’s manual. According to the director, the purpose of setting up the headquarter office in Shanghai is to take the advantages of hiring better talents on architectural design, hence, to develop competitive competence of architectural design, comparing local design level. The design specialties of the office are mainly about civil projects: residential buildings, hotel and office buildings.

4.1.2 Structure:
The time when I was employed as a chief architect at the beginning of 2009, Tianye office issued its official organizational structure as follows.

![Organizational structure of Tianye Shanghai office (2009)](image)

4.1.3 Strategy:
According to the director, Shanghai office mainly deals with civil projects from lower tiered cities, even from a county level. Better talents produce better designs in an effective and quality control manner, hence to get stronger competitiveness comparing to local peers.
4.1.4 System:
Because of the short period of establishment and few experiences of the office, so far, only the administrative system is formally regulated by the employee’s manual. Regarding the project management aspect, it is still a piece of blank. Staff works in a spontaneous manner. Current working performance indicates the disorderly status.

4.1.5 Style:
Director holds the major power on most of issues. Although he is willing to share a democracy management atmosphere with all employees, he worries a lot on staff’s performance. General speaking, it is a centralized management style.

4.1.6 Staff:
Chairman is Ning Zhang, the founder of Tianye office, who is responsible for the overall management of Tianye office. He has a background in civil engineering design.
Vice general director is Shuang Tian, also has the background in civil engineer. He is responsible for daily management of the office and contract negotiation with client.
Chief architect is me, responsibility for this position is to have an overall management on all projects for the three design departments. And shall have an overall quality control on all design submissions to client.(Mainly specialized in architectural and landscape design submissions.)
Vice director is Minghui Xu, who is a Phd candidate of Tongji University, majoring in Urban planning. He is responsible for marketing exploitation and quality control on urban planning project.(He left the office in March 2009.)
Architectural design department is responsible for conceptual design of architectural projects. And so on for other design departments. Marketing department is responsible for exploiting design projects in building market, according to the strategy of Tianye office, mainly exploiting the market from lower tiered cities or counties. Financial department mainly deals with the finance of office. Administration and HR department is responsible for daily office affairs and the management of HR. As the finance, administration and HR issue falls out of the research scope of this thesis, hereafter no details of each will be further discussed.
There are 3 project architects and 5 assistant architects in Architectural design department; one landscape project designer and 2 assistant in Landscape design department; one urban plan designer with one assistant in urban plan department; one marketing manager with one assistant in marketing department; one financial manager with one cashier in financial department; only one regular manager in the administration and HR department. The cashier from financial department also holds a concurrent post to support the administration and HR manager on dealing with the daily office affairs.
Project architect is responsible for the entire design process of a project: concept creating, design submission completing, communication with client on project design, etc... and so on for project landscape designer and urban planner.
Marketing manager is responsible for selecting suitable design project and having negotiation with client on agreement.
Totally, 22 persons constitute the organization at that time. However, due to the high turnover, especially from architectural, landscape and urban plan department, staff number of Tianye office fluctuates from 19 to 25 since 2009 to 2010.
4.1.7 Skills:
Followed with the business strategy, the standards for recruiting employees for each design department are aiming towards whether they have sufficient knowledge or experiences on designing residential, hotel and office projects. At that moment, there are two Class 1 national registered architects and one national registered civil engineer in Tianye office. The qualification for project architect, project landscape designer and project urban planner are more than 5 years working experiences based on having at least a professional bachelor degree. For assistants, usually 1~3 years working experience is the lowest requirement.

4.1.8 Conclusion
In terms of Mintzberg's organizational theory, Tianye office is a simple structure style. The techno structure and supporting staff for the office are rather small and weak. Furthermore, besides administrative regulation, little formalization of behavior is regulated for project design process. Although Mr. Ning Zhang plans a certain middle line for the management of Tianye office, he maintains a centralized control on most issues. It is the major reason that Mr. Ning Zhang feels too busy to handle all the details and why he suggests to change current disorderly management situation into a standardized and regularized style.

4.2 Current conceptual design process of Tianye office

There is no formal statements on organizing the design process in Tianye office. According to interviews and personal observation, the current design process can be illustrated as follows:

- **Stage 1** Project undertaking
- **Stage 2** Project evaluating and arranging
- **Stage 3** Project designing and checking
- **Stage 4** Product submitting and feedback collecting

4.3 Work flow of the current conceptual design process

Either from manager level or project architect, project landscape designer, project urban planner (hereafter abbreviated as project architect) level, each of the above position arranges relevant working procedures in accordance with his/her personal inclination. The work flow is flexibly and randomly arranged by them. Hereafter, only an approximate description on it could be demonstrated.

4.3.1 Stage 1 Project undertaking
There are several means of undertaking a new project:
1) From director
2) From marketing department
3) From others

If the information is confirmed by the first means, director will handle the undertaking procedures by himself (Sometimes, he will also ask a companion, for instance, marketing manager, vice directors, chief architect, or project architect) . And if it is confirmed by the other means, vice director and marketing
manager (Also, they will ask a companion too. Either chief architect, project architect or even director) will visit client and collect relevant design information.

Regarding the initial negotiation on commitment agreement, vice director and marketing manager play important roles. They shall timely report the progress to Mr. Ning Zhang.

4.3.2 Stage 2 Project evaluating and arranging

Usually the decision making on whether undertaking the project depends on a discussion between director and vice directors( most of the time, marketing manager will be also involved, and sometimes the chief architect.) If the project is undertaken by Mr. Ning Zhang, he sometimes makes the decision directly and confidently, because the clients are his old friends. And a good relationship has already established between them.

If director Ning Zhang approves on taking the new project, which is undertaken by himself, he will assign the task to a project architect by oral communication; if the project is undertaken by other means, he suggests the client-contacting person assigns the task to project architect directly, so that the collected information may transfer more precisely. Due to the absence of overall HR allocation, a temporary coordination on task arrangement with project architects is always needed. The coordinator might be director himself, vice directors, chief architect or even the person who contacts the client. They usually take an informal communication with the project architects to decide who is available to be the project leader and how many people are needed for the design team.

4.3.3 Stage 3 Project designing and checking

After project architect gets the assignment, he/she usually arranges the design tasks in accordance with his/her own habit. To my surprise, most of the project architects will not show the exact contents of the final design submission. (Most of the time, the project brief from client is informal and sometimes recorded by the liaison staff. There is no sufficient requirement on the final design contents.) Another find is that some of them will not set the milestone for an internal evaluation on the possible design proposals. They tend to take the date of presenting the design result to client as the deadline. And it seems they do not like an intermediate evaluation on their initial idea and even a check on their final design submission. They just take the design task, and go into the idea conceiving and developing action. When they think that they have already gotten the idea developed, they arrange the design tasks in their mind. And gradually, the drawings, specifications, sketch models appear with his/her mind develops. Usually, the days closed to the deadline are the busiest days for the design team.

As for the personal habit, some of them are used to arrange design tasks to team members based on a fully developed idea, while others are eager to ask the team members to join the design based on a rough idea, or even ask team members to develop their own ideas on the project.

Although project architect seems reluctant to have their design checked, the vice directors, chief architect, the liaison person, sometimes Mr. Ning Zhang will always informally spend some time on reviewing the design result and schedule. They take advantages of their knowledge, experiences and personal influence on requiring some changes on the on-going design. Most of the time, project architect insists his/her ideas on the design, unless he/her is fully convinced by them. However, it seems Mr. Ning Zhang feels also stressful on whether discouraging the design creativity of the project.
4.3.4 Stage 4 Project submitting and feedback collecting
In Tianye office, the project architect is required to present the design submission himself/herself. Accompanied people, usually are director, or vice director, or marketing manager, or chief architect, or liaison between Tianye office and client, or the combination of above mentioned people. Project architect is responsible for the technical report, while others are responsible for the introduction and promotion of Tianye office. After presentation, the project architect is required to take a record on the feedbacks from client. However, the recorded feedbacks are not shared with the client and other meeting attendees.

Practically, the client seldom offers the design office a contract after first round design submission. However, if client shows interests on asking continue work from Tianye office and Mr. Ning Zhang is willing to take the risk, the project architect will take back the feedbacks and return to the stage 3 again. During the stage 4, project architect may take an opportunity on negotiating the deadline for next submission and presentation.

4.4 Data flow of the current conceptual design process

The data flow is also not formally regulated in Tianye office, neither for management data nor for technique data. Roughly speaking, there are no documentation format and no quality standard on controlling the design process and design result.

4.4.1 Stage 1 Project undertaking
Because the clients are mainly from lower tiered cities or counties, some of them are not so professional to make a project brief, and because no formal information collecting method is ruled in Tianye office, It brings great difficulty for liaison person to collect sufficient information from client. The basic conditions (requirement from client, requirement from government, conditions of the site, etc…) for starting the project design collected by liaison person are remarkably diverse. Another important data at this stage, is the agreement between client and design office. Tianye office takes a sample contract issued by Chinese government as a blueprint for negotiating the agreement. Honestly speaking, Mr. Ning Zhang prefers to have an agreement before starting a design task. However, he is also tolerant on the negotiation of the agreement, as one of his strategies on contracting, is that sincerity attitude touches client, efficiently offered high quality design impresses client. When client feels satisfied on both service and design product, the contract will be successfully signed.

4.4.2 Stage 2 Project evaluating and arranging
The information of a new project collected by liaison person, is shared by director, vice directors, marketing manager, and sometimes chief architect by a temporary meeting. During the meeting, the sufficient of project brief will be discussed, the risk will be analyzed. In case they are aware of that some project architects and assistant architects are available, they will assign the design task directly to them and form the design team. However, most of the time, the availability is checked by face-to-face inquiry to the project architects and assistant architects. If the project is undertaken directly by Mr. Ning Zhang, sometimes the meeting is not necessary, as he trusts the client—his old friend. He will assign the design task himself, and oral brief to the vice directors, marketing manager and chief architect afterwards.
When the information is transferred to a project architect, besides the project brief collected from client, (Sometimes, no formal brief) other information are usually transferred by means of oral talking between the liaison person and the project architect.

Within the certain period till deadline, the project architect shall arrange the design tasks himself/herself. However, according to observation, few of the project architects will formulate a task list to show the details for the design team within this period.

4.4.3 Stage 3 Project designing and checking
Unfortunately, during the key stage for producing the design result, Tianye office still has few regulated control on the design process and the design product.

Through the entire conceptual design process, only the finished design submission is required to backup in the hard disk of server. However, as no regulated folder system, the name of documents and folders are various. As for the intermediate design result, although a LAN is arranged in the office, design staffs are all used to store design files in local hard disk. They prefer transferring information by instant-messaging software.

Regarding the quality aspect, project architects may endeavor to work on a creative and innovative concept. They will try their best on offering client unique and impressive design solutions. However, they lay less attention on relative national code. When director, or vice directors, or chief architect is checking the intermediate design result, sometimes by a private discussion, sometimes by a meeting, the suggestions on the design are usually taken as a reference by project architect, they tend to insist their original idea, especially when they are about aesthetic aspect.

In short, project architect maintains a high level of autonomy on his/her own designs. He/she is willing to be responsible for having the client convinced.

4.4.4 Stage 4 Project submitting and feedback collecting
As mentioned before, after the design submission is finished, it is required to backup in the hard disk of server. Practically, because the final documentation is always finished by last minute, it even offers no time for a final overall check, therefore, the backup issue sometimes is ignored as well.

After the presentation, project architect will take a note on the feedbacks from client. This note is recorded as the conditions for the next round of design. Sometimes, this note will be sent to client as a meeting minute, sometimes not. Since, there is no regulated working procedure on the meeting minute; to send or not mainly depends on personal working style.

In the meanwhile, the accompanied vice director, or marketing manager, or Mr. Ning Zhang himself, will have a discussion on the contract issue with the client. Usually, a draft contract (Followed by national standard contract document) will be offered to the client.

4.5 Bottlenecks related with the work flow and data flow of current design process
Accompanied with above mentioned work flow and data flow, hereafter related bottlenecks will be
4.5.1 Bottlenecks at Stage 1

4.5.1.1 Bottlenecks on project selecting method
The employees of marketing department usually are not educated in architectural design. Although orientation training on specialties of Tianye office will be given, they exploit the design market mainly according to their personal relationship. Sometimes, the projects they are contacted are too complicated to be handled by Tianye office. Mr. Ning Zhang has to spend extra efforts on looking for supporting partners. However, the result always turns to be not positive.

4.5.1.2 Bottlenecks on project information collecting
Omission of the information collected by the liaison person happens often. Project architect complains that nearly 50% rework happens just because some requirements from client or government are missing. One reason is that there is no regulated information collecting method as a reference for the liaison person. Another is the information exchanging style—too much oral communication between the client and Tianye office, between the liaison person and the project architect.

4.5.2 Bottlenecks at Stage 2

4.5.2.1 Bottlenecks on project evaluating
Because of no formalized information collecting methods, Mr. Ning Zhang feels stressful on making the decision of whether undertaking the project, unless he, himself, visits the client. On one hand he worries about whether discouraging marketing employees or others, who introduce the new project, on the other hand he worries on the risk of undertaking it.

4.5.2.2 Bottlenecks on project arranging
Regarding the negotiation with client on schedule of a new project, the liaison person seldom consults chief architect or project architects, and tends to accept the requirement from client. Consequence of it are either cause a heavy overwork load, or lower quality design submission, or even cause a submitting delay to client.

As the work flow illustrates, because of no overall management on HR allocation, the extra communication with project architects and assistant architects on availability is always needed. Sometimes, staff tends to find excuse on the new arrangement. Consequently, the arrangement of the new project is assigned passively and difficultly.

4.5.3 Bottlenecks at stage 3

4.5.3.1 Bottlenecks on project designing
During the entire process of this stage, there is no archive system on documentation management, no quality standard for design product, no management method for detail task arrangement and no controlling node on checking and submitting the design result. Consequently, staff works based on personal habits. Individual working style creates numerous information islands, and makes collaboration inefficient; design submission is finished always by the last minute without sufficient checking and auditing; members of design team either have zero workload or suddenly shall overwork day after day.
Regarding the documentation management, everyone is responsible for the data-creation, data-storage and data-version management himself/herself. Data is created by different naming habits, stored in different folders and transferred by instant-messaging software. The problems caused are that the same data is stored in many different computers; if the person, who creates the data, is not in office, others can hardly find it.

When it comes to the quality standard, according to interviews, project architect seems to enjoy the unregulated situation. The argument from them is that they may focus more on developing the creative ideas instead of paying too many efforts on the irrelevant drawing depth or correctness that client may not care. Practically, when the design result is submitted and presented to client, although they care much more on the design solutions, they will get an overall impression on the professional level of the office by the basic quality of drawings. Sometimes, an unprofessional client tends to evaluate a design office by the simple knowledge that they understand. For example, one project architect once was presenting a master plan. Technically speaking, the ideas of the design are great. However, after the presentation finished, one of the client said “The so-called creative ideas are not provable, they are merely assumptions. But the depth of drawings is not enough, and the intersections of roads are even shown by right angle. Please offer us the drawings more professional next time.” Obviously, clients’ concerns are various. The design submission, which meets the basic quality standard helps establishing a better communication platform with the client.

As for the management method on the arrangement of detail design task, project architect has no professional training on managing the workload, members of design team either have zero workload or suddenly shall overwork day after day.

4.5.3.2 Bottlenecks on quality controlling
Before presenting to client, there is no formalized quality control node on the design result. Only an informal and random discussion between the project architect and the chief architect, or vice directors or even director is taken (sometimes with the liaison person).

4.5.4 Bottlenecks at stage 4

4.5.4.1 Bottlenecks on design submitting and feedback collecting
If the client accepts the submitting proposal and shows the intention on negotiating a design contract, it turns to be kind of individualistic heroism of the project architect to win the project. However, most of the situations are that, from the client’s point of view, there are always some serious problems with the design proposal that the project architect has not solved yet. Consequently, client keeps asking revision and negotiating on the design contract. As it seems just about wins the design contract, again and again, the project architect continues working on it. One extreme case is that 4 times presentation working for around 3 months gets no compensation from client. It is hard to get a legal support, because no agreement between client and Tianye office is signed; and there is no evidence to show that client had accepted any design proposals from Tianye office. (no acceptance of receipt is demanded by Tianye office, after submitting the design result). Hence, great risk shall be carried by Mr. Ning Zhang.
4.6 Result of the analysis

In short, the current design process is organized disorderly. There are no formalized work flow and data flow guiding relevant working procedures. Tasks and the responsible person have not been defined clearly. This situation not only results to lower working efficiency and lower quality of the design submission, but also causes great risks to Tianye office.

Furthermore, there is another important issue: reviewing on the project design and design process. After one project is finished, there is no reviewing system for summarizing the work performance on the design process, and no evaluation on employees’ working performance. What affects the design efficiency and design quality, how many workload hours and how much cost for finishing the task have not been investigated for further reference. Besides the involved team members, other colleagues share no knowledge or experiences on the finished project. Yet even within the involved design team, the knowledge and experiences still stay in personal mind.
5. Synthesis and design

5.1 Perspectives on conceptual design supporting tool (CDST)

The perspectives on developing a CDST shall answer the main questions raised by 2.4.1 problem definition. “Management tool” is replaced by “CDST”.

1) How can “the CDST” help an architectural design office to support the management on project design process regarding the conceptual design phase in an effective and quality control manner? 

2) And how can “the CDST” guide an architectural design office to select and adopt an OAS to enhance its management performance on project design process in the conceptual design phase?

Based on above mentioned literature review and case analysis, to answer the two main research questions, CDST shall comprise the following contents:

- Core management tool (Hereafter referred as CMT) on the conceptual design process
- Guidance for setting up an information system. (An IT technology based Office Automation System is recommend)

As we all know, every office has its own characteristics. Although they are all engaged in the same architectural design industry, however, each component of “McKinsey 7S Framework” of the office may be slightly or totally different. Regardless of those discrepancies, the CMT is developed in an universal significance to help a manager to solve the current bottle necks. The CMT shall help a manager to get an integrated and systematic insight on how to improve current management performance in an effective and quality-control manner.

Taking the business process as a backbone, the CMT firstly shows an overall management framework (Hereafter, referred as OMF) on phasing the conceptual design process. Relevant important input data and output data are described for each stage. The OMF helps a manager to get a macro view on the management of entire conceptual design process. Within the OMF, each stage shall be described by detailed work flow and data flow. Work flow shows a series of activities on achieving a certain objective. It is mainly about who is doing what, and how the work is sequentially continued. Data flow shows how input is produced as an desired output during the work flow process. Secondly, the CMT offers a detailed supporting manual (Hereafter referred as DSM). The DSM explains how to establish or optimise the work flow and data flow in an effective and quality-control manner. Relevant parameters will be defined as input for running the DSM. The formulated work flow and data flow shall be approved by the manager level of the office. They represent the refined operating procedure for completing a task at each stage. They shall act as the comparative stable behavior for the office to reach an standardized and regularized management status, unless circumstances are changing and new bottle necks would occur.

5.2 CDST

Based on the above mentioned perspectives, CDST is illustrated as follows: (Figure 5.2 CDST)
5.2.1 CMT (Core Management Tool)

The CMT is a set of process tools and templates designed to be used together to manage project design (in this thesis, “project design” means a conceptual architecture design task) throughout the conceptual design process. It comprises an overall management framework (OMF), which is common within the architectural design industry; and a detailed supporting manual (DSM), which is based on a set of parameters for each stage.

In plainer terms, the OMF is how an architectural design task is managed to the completion within the conceptual design phase. A project design has a natural life cycle that begins before it is started and evolves until the task is completed. The Framework is a management toolkit and enabler, designed to help working in an effective and quality control manner. The OMF supports a successful outcome, whilst minimising work redundancy.

5.2.1.1 OMF (Overall management framework)

The Framework adopts a life-cycle approach and separates the management scope of a project design task into the following five stages:

✧ Stage 1: Project undertaking;
✧ Stage 2: Project evaluating and arranging;
✧ Stage 3: Project designing and auditing;
✧ Stage 4: Product submitting and feedback collecting;
✧ Stage 5: Project reviewing.
5.2.1.1 Setup for the OMF

Regarding different organizational structure of different office, and titles that each office names different positions, in order to get a common sense on the research topic, the organization of Tianye office is taken as an example. Its’ positions and responsibilities of each position are described as follows:

- **Organizational structure**

![Organizational structure diagram](image-url)

**Figure 5.2.1.1 Organizational structure**

- **Director**
- **Office manager**
  - **Financial Department**
  - **Chief architect**
  - **HR Department**
  - **Marketing manager**
  - **Project architect**
    - **Draftsman**
    - **Employee A**
  - **Project architect**
    - **Draftsman**
    - **Employee B**
Position and its responsibility for the architectural design office

The main character of different positions are described as follows,

✧ Director:
Responsible for the business vision and business strategies of the office.

✧ Office manager:
Responsible for contracting and work load arrangement of the office.

✧ Chief architect:
Responsible for the quality on the design achievements.

✧ Project architect:
Responsible for the project design task arranged by office manager, and the on-going communication with client.

✧ Draftsman:
Responsible for the detail design task arranged by project architect.

✧ Marketing manager
Responsible for business exploiting and client relationship maintaining.

✧ Marketing employee
Responsible for project information collecting and initial contract negotiating.

✧ HR manager
Responsible for human resource management.

✧ Financial officer
Responsible for financial management.

Different office may grant different responsible connotations for each position. Generally speaking, the responsibility of each position may have certain overlapping areas. For instance, a chief architect, an office manager, or even a director may also work as a project architect. When they are working as a project architect for a project, they shall also fulfill their basic responsibility to another project. Furthermore, as a project architect, he probably will work for two or more projects at a certain period. As the complex management difficulty it may cause, the OMF will firstly focus on the basic responsibility of each position. After describing the overall management framework and relevant parameters, the suggestion for adopting an OAS (Office Automation System) is recommended to handle the complex role-overlapping and

Figure: 5.2.1.2-1 Overall work flow
project-overlapping difficulties. Hereafter, application of the framework will be explained and illustrated by reorganizing the project design management of Tianye Office.

5.2.1.1.2 Setup for overall work flow and data flow

Work flow represents the activities that the design office is taking for realizing the objectives committed by clients. This part is important for establishing an IT-based information system. Usually, an IT office will be invited to formulate the work flow and data flow together with the design office. After work flow is defined and approved, the data flow will be illustrated in accordance with the sequential actions of the work flow. Data items generates from work flow, served as input or output for each action of the work flow.

- Overall work flow

See (Figure: 5.2.1.1.2-1 overall work flow). It shows an overall view on how a project design task is finished from the starting point—project undertaking to the end point—finalized conceptual design. It is a basic business process of an architectural design office, which illustrated the five stages defined by the OMF. Subdivided work flow is formulated in accordance with it.

- Overall data flow

See (Figure: 5.2.1.2-2 Overall data flow). The overall data flow shows how relevant input be produced to a desired output by a certain system. It shows the general appearance of the entire data processing system, which matches with the work flow. Data flow concerns what kind of data flows in and out during a working procedure; and how the data shall be stored, retrieved, commented. A structured database is crucial for orderly organizing all the activities on dealing
5.2.1.3 Stage 1: Project undertaking stage

- Work flow for this stage

The chart shown above is made in accordance with “BPMN” method. It is recommended to get an IT office involved for illustrating the work flow of each stage. This work flow is redesigned specifically for Tianye Office by researcher (not by IT engineer). It shows who is doing what, and by what kind of sequence to do it. Relevant responsibilities of positions shall be clearly defined.

- Comparison between the refined work flow and the original one

1) A special node for checking the projects selected by marketing people, is added, because two of them are fresh people in the office. And they just recently switched into the architectural design industry and have few experiences on it. This node will be cancelled, till they get familiar with the selected criteria.
2) Before formulating the evaluating table, an action on negotiating a schedule for the new project is introduced between marketing department and design department. Originally, marketing people only accepts the schedule required by client and passes the requirement as an order to design team. It leaves few chances to negotiate with client on rescheduling the design task. And if considering benefits of other aspects, the evaluation meeting finally approves this selected project, it may cause task overlapping to design team; and overwork is always unavoidable. Accordingly, the quality of product submittals tends to be lower and hard to control. This action suggests marketing people to have a communication not only with clients but also with internal people (for instance, project architect or office manager). When a marketing person discusses the schedule with his client, he shall bear this in mind. To finish the design task with better quality and within an acceptable deadline, the design schedule shall be always set up in a mutual agreed manner between the design office and its client. It is crucial for a design office to orderly organize the project design process. And it leads to high consensus on making an evaluating decision by the project evaluation meeting.

- Data flow for this stage

![Diagram of Data Flow for Project Undertaking Stage]

Figure 5.2.1.3-2 Data flow for project undertaking stage

The diagram shows above is a sample made by researcher (not by IT engineer). During this phase, data is mainly about the information of a project and client. It generates from work flow, served as input or output for each action of the work flow. From a possible, uncertain and unstructured status, the data is filtered, structured and orderly stored in a standardized database. Process description for this stage is as follows:

1) P1.1 Select
### A. Pre-communication information of project design task

<table>
<thead>
<tr>
<th>Client</th>
<th>Project name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Formal location</th>
<th>Responsible person of client:</th>
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<td></td>
<td>Tel:</td>
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<tr>
<td></td>
<td>Fax:</td>
</tr>
</tbody>
</table>

#### Check list on required data of project design

<table>
<thead>
<tr>
<th>Requirements on plan</th>
<th>Requirements on individual building</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Relative data of local long-term urban plan</td>
<td>✓ Requirements on building setback from red line</td>
</tr>
<tr>
<td>✓ Property line</td>
<td>✓ Requirements on function</td>
</tr>
<tr>
<td>✓ Attribute of property</td>
<td>✓ Requirements on elevation style</td>
</tr>
<tr>
<td>✓ Topographic map</td>
<td>✓ Requirements on building area for each functionality</td>
</tr>
<tr>
<td>✓ Requirement by urban zoning plan</td>
<td>✓ Requirements on building material</td>
</tr>
<tr>
<td>✓ Building control line</td>
<td>✓ Requirements on energy saving technology</td>
</tr>
<tr>
<td>✓ Client's Requirement</td>
<td>✓ Number of floors, height of each story</td>
</tr>
<tr>
<td></td>
<td>✓ Style of building structure</td>
</tr>
<tr>
<td></td>
<td>✓ Requirements on building estimation</td>
</tr>
<tr>
<td></td>
<td>✓ Requirements on design submission to Government</td>
</tr>
<tr>
<td></td>
<td>✓ Requirements on mechanic system</td>
</tr>
</tbody>
</table>

#### Requirements on project design

- Mutual agreed design schedule
- Required contents of design submission
- Possible design fee
- Mode of project acquisition
  - Bidding with invitation
  - Bidding without invitation
  - Commitment by client
  - Other
- Signature of design office
- Signature of client

**Note:**
- ✓ Bid document is needed for Bidding with or without invitation.
- ✓ Letter of intent is needed for commitment by client.
- ✓ If client has no project brief document, enough information filling in this table can be the replacement, however a signature is needed from client for this table.
According to selecting criteria, the possible projects are filtered. Marketing people choose the one which is suitable for the office.

2) P1.2 collect

The output of this process is the enough information of a project for starting the design task. Enough information contains technical aspect and business aspect. Please see Table A1: Pre-communication information of project design.

Some clients are experienced and normalized for offering an approved project brief to design office; however, most of the clients, which located in small cities or counties, are not. This table can be a check list for both situations. To collect the enough information, marketing person shall make a tentative negotiation with client on the business aspects (It can be regarded as the initial negotiation on contract issue):
- A schedule that both parties agreed
- Possible design fee offered by client
- Required contents of design submission

3) P1.3 Catalogue

If enough information is collected, it shall be filled in the table--"A1 Pre-communication information of project design", and be stored into "C1 Management data store". Part of the information, which is related with customer relation management, shall be stored into "C2 Client and project data store".

● Comparison between the refined data flow and the original one

1) Data items are defined.

Previously, there is no system for storing and exchanging the project data. The data for each project is kept only by personal printing document. Now, it can be easily shared among the marketing department and manager level in the office.

2) Selection criteria is formulated for choosing a suitable project

Originally, only some informal communication on how to select a suitable project for the office is taught to marketing employees. However, they kept choosing a project according to their personal experience. Well, informal teaching is easy to implement and also easy to forget.

3) Standard information table is formulated for collecting enough information

As interviewee mentioned that the insufficient information collected in undertaking stage is one of the reasons that may cause repetitive effort of a design team. Marketing person or project manager/architect may take this standard table as a checking list during the face-to-face communication with client.

5.2.1.1.4 Stage 2: Project evaluating and arranging

● Work flow for this stage
Marketing manager sends message to project architect, office manager, chief architect, director and inform them. An evaluation meeting will be held on the selected projects. He/she will present the evaluation report during the meeting. And a final decision on whether to undertake the selected projects shall be made by director. If the decision is not to take the project, marketing person shall inform client and keep the relationship maintaining as a potential client. If the decision is not to take the project because of the unacceptable CCA (conditional commitment agreement), then marketing person will get the message to renegotiate with client till the agreement is accordingly refined. If the decision is to take the project on current CCA, office manager shall arrange the task in according to current human resource allocation and then formally inform project architect and client on the arrangement. Project architect shall make a detail task list for the design team. And send it to each team member as well as the marketing person, who is responsible for contacting the client. (in this study case, as mentioned by 5.2.1.1.1, project architect is only responsible for technical aspect of the project, any business related negotiation will be carried by marketing person, office manager and director). Each team member shall sign on the detail task list to confirm everyone’s responsibility on the design task.

- Comparison between the refined work flow and the original one

1) Since the evaluation report is rather important for analyzing the risk of whether undertaking a
project, to get chief architect, office manager, director and project architect involved in the evaluation meeting is necessary for making an overall and precise judgment. Comparing original decision making style, it can greatly release the stress from director and improve the sense of involvement and hence the sense of responsibility for all the attendees.

2) The two levels of task arrangement approach provide an overall control on all projects running in the design office and a relative flexible mechanism for each design team. The procedure of asking a signature on the task arrangement table provokes the sense of commitment for all team members.

● Data flow for this stage

**Figure 5.2.1.1.4-2 Data flow for project evaluating and arranging stage**

1) **P2.1 Discuss**
   Evaluators show their opinion on whether to undertake the selected projects. This process could be a meeting holds by marketing manager. The involved evaluators are defined as follows:
   ✦ Director
   ✦ Office manager
   ✦ Chief architect
   ✦ Marketing manager
   ✦ Project architect/manager

2) **P2.2 Decide**
   Input for this step is the opinions concluded by P2.1. Based on all the opinions, a decision making method shall be defined for this step. As director is the ending responsible person for the office, usually, he/she shall carry the role to make the final decision over the discussion on whether undertake the project.

3) **P2.3 Arrange**
   Regarding different decision, different arrangement shall be taken.
   ✦ If the decision is no, the marketing manager shall reply the client, and keep them contacted as a
If the decision is no, but the CCA (Conditional commitment agreement) is negotiable, then marketing manager shall start a renegotiation with client till the mutual agreed CCA is reached. And the decision turns to be “yes”.

If the decision is yes, based on current work load and human resource, the office manager shall make a new arrangement for the design task. The arrangement usually comprises following aspects:

a) People. Form a design team, and nominate the team leader--project architect.
b) Schedule. Set milestones and deadline for contacting client during the whole design process.
c) Maximum work load hours. According to risk analysis, the maximum work load hours for finishing the design task shall be set up as an alert to arrange work load for the design team.

4) P2.4 Sub-arrange
According to the task arrangement issued by office manager, the project architect sub-arranges and formulates a detail design task list for his/her team members. The detail design task list shall comprise the following aspects:

a) Task contents.
According to the client’s required design submission and the internal design quality manual, the detailed task is planned by the project architect. Besides, it is also related with the art of story-telling on the presentation to the client.

b) People
Team member, who is responsible for what task?

c) Deadline
When shall the detailed design task be finished?

d) Milestone for internal evaluation meeting
Draft design options are necessary for the initial phase to illustrate possible design directions for a project. An internal evaluation meeting on those options shall timely be hold in order to get a brainstorm on some aspects that may be missed by the project architect, and to make a decision on the hopeful directions.

e) Milestone for design exemplar
Design exemplar is kind of prototype that has been thoughtfully considered by a project architect and is possible to be transferred to an assistant architect to finish in detail. Followed by the hopeful directions decided by the internal evaluation meeting, the project architect shall finish relative design exemplars as soon as possible, and synchronously assign them to his/her team members.

f) Milestone for the first-round presentation to client
It is very important to show the capability of a design office by the first presentation to client. Presenting content shall be enough prepared and the art of story-telling shall be impressive.
B1. project evaluation and design task arrangement

<table>
<thead>
<tr>
<th>Project name</th>
<th>Serial number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td></td>
</tr>
<tr>
<td>Project function</td>
<td>Project scale</td>
</tr>
<tr>
<td>Start time of design</td>
<td>Date  month Year</td>
</tr>
<tr>
<td>Deadline</td>
<td>Date  month Year</td>
</tr>
</tbody>
</table>

Evaluator signature
- Marketing manager
- Office manager
- Chief architect
- Project architect

Contact information of client
- Name
- Position
- Mobile number
- Email address

Requirement of design task

Maximu work load hours

Arranged project architect
- Signature of chief architect

Arranged assistant architects
- Signature of assistant architect

Table B1

Table B2
- Comparison between the refined data flow and the original one

1) Task arrangement table and detail task design list are introduced to the design process. It offers a formal arrangement to all design team members and confirms the daily task for them. On top of that, the office manager may have an overview to balance available HR and possible work load for undertaking a new project.

2) Datastore for record the information of client and project is recommended. It offers a foundation for maintaining the relationship with possible clients (Either a target one, potential one or a contracted one).

5.2.1.1.5 Stage 3: Project designing and auditing
This stage is the core stage among the five stages. The intermediate and final design submission
Figure 5.2.1.5-1 Work flow for project evaluating and arranging stage
presented to client are all produced through this stage. It a key stage that the design office shall put its efforts on improving the design efficiency and controlling the design quality.

- Work flow for this stage
Illustrating by the overall work flow and detailed work flow for project designing and auditing stage, three work loops cross through this stage. They are:

1) Internal loop
To maintain a certain quality level for the design office, internal evaluation procedure on the design result is needed. For instance, the internal evaluation meeting on the draft options checked on the daily design result and audit on the design submissions can be all counted into this loop.

2) Client-design office loop
Presentation to client and modification feedbacks collected to restart a design process, either for revising or redesigning. Usually it is greatly depends on the project development schedule and the design quality itself.

3) Government-design office loop
Design application document is submitted to government by client, and feedbacks from government are transferred to design office by client. Project architect’s knowledge and experiences on the understand and explanation of national and local building code plays a important role.

All these loops lead to get consensus internally and approval from both client and government. Given conditions that both client and government have no force majeure incidents or other circumstances beyond control, the efficiency and quality of designing process in this stage shall be the key power and act as an engine to shorten the cycle of these loops. On the other hand, regarding to design office, this stage also plays a crucial role on minimizing the business risk for undertaking a project design task. Focusing on offering the client a high quality design, the work flow (see Figure 5.2.1.5-1 Work flow for project evaluating and arranging stage) shows a refined procedure for project designing and auditing stage.

Before explaining the detail work flow, the definition on high quality design submission shall be investigated. As the management of design process can be separated into 3 independencies: cost, time, quality. When addressing the capabilities of the design office, cost performance is the ability to meet high expectances of building performance in terms of e.g. esthetics, functionality, energy for relatively low cost (decide whether you mean design cost, building cost or life cycle cost) Time is the ability to deliver a complex design in short time. Quality is the capability of the design office to perform in a predictive way: deliver what has been promised within time and budget. According to the literature review and practical experience, it shall comprise the following contents:

1) Creative design solution, which maximizes the value for client without ignoring adding value to society

2) Design submission shall impress client with creating added value, and without exceeding building budget. Otherwise, convince client that the long term benefit will cover all the extra cost and bring
3) Basically, the design submission shall meet current national building code and specific controlling requirements issued by local government.

4) The expression of design drawings shall represent the aesthetic taste of the design office.

5) The design submission shall meet the schedule required by client.

As for the refined work flow, a kick-off meeting with client is suggested before the design team starts its work. Meanwhile the project architect may take a survey at the project site. He will mainly discuss on the technical aspect of the project during the kick-off meeting. Exploring some other useful information that may help conceiving on the conceptual designs either through the kick-off meeting or surveying around the site.

After the kick-off meeting, the project architect mainly works for the analysis of the project design and possible options for internal evaluation meeting to confirm the design direction. The Assistant architect may take a part time to help the project architect to collect some reference resource or drawing analysis diagram.

The evaluation meeting is presided by the chief architect and attended by relative marketing employees, project architects, assistant architects, office manager and director. After presenting on the possible options, a brainstorm will start among all the attendees. Based on the brainstorming, the chief architect shall be responsible to make the final decision on the hopeful directions. The responsible project architect shall make meeting minutes on the decisions and develop the design exemplar on the hopeful directions afterwards. The standard of design exemplar shall be described in quality manual < the quality manual specifies all procedures and standards needed to make sure that the process delivers to expectation>.

Design exemplar transforms a conceptual option into several divisible tasks. For instance, axis system of a plan, typical element of a façade, typical layout of a unit plan, typical element of a 3-d model, etc... It is then transferred to the assistant architects to be finished in detail. The Project architect will check their daily design result. While relevant design achievements are being finished, the project architect shall work on the specification and layout for the presentation document in accordance with his/her idea of storytelling.

Before the submitting deadline, the intermediate design achievement is suggested to have an audit by chief architect. Only approved by chief architect, can the design submission be presented to client. If the client shows interest in the design submission and is willing to contract, then the design process runs into the next loop--presentation to client and feedback collecting loop. And in the same time, a contract negotiation flow with client launches. If client shows interests but still wants the design office to work on a revised version and temporally has no intention to contract the design office, then the decision for whether continuing the work goes back to Stage 2 to have an evaluation meeting again. If client shows no interests and no contract intention, then the CCA ends.
Comparison between the refined work flow and the original one

1) A kick-off meeting is suggested to establish the contact between a project architect and client to enhance the co-operation for future.

2) Design process is divided into 3 phases:
   - Draft options phase;
   - Design exemplar phase;
   - Design submission phase;
   Three phases match different work load arrangement can greatly improve the efficiency of HR allocation.

3) Parallel working method on the contract negotiation and further developing selected proposals after first-round presentation, keeps the design risk controllable, and meanwhile, wastes no time for continuing the design process.

4) Responsibility of each position has been clarified. Design quality is secured by multiple control nodes during the entire design process. Project architect, assistant architect, chief architect find their positions during the design process and know when to do what, how to do it.

5) A formal internal evaluation meeting is introduced as a decision making method for solving relevant key design problems through collective brainstorm, a final decision shall be made by the chief architect. Project architect gets the trial opportunity on presenting; assistant architect widens relative knowledge and feels more involved in the conceptual developing process. Chief architect makes a more accurate decision based on collective intelligence and his/her personal experience. Other people, although maybe not show the opinion in a professional manner, they can be regarded as outsiders, for instance, as users or even clients. This internal evaluation meeting not only controls the design quality, but activates creative atmosphere for design, improves knowledge/experience sharing and team spirit building.

6) Detail divided design process defines sequence on both designing and contracting. Working efficiency improves without losing control on the business risks.

Data flow for this stage

Please see Figure 5.2.1.1.5-2 Data flow for project designing and auditing stage.
1) P3.1 Design
Members of the design team get task list, which is issued by P2, from management datastore. This acts as an input for P3. Project architect formulates a design schedule for auditing by P2. If approved, Design team shall run business as scheduled. This design schedule comprises:
- Milestone for site investigating and communicating with client
- Responsible person for design content and due time to finish
- Milestone for discussion on conceptual design achievement
- Milestone on offering phased design achievement for checking and auditing

2) P3.2 Discuss
As conceptual design belongs to creative industry, an internal evaluation meeting is presided by chief architect to guide directions of a project design after the project architect had finished pre stage conceptual design achievement. This achievement comprises:
- Analysis sketch on site plan
- Possible draft options
- Design concept of each option
Sketch of master plan for each option
Sketch of perspective or bird-eye view for each option
Table D is recommended as follows for storing relevant data for this work procedure.

<table>
<thead>
<tr>
<th>D. Design evaluation meeting minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project name</td>
</tr>
<tr>
<td>Client</td>
</tr>
<tr>
<td>Project scale</td>
</tr>
<tr>
<td>Meeting date</td>
</tr>
<tr>
<td>Meeting participants</td>
</tr>
<tr>
<td>Meeting minute</td>
</tr>
<tr>
<td>Note</td>
</tr>
</tbody>
</table>

This Table fits both internal (within design office) and external meeting (with client, government, etc…). It shall be noted by project architect within 24 hours after the meeting is over, and shall be copied to director, director manager, chief architect and HR manager (or to client, depends on real situation).

Table D, Design evaluation meeting minutes

3) P3.3 Check and audit
This process is specially set for quality control. It separates into
Two sub-processes:

- Check (also called as Review.)
  After designers finish his task according to planned schedule, designers are required to check the achievement mutually. Checking criteria is described by management regulations, which is categorized into management datastore. In other design worlds this is called Review: assigned peers a specialists view the design document and check for correct interfacing with other design tasks, with company standard, public standards, input specifications etc.

- Audit (also called as Release.)
  The checked achievement is sent to chief architect/vice-chief architect for further auditing. Only the achievement has been approved by them, can it be submitted or presented. Generally it is also called Release. A person with sufficient authority assumes company accountability for the design result as specified in the document. Before doing so he should check whether reviews procedures have properly been executed. If he approves, the document has status ‘Released’.
4) P3.4 Present
Under the provision of CCA (conditional Commitment Agreement), a presentation to client is needed after design submission has been completed. There are two objectives for this procedure:

- Concept presenting
A face-to-face presentation is the best way to thoroughly transfer designer’s idea to his/her client.

- Client’s feedback collecting
The feedbacks are not only on the design submission, but on the intention of contracting. If the presentations agreed by CCA have been shown out, a design office shall confirm client’s intention of whether contracting with its further work.

5) P3.5 Contract
In case client is interested in the presented design proposals, a draft contract will submit to client to launch a negotiation. Both formal and informal communication between design office and client are important to have the mutual agreed contract signed.

- Comparison between the refined data flow and the original one
1) Data management standard is suggested to be formulated for creating and storing relevant data—what shall be stored; where to store it, how to get the retrieval, etc.…

2) Database is established for supporting the design process. Followed by the data management standard, team members can easily get the access on desired data. Information exchanging delay is avoided.

3) Design quality standard is formulated for the three design phases of this stage. Including standards for design results of each phase: checking standards and auditing standards.

4) Technical standards, such as drawing standards, printing standards, external xref attachment standards, etc.…, are formulated for collaborative design among team members.

5.2.1.1.6 Stage 4: Project submitting and feedback collecting
This stage is specifically defined after CCA becomes invalid. Either design office ends the project or continues with a new contract for further work. Follows the contract, a design office further develops the agreed design proposal until it is fully accepted by both client and government.

- Work flow for this stage
Practically, if the client has the intention to contract a design office after agreed presentations finish, design office shall concurrently work on both further developing the selected design proposals and contract negotiation. Before submitting another round of design result, the signed contract shall be completed. Following the contract, the design office runs the iterative process by linking stage 2 and stage 3 until 100% percent of the design submission is accepted by client. As soon as the intermediate design submission regulated by contract, has been approved by client, design office may declare the
phased payment. Finally, design office shall start formulating the application document and send to
government for approving. Due to different understanding of the national and local code, usually several
times repeating application from design office to government are inevitable. While the final design
submission is approved by government, besides declaring the payment of design fee, design office shall
start collecting feedback on the service performance during the whole design process from client.

1) Efficiency balances with risk control
The control node on design submitting is emphasized: Before scheduled deadline for submitting the first
round design results and showing a presentation to client, the contract has been signed between client
and design office. According to the refined workflow, the content of design submission for the first round
submitting shall not be planned too much; the work load shall be controlled as less as possible. The
reason is that even if the contract negotiation is failed, the loss to a design office will be acceptable. Designs for the first round submission and contract negotiation are executed in a parallel manner. And risk for design office is controlled by this specific node.

2) Working attitude to client improves
The feedback collecting procedure for each important position, which contacts client, is set up. Either project architect, marketing manager, chief architect or office manager are required to collect feedback from the member of the client that they have contacted. Thus the working attitude to client of those important positions improves.

- Data flow for this stage

*Figure 5.2.1.6-2 Data flow for project submitting and feedback collecting stage*

1) P4.1 Submit
Follows the schedule of signed contract, the audited design achievement is submitted to client (usually a presentation shall be shown together, depend on the provision of contract). Client either approves the design submission or feedbacks on it. See: *Table E*
E. Receipt of delivery

<table>
<thead>
<tr>
<th>Project name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td></td>
</tr>
<tr>
<td>Content of design submission</td>
<td></td>
</tr>
<tr>
<td>Phase of design submission</td>
<td></td>
</tr>
<tr>
<td>Format of design submission</td>
<td>Digital</td>
</tr>
<tr>
<td>Copies of design submission</td>
<td>Digital</td>
</tr>
</tbody>
</table>

(The followings shall be signed by client)

<table>
<thead>
<tr>
<th>Recipient (Signature)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>year</td>
</tr>
</tbody>
</table>

Note: Content and phase of design submission follow the contract.

Table E, Receipt of delivery

2) P4.2 Collect

Project architect is responsible to collect the feedbacks from client and record it as meeting minute (recording is synonym with storing in company database). If feedback comprises excessive requirement (not regulated by contract), the project architect shall have it reported to office manager. Depending on specific conditions, an extra evaluation meeting on arranging the extra design task may be needed. Response from client on the design submission shall be recorded by project architect. Table D can be taken as the default format for the meeting minute. If finally get the message that government has approved the final design submission, Table F shall be used by project architect, marketing manager, office manager and chief architect for collecting feedbacks from client on evaluating the work performance during the entire conceptual design process. (Director may have a personal informal communication with the people from client, who works at a higher level, to collect the evaluation feedback on the performance offered by design office.) See: Table F

F. Evaluation feedback from client

This table shall be used after getting approval from government to evaluate the work performance during the entire design process.

<table>
<thead>
<tr>
<th>very bad</th>
<th>normal</th>
<th>very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>-4</td>
<td>-3</td>
</tr>
<tr>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following is correspond to the score of performance evaluation

| 0  | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3  |

Suggestions:

signature of client: year month day

Table F, Evaluation feedback from client

3) P4.3 Apply

If client approves the final design submission (100% percent of conceptual design), project architect
shall compile a formal application document for applying approval from government. The output for this action is either approves or gives feedback on the application document.

4) P4.4 Invoice
Follows the agreed payment schedule, when each submission is approved by client or government, design office shall be capable to declare the relative payment. The output is practical schedule of payment.

5) P4.5 Formulate
While the notice of getting approved by government comes, the major work for the project is finished. (sometimes, client will ask a design office to continue the work till developing design or even construction finished phase. However, this falls outside the research of this paper. Project architect, office manager and director are suggested to collect client’s feedback on the entire conceptual design process. Project architect is responsible to formulate a management report for reviewing relative problems happened in the design process.

- Comparison between the refined data flow and the original one
  1) Procedure gets recorded
  Originally, there is no requirement and standard on submission and feedback collecting. These procedures do happen, however, there is no record on it, neither for getting a receipt from client or having a meeting minutes shared between client and design office after a discussion meeting. Refined data flow emphasizes the record on both of the two aspects. As we all know the design process is an iterative and knowledge-intensive task, great efforts not only cycles by internal evaluation loop, but cycles by client and government feedback loops. External changes on project design are usually happened by client’s and government’s feedback on the design submission. Meeting minute is a very good method to share consensus between client and design office. To get the procedures and feedbacks recorded will be helpful to have an extra compensation agreement with client, in case the changes are beyond the regulation of existing contract.

  2) Feedback data from client for further personal work performance evaluation is collected
  Design business is mainly a knowledge and esthetics service industry. Service attitude to client is another important issue during the entire conceptual design process. Friendly relationship with each member of client lubricates the design process, smoothers mutual communication, thus improves efficiency for the design process in an immeasurable manner.

  3) Management report for experiences and lessons collecting is regulated
  After getting approval from government, project architect shall timely summarize the entire design process on both technical aspect and management aspect will greatly improves the competence of design office.

5.2.1.7 Stage 5: Project reviewing
This stage is mainly for reviewing the entire conceptual design process, any problems or experiences generated in the process may be an alert or reference for next project. It is important for a design office to accumulate whatever useful knowledge, either on technical aspect or on management aspect.

- Work flow for this stage
Figure 5.2.1.7-1 Work flow for project reviewing stage

Office manager collects the management report from project architect together with client’s feedbacks getting from project architect, marketing manager, director, himself and continues completing the report on financial and workload aspect. After completion of the management report, a notice of a reviewing meeting holding by director will be informed to marketing manager, project architect, and chief architect. Office manager shall make a summary on the reviewing meeting and has it stored in the management datastore.

- Comparison between the refined work flow and the original one

Originally, the reviewing procedure is only carried by informal oral communication between director and employees he/her is willing to discuss. Different experiences and lessons are separately hidden in people’s mind. Through the refined formal reviewing meeting, the experiences and lessons from
attendees are collected and summaries on them are concluded. The benefit is that people learn from each other, and share consensus on current management bottlenecks. Thus the refined work flow not only accumulates public sharing knowledge for the design office, but also leads to higher acceptance on possible reform within the design office in future.

- Data flow for this stage

Figure 5.2.1.1.7-2 Data flow for Project reviewing stage

1) P5.1 Gather and analyse
The management report finished by project architect is mainly about experience and lessons of technical aspect plus record on the key nodes of design process. Together with client's evaluation feedbacks collected by project architect, marketing manager, chief architect and office manager himself, a final management report shall be finished for launching a reviewing meeting on the entire design process.

2) P5.2 Review
Taking the final management report and brainstorm from meeting attendees as input during the review meeting a summary is concluded. Useful experiences, lessons are shared by all attendees, and knowledge gaining from the design process is stored in database for further reference. Bottlenecks occurred during the design process, possible proposals to handle the new bottlenecks and improving suggestions on coping with lessons, etc… All those information shall be categorized and stored in central database for further investigation to launch a new quality-enhancing and efficiency-improving reform for the organization at a certain moment.
• Comparison between the refined data flow and the original one

Originally, people only get separated individual experience and lessons from a finished project design process. There is no public reviewing meeting in the design office. Bottlenecks are only discussed privately among the office, mainly at the manager level. After refinement, summary of the reviewing meeting offers basic data for launching another reform on organization changing, when the right time comes. Since staff is aware of the existing bottlenecks and possible solutions, when the right time comes, the resistance for relevant reform tends to be smaller and the sense of participation for the reform is improved, thus the reform gets bigger chance to succeed.

5.2.1.2 DSM (Detailed supporting manual)

As the work flow and data flow greatly influence the working efficiency and the quality of design submission, DSM will focus on refining or creating them to answer the sub-questions: How can the management tool support managing each stage in an effective and quality control manner?

5.2.1.2.1 Parameters defined for DSM—elements of Mckinsey's 7-S model

As different organizations have different characteristics, and the different characteristics determine different processing style of work flow and data flow. According to Mckinsey's 7-S model (See Figure 5.2.1.2-1 Mckinsey's 7-S model), given relatively stable condition on the elements of shared value, strategy, structure, staff, skill and style, DSM mainly helps changing organization through supporting the revision of the “system” elements – management system for conceptual design process. On one hand, it is possible to take the 7 S-elements as parameters for designing how to refine or create a work flow, data flow and hence the information system specifically suitable for the organization; on the other hand, due to the interaction of 7-s elements, the revised "system" may cause changes to other 6-s elements.

Each of above 7-s elements has internal and external aspect, which influence the status of an organization. They are not only affected by external business circumstances, but interact each other. Taking them as parameters to analyse current bottle necks and design for the revised "systems", the entire organization may hence refine each s-elements accordingly and step in the status of desired effective and quality-control management style. See Table 5.2.1.2.1

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Supporting manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared value</td>
<td>1. Influenced by the founder of a design office; accepted and shared by all members of the organization.</td>
</tr>
<tr>
<td></td>
<td>2. Guiding the formulation on project-selecting criteria.</td>
</tr>
<tr>
<td></td>
<td>3. Guiding the formulation on design quality standards.</td>
</tr>
<tr>
<td></td>
<td>5. Guideline for shaping the reputation of the design office</td>
</tr>
<tr>
<td>Structure</td>
<td>1. Starting point to reorganize the operating process through different department/position. (Through arrangement on the working procedures, working positions and responsibilities can be defined. Either add, cancel</td>
</tr>
</tbody>
</table>
ADMS Conceptual design supporting tool between an architectural design office and its client Synthesis and design

<table>
<thead>
<tr>
<th>Strategy</th>
<th>1. Influenced by external business situation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Guiding the balance on efficiency and design quality.</td>
</tr>
<tr>
<td>Staff</td>
<td>1. Work flow shall match the competences of employees</td>
</tr>
<tr>
<td></td>
<td>2. Work flow shall show exactly who is responsible for what task</td>
</tr>
<tr>
<td></td>
<td>3. Responsibility of work position shall be defined for the work flow</td>
</tr>
<tr>
<td>Skill</td>
<td>(Either to hire a new staff, to train/motivate current staff, or to evaluate the work performance on them, all serve for developing competent ability to effectively work in a quality-control manner.</td>
</tr>
<tr>
<td>Style</td>
<td>1. Balance the decision making process for the work flow</td>
</tr>
<tr>
<td></td>
<td>(Democracy style helps to activate creative working atmosphere, improve subjective working attitude and solve a problem based on thorough discussion from all sides. Centralized style helps to make an effective working pace.)</td>
</tr>
<tr>
<td>system</td>
<td>1. Other systems may influence the project management system for conceptual design process. For example: recruiting system decides the quality of staff, and the quality of staff affects the working procedure.</td>
</tr>
</tbody>
</table>

Table 5.2.1.2.1

5.2.1.2.2 Principles on refining the work flow and data flow for each stage

Firstly, principles for refining or creating the work flow for all stages will be introduced. Then detail instructions for different stages will be illustrated respectively. As the research suggests, an IT office is recommended to involve in this work to hence develop a computer based OAS (Office automation system).

● Principles for refining or creating the work flow for each stage:

1) Value of work procedure
Each working procedure shall serve for creating value either for internal office or for its client. The one, create no value for them shall be cancelled.

2) Context of current bottle necks
Focus on current bottle necks. Find its context related with the 7-s elements. Define current ill-structure procedures which cause them. Bottle necks are process steps having long input queues and thus causing delay, This can be solved by either increasing capacity or changing the work allocation process.

3) Uniformity between procedure and competence
Working procedures shall match the defined capability of each position. It means that the employed person shall be fully competent for his position.

4) Balance between effectiveness and quality controllability
Work flow shall balance the effectiveness and quality controllability. From the effectiveness’ point of view, work flow shall be as simple as possible. And the less people involved in the procedure, the more...
efficient the work will be finished. However, as architecture design is not only an aesthetic profession, but technical as well, one person can hardly make all things right. Thus, a quality-supervising procedure is needed for intervening the design process. Where quality is not measurable, it must be assured by proper procedures (as with software design)

- **Principle for refining or creating the data flow for each stage:**
  Data flow follows the procedures of work flow, describes relevant input and output through different working activities. The establishment of central Database is crucial for organizing the information system throughout the entire work process. Acting as an information sharing platform, it mainly deals with data recording, retrieving, commenting, revising etc…

  1) **Description and logic relationship of data items**
  Each data item and the logic relationship among them need to be defined. Volume of the data shall be estimated for preparation on adopting certain space of hardware disk and other relevant IT hardware (i.e. CPU, VGA, etc.).

  2) **Data creating method**
  Data shall be stored in a certain method to be easily catalogued, and easily retrieved in future. Traditional method on creating new data is staying in a folder management system. For instance, the method showing below is to create a folder for a new project, all related files shall be manually stored into the pre-designed folder:
  
  Y-M-D LOCATION. FUNCTIONALITY. STORIES. PROJECT NAME
  
  Example: 2011-10-11 Shanghai Office 5F Block 4

  Through the name of the folder, we may know its starting date, its functionality, its stories (different stories match different building code). Belongs to this folder, some more folders are needed, i.e. management data store, project design data store, project and client data store etc… and so forth to organize other documents.

  The recommended method on creating the data are: A certain rule shall be designed for database to collect relevant attributes, which may be features on retrieving the data in future.

  3) **Data retrieval management**
  Database is built as a platform for knowledge sharing. Employees may collect relevant information beyond the boundaries of department and working phases hence to launch a parallel working style. Commenting approach on the retrieved document is needed for realizing the check and audition procedure within a workflow.

  4) **Data authorization mechanism**
  To safely manage the data, a document authorization approach shall be taken. Who has the power to access, comment, revise, approve what kind of documents is needed to thoroughly discuss with the IT office. Especially for serious private arguments, like for salary, work evaluations etc. In addition, certain data must be accessible for outside parties like client and government, but it may be granted only when explicitly required.

  5) **Data approval method**
  To orderly manage the working procedures in quality-control manner, the approval method shall be adopted to define the responsibilities for relevant positions.
6) Data version management
A proper versioning and status control system must be defined. The principle of versioning is that if a content of a document has been shared between the author and one or more other persons, and the author has been changed the contents and wants to share the new contents (with the same or other persons) these new contents should be stored as a new version of the document, leaving the old content available as old version for possible later reference.

Status is an attribute of a document version, indicating its maturity and more specifically the purpose for which the contents may be used (information only, review, full intended use). Note that the proper version for a specific task is not always the newest one. Precisely get desired version of the data is the first prerequisite to finish a task.

5.2.1.2.3 Principles for quality control
It is not suggested that a small scale design office shall strictly implement the so-called ISO 9001 2000 requirements. However, the spirit of this standard can be a reference. Hereby summarize as follows:

- Process control
  Regarding weaknesses of current organizational situation, design a special control procedure for relative work flow process, for instance, the drawing of a fresh employee needs an extra checking procedure. Or otherwise, offer him/her a specific training procedure in accordance with his/her deficiencies.

- Standard formulation
  The standard comprises not only regulations for working result, but for working procedures. While work flow formulation deals with the working procedures, the element—quality standard or document formulation standard for relevant working results (in terms of documents, drawing, model, specification, etc...) of data flow deals with the working results. Detail description on the latter aspect may find at the article of referenced standards and documents for each stage.

5.2.1.2.4 DSM for the stage 1
From the architectural design office’s point of view, project undertaking stage is mainly about marketing—to find suitable business opportunities for the office. It is the initial stage for the conceptual design process. Followed by selection criteria, the appropriate projects which are suitable for the organization are selected for further evaluation.

- Key working contents:
  At this stage, the initial communication with client is crucial for a successful co-operation. Being an architectural design office, the following aspects shall be emphasized:

  1) Promotion: characteristic and specialty of the design office shall be transferred clearly to client.
  2) Demands: client’s demands on the project design shall be collected tactically.
  3) Schedule: mutual agreed design schedule is essential for orderly organizing the design process
  4) Intention: the intention of corporation shall be clarified to the client clearly before the design office starts working.
Referenced standards and documents for this stage
1) Promotion documents. Either by website or a material brochure, the characteristic and specialty of the design office shall be described.
2) The selection criteria shall be formulated in accordance with following aspects:
   - Project shall meet business scope of the organization
   - Project, which meets the business vision of the organization and is profitable, takes the priority.
   - Similar projects, the one, which brings long-term benefits has the priority to be selected.

Contents of evaluation reports on the selected project are as follows:
1) Input information of the project.
   Table A1 could be reference.

2) Estimated HR allocation
   Before and after having an agreement with client, an estimated HR allocation is needed to balance the declared total design fee. It can be estimated through analyzing the required schedule and design submission, or through browsing the task arrangement list of similar projects done before through the management data store.

3) CCA (Conditional commitment agreement)
   Due to the business background described by paragraph 1.3, many clients will not sign a contract with an architectural design office, until a first round presentation on the conceptual design has been shown to them. So, before client has intention to sign the contract, an architectural design office shall try its best to have a conditional commitment agreement with client to define relevant duties and rights. For instance, to negotiate a compensation fee for the first round presentation, in case client is not satisfied with it and has no intention to contract with the office.

Scenario: Some offices have no marketing department. However, they still need to cope with this stage and bring a suitable business to the office. For instance, a small office which is strong-idea type, the office may focus on selecting a competition project. Its director may do it all by himself/herself. All they need to do is to get the design brief and a satisfied conditional commitment agreement which included in the bidding brief. The work flow at this stage for them is much simpler; and it specifically suits the office.

5.2.1.2.5 DSM for stage 2
This phase is mainly dealing with the evaluation and arrangement on the selected projects at stage one. If the decision is yes, an arrangement table shall be formulated for the undertaken project. If no, but the CCA (conditional commitment agreement) is negotiable, then a renegotiation with client will start, till a mutual satisfied one is reached. If the decision is no, and no necessary to have further negotiation on the CCA, then only an intention on maintaining relationship with client will be kept. Accordingly, the decision and arrangement on the projects will be timely informed to client.

Key working contents:
Key working contents are as follows:
1) Decisions on whether undertaking the selected projects.
2) Communication or renegotiation to client on current CCA.
3) Refined CCA
4) Task arrangement table
5) Detail design task list

- **Referenced standards and documents for this stage**
  1) Evaluation criteria
     Followed by the selecting criteria, the evaluating criteria shall emphasize more on the following aspects:
     - Project shall fit the enterprise resource allocation. Otherwise, an additional and feasible outsourcing proposal shall be planned.
     - Before contracting with client, the risk on initial investment of enterprise resource shall be analyzed. The analyzed results shall be acceptable, considering current business situation of the organization.
     - Similar projects, the one, which brings long-term benefits has the priority

2) Task arrangement table. *Table B1* can be a reference.
This table is formulated by office manager as a formal notice to undertake a selected project. It controls an overall balance on HR allocation on all designers of an office. Manual for HR allocation can be the guidance. See *Figure 5.2.1.2.1-5 Manual for HR allocation*. As for the task arrangement table, it comprises basic information of the project. (Usually a design brief from client will be an appendix to this table.) project architect and its team members are specifically chosen to form a design team for this project. A maxium workload of the project is listed for project architect to allocate detail workload for his/her team member. Schedul of the task is another essencial content of this table. It is necessary to mention that *Table B1* can not only be used for assigning a new undertaking project, but the on-processing project as well, in case its requirme nts change. Assigning changed task on the on-processing project by this table, can be regarded as coping with dynamic changing business environment under a designed controling structure.

3) Detail design task list. *Table B2* can be a reference.
This table is designed for project architect to allocate workloads for his/her team members in accordance with the required design submission and schedule. Totall work load hours shall not exceed the maximu work load hours limited by Table B1. After *Table B2* is approved by chief architect together with office manager, *table B1* shall be signed by both project architect and his/her team members. Since it is crucial to organize the following design process. Recommendations for formulating the detail task list is as follows:

- Focus on the requirement of design submission and design quality manual, try best to arrange a parallel working pace. Take the suggest work load model for project architect and assistant architect as reference. See *Figure 5.2.1.2.1-1 Suggested work load model for Project architect* and *Figure 5.2.1.2.1-2 Suggested work load model for assistant architect*.
- Balance the work load of each member
- Arrange the first internal design evaluation meeting as soon as possible.
- Followed by design quality manual, be sure to make enough preparation for the first presentation to client.
5.2.1.2.6 DSM for stage 3

Project designing and auditing stage can be regarded as the core phase that a design office transfer its professional skills into a conceptual design submission. Value for both client and design office itself is realized at this stage. It is an iterative process that leading the conceptual design from initial proposals to a design submission for getting approval from government. At the beginning, client usually demands several draft options on the project design and have them compared on multiple aspects (such as: functional reasonableness, economy of building cost, aesthetic value, possible benefit yielding, etc…) to choose an optimal result. Afterwards, detail of the selected proposal will be developed by design office, including layout of each floor plan, elevation of each façade, details and technical index, etc… the on-going communication and intermediate presentation are essential to reach consensus on the conceptual design between design office and client. In the meanwhile, after first-round presentation to client, a contract negotiation with client shall start, and the contract shall be completed as soon as possible, at least, in case the CCA has greatly lowered the risk, before showing client the final presentation.

- **Key working contents:**
  1) Draft options for internal direction orientation meeting
  2) Developed design exemplar for assignment to assistant architect
  3) Checking and auditing on the optional design prototypes
  4) Optional design prototypes for first-round presentation to client
  5) Checking and auditing on the design submission
  6) Design submission for presentation to client
  7) Presentation
  8) Draft contract
  9) Signed contract

- **Referenced standards and documents for this stage**
  1) Manual for formulating detailed design task list

This manual is a reference for stage 2. However the guiding work is mainly implemented at this stage. So, it is more suitable to explain the manual here. During this stage, a detailed design task list for each project, either it is on-processing or to be undertaken, is a pivotal for orderly balancing and arranging the HR allocation. The detailed design task list illustrates the detailed work flow within a design team. It responses all the feedbacks collecting through the three loops and guides the daily work for each team member.

According to the investigation on work load allocation during the project design and auditing stage, the work load allocation models for project architect and assistant architect are recommended as the following figures. (see [Figure 5.2.1.2.1-1 Suggested work load model for Project architect](#) and [Figure 5.2.1.2.1-3 Suggested work load model for assistant architect](#))
Figure 5.2.1.2.1-1  Suggested work load model for Project architect

Figure 5.2.1.2.1-2  Explanation on suggested work load model for project architect

Figure 5.2.1.2.1-3  Suggested work load model for assistant architect
Description on the models showing above:

Taking 3 weeks as a presumed basic period for offering a round of presentation to client, focusing on providing client an impressive design submission, project architect shall make a design on the contents of presentation documents and assign them as tasks to each team member. After the detailed task arrangement is issued by chief architect and office manager, project architect shall carry the role on developing possible directions for the conceptual design.

Several conceptual options shall be presented for the internal discussion and evaluation meeting hold by chief architect. This period is recommended to be less than a quarter of the whole schedule, in case the proposed prototypes are all rejected during the internal evaluation meeting, project architect may still have enough time to follow the new directions decided by the meeting.

The second quarter is for design exemplar developing. Project architect develops the typical details of the prototype. For the rest period, the defined exemplar, then, switches to assistant architects, who are responsible for further developing it into the desired design submission. Project architect will spend less time and mainly take the responsibility on checking and commenting the daily work and schedule of the assistant architects. When all the required design achievement are ready, project architect shall spend a little more time on guiding assistant architect to finish the design submission. He/she mainly works on compiling, layout and the structure of story-telling for the presentation to client. (The design depth for prototype, exemplar and design submission will be standardized in the quality control manual, which will be further described in the DSM for data flow at this stage.)

The blue line in Figure 5.2.1.2.1-1 (Work load model for Project architect) shows the above mentioned work load of a project architect. Through this figure, we may also see that another red dash line, which represents work load for project B, is possible to allocate to the project architect, in case project B start around at the time that a design exemplar for project A has been defined.
As for assistant architects, they may spend less time before an exemplar had been defined, they usually do some preparation work for project architect, for instance, to collect some similar examples, help to draw analysis diagrams on the project, help to show the intention of the options developed by project architect. The peak of their work load reaches at the time that the design exemplar has been defined and lasts till the presenting design submission has been finished. Similar as project architect, they are also capable for working on another project during this period. See the orange dash line illustrated by Figure 5.2.1.2.1-3(Work load model for assistant architect).

Conclusion:
To formulate a detailed design task list, a project architect shall take Figure 5.2.1.2.1-1 and Figure 5.2.1.2.1-3 as reference to assign relevant tasks.

2) Manual for HR(Human resource) allocation on different projects

In case several projects shall be undertaken with current limited HR in the same certain period, the method to assign them is a precondition to organize an effective and quality-control design process for all the projects.

Assumption:
There are 3 project architects and 6 assistant architects within an architectural conceptual design office. And the office has 6 projects concurrently running in a certain period. Given the model presented by Figure 5.2.1.2.1-1 and Figure 5.2.1.2.1-3, Figure 5.2.1.2.1-5 is presumed to explain the manual for HR allocation on different projects. Figure 5.2.1.2.1-5 Manual for HR allocation shows that the recommended HR allocation style is capable to work for the 6 projects by only 3 design teams. Practically, the difficulty of different projects is quite discrepant; and the mutual agreed schedule will not be the same; workloads for different projects are also surely different. The simple style for organizing design teams shall be recommended, as it greatly reduces the unpredictable communicational difficulty between different design teams, project architect may easily balance the work load for two projects with his/her same team members.
Conclusion:
Office manager may assign the maximum two projects to one design team in a same certain period, and assignment of the two projects shall be staggered. It is recommended that the second project shall be assigned after the design exemplar for the first project has been finished. Let the same team leader to balance the work load for them.

3) Manual for collaborative design
Besides the above mentioned management methods on task arrangement, technical methods on collaboration for designers shall be also emphasized to improve working efficiency. Generally speaking, collaboration within a design team is much easier and simpler than the definition of “collaborative design” indicates. Three key aspects for implementing the collaboration is recommended as follows:
- Unified drawing standard
  Unified drawing standard is the foundation for implementing collaborative design. This standard means not only on physical drawings, but for its working process. A good standard shall be easy to understand and to implement. Furthermore, it shall be adaptive to the complex background of different types of building projects.
- Information sharing platform and centralized database control system
  An information sharing platform is necessary to organize the design collaboration. All relevant design information shall be managed in a centralized manner. It is not only related with data store and retrieval, far beyond that, it is about data authorization management, data version management, data approval management and data logic relationships management etc…
- Establishment on sharing design space
  To implement collaborative design, the establishment for a sharing design space is the core issue. AutoCAD provides a 2D style sharing design space—External Reference Attach. And Revit offers 3D style sharing design space—BIM.

4) Quality standard of design result
In accordance with the working node of this stage, the quality manual regulates the design result by the following types:
- Quality standard on draft options
- Quality standard on design exemplar
- Quality standard on optional design prototypes
- Quality standard on design submission
  The quality standard shall not only regulate on the design result, but the range of responsibility for design, check and audit as well. As the quality standard represents the shared value of an organization, a design office may take a selective emphasis on above mentioned types.

5.2.1.2.7 DSM for stage 4
Stage 4 is the key moment related with design changes. It contains two external design loops: client-design office loop and government-design office loop. After submitting and presenting the design result to client, usually different kind of feedbacks will be responded from client. Some feedbacks may cause great changes or even starting the design all over again. It is important to distinguish whether the feedback is within the agreed regulation of signed contract. Thus design office shall rearrange the design tasks and diminish the business risks.

- Key working contents:
1) Presentation (most important mean on transferring design information to client)

2) Meeting minute
Project architect shall be very familiar with the requirements of design achievement regulated by the contract, hence to distinguish whether the requirements belongs to the working range. If all requirements are within the range, project architect shall follow the original schedule and make a new detailed task list for team members. If not, project architect shall have the extra requirement reported to the office manager and director, the work flow of Stage 2 will be repeated—a new evaluation meeting might be needed to analyze the workload and balance other on-going design schedule. Most important of all, the new schedule and compensation for this extra work shall be timely renegotiated with client. Before submitting the extra demanded design result, the additional contract/agreement shall be signed between client and design office.

3) Practical schedule of payment

4) Management report
This report is formulated by project architect on two aspects: technical aspect—experiences and lessons obtained from the project design process, management aspect—key nodes of the design process

- **Referenced standards and documents for this stage**
  1) Evaluation meeting minute (*Table D can be a reference*)
  2) Recipient of delivery (*Table E can be a reference*)
  3) Evaluation feedback from client (*Table F can be a reference*)
  4) Management report

5.2.1.2.8 DSM for stage 5
This stage is formally emphasized for reviewing the finished entire design process. Relevant knowledge, experiences and lessons gained during the process are discussed and shared in the organization. It could be regarded as the analysis work for launching a reform in an organization in future. This stage not only analyses bottlenecks of management aspects, but also accumulates technical knowledge and experience for further reference. The benefit of this stage is that people learns from each other, and shares consensus on current management problems. Thus it leads to higher acceptance on possible reform within the design office in future.

- **Key working contents:**
  1) Final management report on the design process.

Continuing with the report formulated by project architect, office manager mainly analyses the workload and financial aspect on the design process. Evaluation on the work performance from client is collected from the positions that frequently contact client.

  2) Reviewing meeting

Based on the description of management reports, meeting attendees exchange their personal knowledge, experience and lessons obtained during the design process. Bottlenecks that affect the design quality or work efficiency are brainstormed and relevant solutions are proposed.
• Referenced standards and documents for this stage
  1) Final management report
  The final management report mainly contains three aspects: technical aspect on specific building knowledge, management aspect on experiences and lessons of project management, financial aspect on workload allocation and profit gaining.
  
  2) Summary on the reviewing meeting
  The summary mainly describes current management bottlenecks and relevant solutions for further reference.

5.2.2 Guidance for setting up an IT based OAS
As computer age brings numerable benefits to the architectural design office, most of architectural design offices adopt variety software for their daily work. However, that software is mainly installed in separated computers for executing personal design tasks. CDST suggests building an IT based information system not only for implementation of the above mentioned CMT management method, but for knowledge supporting for the personal design tasks. This information system is kind of Office Automation System (OAS) specifically for project management aspect for an architectural design office. The main principle is that all data (procedural records, design documents, reference knowledge resource, etc…) is stored in a central database, from where it is accessible for all tasks involved. The effect is that:

1) Transport delay between data recording and data availability is eliminated, thus speeding up the process,
2) Avoiding the distribution of redundant copies: when needed information is retrieved from the single source in the database, thus securely providing the proper version, improving quality and eliminating the cost of errors,
3) Automating and thus reducing the cost of handling data. This enables to record more details about the process in order to enable finer control and coordination and thus reducing time and increasing flexibility.
4) Easier access on relevant technical knowledge resource. Shorten the time to check and find applicable national/local code, reference resources, etc…

5.2.2.1 Types of OAS in current software market
Four major contents of OAS are: document management systems, message handling systems, teleconferencing systems and data analyzing systems. In terms of the service style that the OAS provided, they are integrated into an united OAS by the following three types:

1) C/S (Client server) model based OAS.
This is a distributed application that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients.[1] Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server machine is a host that is running one or more server programs which share their resources with clients. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await incoming
requests.

2) B/S (Browser server, also known as browser-based and web-based) model based OAS. This model is a software application for retrieving, presenting, and traversing information resources on the World Wide Web. An information resource is identified by a Uniform Resource Identifier (URI) and may be a web page, image, video, or other piece of content. Hyperlinks present in resources enable users easily to navigate their browsers to related resources. A web browser can also be defined as an application software or program designed to enable users to access, retrieve and view documents and other resources on the Internet. Although browsers are primarily intended to access the World Wide Web, they can also be used to access information provided by web servers in private networks or files in file systems.

3) SAAS (Software as a service) based OAS. Sometimes it referred to as "on-demand software". It is a software delivery model in which software and its associated data are hosted centrally (typically in the Internet “cloud”) and are typically accessed by users using a thin client, normally using a web browser through the Internet. SAAS has become a common delivery model for most business applications, including accounting, collaboration, customer relationship management (CRM), enterprise resource planning (ERP), invoicing, human resource management (HRM), content management (CM) and service desk management. SAAS has been incorporated into the strategy of all leading enterprise software companies.

SAAS is also kind of B/S mode. The discrepancy is that the server deployment for B/S mode, may be located on-premise, while SAAS offers them by its vendors’ data center, about cost efficiency. At least it should be for the up-front costs. Performance is significantly better with C/S mode, because LAN causes lower latency. With C/S and LAN, the OAS gains much more control over both the server and client side, which allows better optimization. SAAS is more likely for mobile clients/ public services/ anything connects via internet. C/S is for regular office work.

5.2.2.2 Types of documentation management of database
Above is about the software technology used. Another issue is the document management functionality.

1) Folder system:
Use the windows explorer folder system and define standard folder structure for the office. First problem is that there is no version management: version number must be part of file name or check the time created. Second problem is that folder structure is hierarchical, so there is only one search sequence. If a document is stored in the wrong folder, it is very difficult to retrieve. Third problem is that the composed filename may be redundant with folder names.

2) Document management system (e.g. Microsoft sharepoint):
Storage of files does not depend on folder structure, but on attributes like author, project, building type, date, office etc. Problem 1 is that user may omit to fill in attribute values. This can be overcome by a working method where checking the proper values is part of the review process.

3) Item based BIM system (e.g. Revit):
Each design entity is represented by an object in the system. From the 3D models a visual model of the
building is constructed. Retrieval becomes visual too: the user simply points the component he needs information about, and the system responds with a list of related documents.

● conclusion
As architecture design task is mainly dealing with pictures and drawings, requirement on data transferring speed tends to be higher than other documentation work. However, relevant management data, e.g. project brief, design task arrangement, detail design task list, etc…are not so sensitive on the transferring speed. The suggested solution for planning the OAS for an architectural design office usually adopts a multitier system with both WAN and LAN servers. Considering the transmission speed, the investment on the OAS, the combination style between C/S, B/S and SAAS can be a ideal method for the small and simple structured design office to establish its specific OAS and step into the digitized information management era.

5.2.2.3 Suggestions on planning the OAS
According to the literature study and above research work on the design and synthesis for CMT, the guidance for planning the OAS are summarized as follows:

1) Clarify the business strategic goal of the design office
2) Make a plan on the OAS implementation
3) Consult an IT software office
4) Analyse current bottle necks during the entire conceptual design process
5) Refine or create new work flow and data flow
6) Select and refine a existing specific software for the OAS
7) Train involved employees on the OAS
8) Pilot project for testing the draft OAS
9) Adjust the improper programs of the OAS
10) Implement the revised OAS with detail operational manual

Regardless of any selection among current OAS packages, the following aspects, which are related with project management, shall be emphasized:
1) Data vault and document management: secure storage of versioned documents,
2) Workflow and process management: create task with link to proper documents according to defined workflows,
3) Program management: link workflow tasks to project plan tasks and thus monitor progress of the project. Provide visibility to project management.
4) Product structure management: maintain product structure in order to be able to build visual model, know relationships, interfaces and interferences between components and perform clash control and impact analysis for changes.
5) Classification: provide a classification of standard components to support designers in selecting existing components in solutions.

5.3 Functionality of CDST

5.3.1 Overall functionality
The CDST functions as follows to help an architectural design office to improve its current management
performance on the conceptual design process:

1) By the defined OMF of CDST, a manager will get an integrated and systematic insight on the process oriented management method for the entire conceptual design process.

2) The process oriented CDST will guide the manager to establish or redesign a standardized, regularized and informatized management system. Furthermore, according to the changing parameters, CDST comes up a way of tuning the reconstructed management system in a dynamic changing manner.

3) CDST can be guidance for a manager to plan the project management aspect of an OAS regarding the conceptual design process.

From the management reform’s points of view, CDST shall help a manager to execute a management reform at three phases. See figure 5.3.1-1

*Figure 5.3.1-1*

The first is “Analysis” phase. During this phase, CDST will guide a manager on how to describe current management situation and find its relevant bottle necks. The outputs of this phase are as follows:

- Current work flow diagram and data flow diagram
Current management and product standard
Current organizational structure and responsibilities of each position

The second phase is "Design". CDST will explain how to reconstruct the existing work flow and data flow, and how to set up relevant standard for either management or product. The outputs of this phase are:

- Refined work flow diagram and data flow diagram
- Refined management and product standard
- Refined organizational structure and responsibilities of each position

The last phase is “Synthesize”. CDST will give suggestions on how to establish an information system--an OAS for managing the entire design process.

5.3.2 CDST helps to improve the project management in terms of actors' point of view.

5.3.2.1 Client
A well defined client-interacted information system may help an architectural design office have a better shared vision with its client regarding the project design. On one hand, client is the service target of the design office; on another hand, client may cause business risk to the design office. Both of above aspects shall be emphasized in the OAS.

5.3.2.2 Director
- Take CDST as a management tool to realize the strategies of the design office.
- Risk control on selecting target project and hence contracted client
- Have an overview on human resource and workload allocation of the office.
- Decision making on unpredictable situations happened in project design process (at director level).
- Easy access on checking and commenting finished design documents (quality control aspect at director level)
- Focus on values that its client concerns.

5.3.2.3 Office manager and chief architect
- Have an overview on all schedules of current running projects
- Work load control on human resource allocating among current running projects
- Easy access on checking and commenting finished or ongoing design documents (quality control aspect at chief architect level. The formal checking time is scheduled by office manager)
- Decision making on unpredictable situations happened in project design process (at Office manager and chief architect level).
- A tool for launching a reform within a design office

5.3.2.4 Project architect/Project manager
- Schedule control on project design (arrange detailed design tasks to team members and set milestone according to the schedule issued by office manager)
- Quality control on the product of project design (easy access on checking the finished or ongoing drawings done by team members)
- Decision making on unpredictable situations happened in project design process (at Project manager and project architect level).
5.3.2.5 Architect and assistant architect

- Focus their efforts on design tasks arranged by project architect.
- Data sharing and supporting for working on the daily design tasks.

5.4 Features of CDST

5.4.1 Client involvement oriented tool—CDST

From client's point of view, the core objective of hiring an architectural design office is to help them to create and realize the maximum value for the project. Exploring the expectation of a client, and fulfilling them based on its professional knowledge are essential tasks to the design office. However, to achieve more competitive advantages, a design office shall make a breakthrough on helping client to excavate added value for the project. No matter the essential task or gaining added value, all the efforts shall get client involved and convinced.

According to the analysis chapter, to communicate with client at the right time and exchange enough right information is important for leading an effective and successful corporation during the entire design process. For each specific node of the process, CDST shall mark the key issues that need client involvement to make an agreement or confirmation. These marks will be described by work flow and data flow with respect to each stage to remind the communication or result that has to be achieved between the design team and the client.

5.4.2 Efficiency improving and quality-control balanced tool—CDST

Through the literature review chapter, the less procedures of work flow for each stage, the higher efficient the work will be finished. However, the purpose of client is not only to get a product as early as possible, but the value maximized product! CDST aims to build an Efficiency improving and quality-control balanced management approach in accordance with the specific situation of each project. For instance, the standard of design result regulates the depth and contents for the design result with respect to each design phases in a common manner. However, regarding the specific requirement of a client, the task arrangement table will specify the details on the column of "requirements of design task", so as to add or reduce the work load on the specific project.

5.4.3 Standardization and regularization based tool--CDST

Focusing on creating the maximum value for client, CDST suggests taking the following improvements:

- Draw current work flow and data flow for each stage and find bottle necks that happened at a certain stage. To cope with the bottle necks, CDST emphasizes that all procedures arranged for the work flow shall serve for two objectives. One is to find and accumulate fortune for the design office itself; the other is to create value for its client. Optimized and standardized work flow leads to efficiency, and guarantees the quality of product.

- Formulate a set of standards for management and production of the work flow for each stage. The standard is generated from realistic working practice. As long as a procedure without a guiding specification to an operator may lead to ambiguous result, a standard need to be defined for it.
CDST encourages manager to establish or refine relative standards in accordance with the real working situation. Relative standards will be described at each stage during the entire conceptual design process.

5.4.4 Informatization enhanced tool--CDST

CDST suggests adopting an Office Automation system (OAS) for reconstructing the information system. To redesign an information system for the conceptual design process, the following steps shall be taken:

- Adopt an existing office automation software package and have a thorough discussion with the IT office. Ask them to join the management reform process from the “Define and Analyse” stage.
- Reconstruct work flow process and data flow process
- Establish a document management approach
- Create a viewing and commenting mechanism
- Analyse the stored data from the point of a manager’s view for reviewing the management performance, hence to help relevant decision-making process.

Apart from building an internal data exchanging system, CDST emphasizes the information system shall integrate the aspect of getting client involved and help to balance the efficiency improving and quality-control.

5.4.5 Continually optimized tool--CDST

Considering the dynamic changing parameters happened in real-life practice, CDST suggests accordingly optimizing relative work flow or data flow diagram. For instance, the architectural design industry is talent-oriented business; CDST holds that work flow procedures shall match the capability of current human resource. Otherwise, the current human resource shall be adjusted, either by offering a training course or recruiting qualified employees.
6. IMPLEMENTATION

Unexpectedly, the implementation of CDST is linked in two offices. One is for Tianye office; another is for Steinberg Architects, Shanghai office. Originally, the implementation for Tianye office was scheduled to be finished in Sep. 2010. However, due to the significant and continuous restricting policy on real estate development, which was starting at the beginning of 2010 in China, the real estate market sharply declines, few new projects are to be registered in developing. Only the projects, which have already been approved by government, have to continue developing. Mr. Ning Zhang changed the business strategies of Tianye office: Conceptual design will not be the primary but subsidiary business. Construction design replaced as the main business of the office. Design staffs for conceptual design are gradually cut down. And new employees for construction design are recruited. The development of the OAS for its conceptual design is hence terminated. And the implementation of CDST is thus failed to be completely finished.

6.1 Implementation in Tianye office

According to the discussion with Mr. Ning Zhang and meeting with design staffs, the implementation is structured for two phases. The first phase is to get warm up. To get the management improved within current hard ware system. After OMF of each stage has been developed, it is implemented to the practical work. Work flow and data flow regulated by the OMF guides the new project design process. During the first phase, tasks and responsible persons are defined; relative standards and referenced documentations are formulated; methods of HR allocation and the node of quality control are recommended. The second phase is to develop an OAS for linking the OMF to a software based information system. It is the final implementation phase that staffs execute their daily work in accordance with the OAS. As Mr. Ning Zhang puts it, "If staffs are getting used to the new working style, to implement the OAS is just a natural step."

6.1.1 Phase 1: warm up—OMF implementation

The first phase can be regarded as a transition period offered to each staff to get acquaintance. During this period, relevant management approaches may also get the chance to be tested and improved. Practically, the boundaries between analysis, synthesis and implementation for this research are not strictly distinguished.

Furthermore, based on the requirements of practical work, the implementation was not started after the entire CDST has been designed and accomplished. The refined management approaches for each design stage are not implemented in the same time. They are implemented stage by stage according to the urgency and influence of each stage. For instance: Mr. Ning Zhang hopes to standardize and regularize the stage 3—project designing and checking firstly, because the stage 3 influences most urgently on daily working efficient and the quality of design product. So, stage 3 takes the priority on the sequence of research and implementation.

As I shall also work for project design and can only switch to the research after working hours, it took me
around one year on developing the OMF of CDST for the entire design process. Timeline of the research and implementation sequence are as follows (see Figure 6.1-1):

![Figure 6.1-1](image)

### 6.1.2 Phase 2: OAS
While the OMF was designing and implementing within Tianye office, the OAS has been started planning since Mar. of 2010. The implementation plan has been made. And some existing software packages of OAS have been investigated: Microsoft SharePoints; ZOHO; QuanCheng i-OA; ZZSOFT (see the comparison among them in the appendix). However, due to the reason mentioned in the beginning of this chapter, this phase is in fact terminated since June. 2010. Because of the new business strategy of Tianye office, I left this office when my employee contract was expired on Feb. 2011.

### 6.2 Scenario for Steinberg Architects, Shanghai office
As my labor contract with Tianye office was ended on Feb. 2011, I started a new job in Steinberg Architects Shanghai representative office in the late of Mar. 2011. My position in the office is a project architect.

#### 6.2.1 Motive
After successfully passing the 2-months trial period in Steinberg architects, Shanghai office, I was considering the management performance of the office. This office is also a small architectural design office, which mainly engaged in the conceptual design phase. It is well-reasoned for the research to test the CDST by taking Steinberg Architects, Shanghai office as a scenario.

#### 6.2.2 Introduction of Steinberg Architects
Steinberg Architects, founded in 1953, is an old architectural firm that brings a thoughtful, innovative approach to design. With over 130 employees and offices in San Francisco, San Jose, Los Angeles, and Shanghai, Steinberg Architects is a dynamic team of individuals with the experience and talent to understand, collaborate with and challenge its client in order to achieve results beyond typical expectations.

The Shanghai office is set up in the beginning of 2009 as a representative division of Steinberg Architects. Till now, there are 19 people working for this office. 3 of them are in manager level, another 3 work for administrative affairs. The others are all designers. The office mainly engaged in the civil
project architectural design. Due to Chinese policy, so far Shanghai office hasn't gain a qualified architectural design certification from Chinese government. So, the business of Shanghai office is mainly limited within conceptual design phase.

Hereafter, the Mckinsey’s 7S organizational model is taken as a tool to analyse the current organizational situation of Steinberg Architects, Shanghai office.

6.2.2.1 Shared Value:
The shared value of Steinberg Architects, Shanghai office is to help and challenge client to get a design product beyond typical expectations. According to the director, the purpose of setting up the representative office in Shanghai is to take the advantages of the creativity and successful experiences of American office to help refining skyline and building exciting new communities across china. The design specialties of the office are mainly about civil projects: residential communities planning, club house, residential building, hotel, office building, educational building, etc...

6.2.2.2 Structure:
Its’ organizational structure shows as follows:

![Organizational structure of Steinberg Architects, Shanghai office](image)

6.2.2.3 Strategy:
According to the director, Shanghai office aims at high-end projects. The strategy is to do every project design well, gain trusts from each client and establish long-term business relationship with client.

6.2.2.4 System:
The office issued its formal employees’ manual in Oct. 2011. It regulates the administrative management system of the office. Regarding the information system, it is mainly based on a folder
management system and Microsoft office outlook email system. As for the project management aspect, office manager takes the role on workload analysis and HR allocation. With respect to the quality control system, although it is not specified in written, the chief architect and associate principal take the responsibilities. They will check and refine the design result of each project almost every day, in case they are available.

6.2.2.5 Style:
The office shares a democracy management atmosphere. However, regarding confirmation on the conceptual design of each project, the associate principal and chief architect take the centralization authorities.

6.2.2.6 Staff:
There are around 15 to 19 people in the office from April, 2011 to Dec. 2011. No formal responsibilities of each position are regulated. Hereafter, the responsibility on each position is described by personal observation.
Associate principal is Henry Zeng, the founder of Shanghai office, who is responsible for the vision setup and overall management of the office. He is a licensed architect in US. And has a background in architectural design.

Office manager is Jason Briscoe, member of AIA. He also has the background in architectural design. He is responsible for project management and HR management of the office and sometimes work as a project manager.

Chief architect is Hong Chen, he is a senior licensed American architect, member of AIA. His responsibility is to have an overall quality control on all projects for the design result submitted to client. He also usually works as a project architect for certain projects.

Financial department and HR department are not formally set up, currently financial issues are committed to an external financial agency. As mentioned before, office manager is in charge of the HR affairs. Office secretary helps him and sometimes project architect will be involved in interviews with applicant.

Project architect is responsible for the project design. Project architect shall mainly fulfill the following tasks:
1) Organize the design team for the project design from the start of task assignment to the end of finishing the project contract.
2) Conceive on the design concepts, make proposals on design solutions.
3) Finish the design submissions in time according to the project contract and shall be responsible for the quality of the design submissions.
4) Communicate with the client on design content and maintain a good relationship with them.

Sometimes, a project manager will be needed to support the work of the project architect in accordance with specific conditions. A project manager mainly works for the management issues related with the project design team, for instance, schedule control, task arrangement, communication with client on business aspect, etc…
Draftsman is responsible for the task arranged by project architect or project manager. They shall check the design result by each other and revise it accordingly.

6.2.2.7 **Skill**
Skills of the office are mainly on architectural design, urban planning design and interior design of civil projects.

6.2.2.8 **Conclusion**
Comparing to Tianye office, there are some similar aspects sharing by the two offices: Steinberg Architects, Shanghai office is also a small organization and with a simple structured style. The techno structure and supporting staff for the office are also weak and small. Besides administrative regulation, little formalization of behavior is regulated for the management on project design process. However, the distinctions are also obvious: Steinberg Architects, Shanghai office is a foreign representative office in China, with longer history running in America and less experience in China. Steinberg Architects has already established its reputation in residential project design, educational project design, and recreation project design in America. Shanghai office follows the existing data management system running in the American office. Its quality of design result is mainly controlled by frequently unplanned checking and discussing between a designer and chief architect/associate principal.

6.2.3 **Implementation proposal for Steinberg Architects, Shanghai office**

Firstly, a team of implementing the management refinement will be set up. the team can be named as an informatization team. The associate principal—Henry Zeng is suggested to be the head of the team; office manager—Jason briscoe will be the organizer to coordinate actions between the team and all employees. Me—JiangTao Shen acts as the executer on planning and designing sequential actions related with the refinement. An assistant will be needed on word arrangement, for instance, recording and summarizing information collected either through interview or meeting, formulating a report, etc…

Followed by *Figure 5.3.1-1*, the proposal for implementing the CDST on the refinement of project management of Steinberg Architects, Shanghai office could be divided by the following phases:

1) The first phase: Analyze
2) The second phase: Design
3) The third phase: Synthesis
4) The fourth phase: implement

6.2.3.1 **Phase 1, Analyze**
A kick off meeting with all employees is recommended for launching the management refinement. The purpose of forming an informatization team and the role of each team member shall be introduced. Description on the sequential movement for each phase shall be explained to all employees. And the mind change on adopting the new working style will be emphasized.
According to CDST, during this phase, the current management situation will be analyzed; problems related with causing lower efficiency and worse quality will be investigated; objective of the management refinement will be clarified. So actions for this phase are planned as follows:

1) Brainstorm workshop
This workshop is organized for brainstorming how to improve the working efficiency and how to control the quality of design results. The purpose of this workshop is to stimulate employees’ interests on how to work efficiently and how to control the quality of design result. This workshop will be presided by organizer (office manager). The time for this workshop is scheduled within one hour. In the first 5 minutes, office manager will make a brief introduction on the topic. Afterwards, executer will explain the boundary for the discussion on this topic in another 5 minutes. The boundaries are that, for example, the improvement approaches shall not be harmful to the reputation or benefit of the office; we could not say to control our client. Then, within 10 minutes, each employee will be asked to brainstorm on his/her own suggestions and written down them on a paper for further discussion. After that, each employee will have around 1 minute to state his/her personal suggestions. Considering the real-life situation, this section will last around 20 to 25 minutes. Assistant shall write down all the suggestions brainstormed by each employee. Afterwards, I will make a summary on all the suggestions in 5 minutes. By the last 10 minutes, each employee may speak freely on a certain points, either it is summarized aspect or not. For last minute, office manager may ask each employee to keep the topic in mind, and may offer the suggestions to the assistant any time after the meeting.

This workshop is to get each employee warm-up on investigating the topic of improving efficiency and controlling the design quality.

2) Problem definition workshop
I will preside this workshop. Within 15 minutes, CDST will be systematically introduced to each colleague. Let everyone know the connotation of work flow and data flow. Afterwards, within 10 minutes, 1 project architect and 1 assistant architect will be ask to demonstrate their personal understand on current work flow and data flow that the office runs. Then, within 5 minutes, I will propose the current work flow and data flow diagram. (General speaking, in case there are no standardized working procedure, the work flow and data flow tend to be random and not specifically regularized as a management approach). Some examples will be presented to illustrate the significance of adopting a regulated work flow and data flow. After that, the workshop goes into problem definition section. This section needs around 25 minutes. According to the result of the first workshop, the improvement suggestions raised by each employee, will be asked to match current work flow or data flow of the design process. Hence to define whether there are problems happened within the specific work flow or data flow. Each employee may have around 1 minute to describe the problems and define within what work flow or data flow these problems happen. For the last 5 minutes, all the problems discovered by each colleague, will be summarized and categorized.

This workshop helps colleagues to define and link the bottlenecks with specific work flow or data flow.

3) Objective definition
This action could be operated within the informatization team. ( in case of necessity, other colleagues could be also involved). The purpose of this action is to decide to what extent the office shall solve the
defined problems. According to the results getting from the former two workshops, through this objective action, a report shall gradually be formulated on how and to what extent to realize the management improvement. Hereafter, taking the decision to adopt an OAS as the objective of the management refinement as the scenario for further discussion in this paper. The detail requirements on the functionalities of the OAS shall be described in the reports. And potential software packages shall be investigated. The contents of the objective report shall comprise the following aspects.

- Current organizational structure and responsibilities of each position
- Current work flow diagram and data flow diagram
- Current management and product standard
- Objective of management refinement
- Detail statements on the content of possible management improvements or changes.
- Investigation of current OA software packages (including: conditions of realization, features of the package, budget requirement, service conditions, etc…)
- Schedule on implementing the management refinement (this schedule can be made by consulting the software companies.)

By the end of this phase, the objective of management refinement shall be clarified; the plan and requirement of the OAS shall be formulated; an IT company shall be selected.

6.2.3.2 Phase 2, Design
Reflecting on the organizational changing theory, this phase is designed to have all members involved in the changing process. Members join the discussion on what shall change, how to change, etc… Within this phase, the selected IT Company shall be involved in reconstructing the existing work flow and data flow. Chief architect and associate principal shall be responsible for setting up relevant standards for both management and design result. 2 sequential workshops are planned for this phase:

1) Sequential workshop of recreating work flow and data flow
This workshop can be divided into 8 sections. Each of them needs attendance of all colleagues. Its purpose is to refine or recreate a mutual agreed work flow and data flow for the conceptual design process. Another topic is that how to implement the work flow and data flow in a flexible manner. The first section will be presided by me. The DSM part of the CDST will be presented to all colleagues. Relevant background knowledge on work flow and data flow will be shared with each colleague, examples will be demonstrated to show the important significance of the design on the work flow and data flow for the entire conceptual design process.

In the second section, colleagues will be arranged into two groups. An assignment will be arranged to the two groups. One week is scheduled to take the result of the assignment. The first group will be responsible for refining the work flow of stage 1 and stage 2(project undertaken stage and project evaluating and arranging stage); the second group will be responsible for refine the work flow of stage 3, stage 4, stage 5. (Project designing and auditing stage; project submitting and feedback collecting stage; project reviewing stage).

One week later, after collecting all results from the two groups, the third section begins. It needs around 30 minutes. Each group shall present the result and make a summary on the refined work flow in less
than 15 minutes. The informatization team, together with the technician from IT company shall make a professional version of the work flow in accordance with the results collected from the two groups in another week.

This professional version will be demonstrated in the fourth section. Critics and suggestions on the work flow of this version will be collected to formulate a final version. This final version shall be approved by associate principal.

Repeating above mentioned sequential sections, the final version of data flow can be formulated by the end of 8th section as well. It is worth to emphasize again, that the formulation of data flow shall follow the approved work flow.

Totally, around one and a half month is needed to get the following results:
✧ Mutual agreed work flow and data flow for each design stage.
✧ Flexibility on implementing the agreed work flow and data flow.
✧ Refined organizational structure and responsibilities of each position

2) Sequential workshop of formulating standard of management and design product.
Following by the approved work flow and data flow, and the guidance of CDST, relevant standards and documents shall be formulated for the work flow and data flow of each stage. Sections for this sequential workshop can be organized similar as the previous one. Another 1.5 months later, by the end of this sequential workshop, the following aspects shall be formulated.
✧ Mutual agreed standards of management and design results for each design stage
✧ Sample documents, tables, for each design stage.

6.2.3.3 Phase 3, Synthesis

Based on the achievements getting by phase 2, and the existing software package of the IT company, the IT company takes the main role for realizing the computer based informatization system—OAS, which is specifically designed for Steinberg Architects, Shanghai office.
During this phase, the informatization team may act as a supervisor and adjustor to help the IT office debug the program.

6.2.3.4 Phase 4, Implement

During this phase, relevant actions shall also mainly follow the instruction of the IT company. Usually the following preparations are necessary before implementing the new OAS.

1) Hardware and software preparation
Relevant hardware shall be prepared in accordance with the requirements of the new OAS. The hardware shall be estimated during the design phase, and the detail list shall be offered to the design office by the end of the synthesis phase.

2) Data preparation
Relevant data generated by phase 2 shall be catalogued and inputted into the database for running the
3) Training course to all employees of the office
Before running the OAS, a training course will be given to all employees. The mindset change for each employee on adopting the new system to cope with the work task during the entire conceptual design process will be emphasized. Usage and features of the OAS will be described. Matters needing attention will be explained.

4) Pilot project for testing the OAS in real-practice
While prepare for above mentioned issues, a pilot project (either a new design project or some certain stages of several current running design projects) shall be available for testing the entire program. During the test, employees may get acquaintance with the OAS, and the IT office may find and debug the problems happened in the test of the OAS.

If the test succeeds, an operational manual for the OAS on the work procedure shall be formulated. And the OAS can be formally implemented in the office. In the meantime, the technician from IT company shall periodically maintain the system running properly.

Before ending this chapter, the purpose of CDST shall be clarified again: it is developed to help an architectural design office improve its working efficiency and control the quality of its design results. Following the development of computer-based web technology, although CDST suggests the design office to establish an OAS for managing the entire conceptual design process, it is not the only result. To what extent that the manager of the office feels satisfied with the refined management performance not only depends on the requirements of practical work, but also depends on managers’ personal opinion.
7. Conclusion, discussion and reflection

7.1 Conclusions on conceptual design supporting tool (CDST)

Regarding the current Chinese changing policy on controlling the real estate development, architectural design offices are about to face a new round of realignment. Those who possess more competitive advantages will be more likely to survive. Doubtlessly, to work in an effective and quality-control manner will be one of the most important components of those competitive advantages. Architectural conceptual design process is an effort-consuming, intelligent-intensive, and on top of that, an iterative process. How can a design office respond the request of its client, exchange the right information in time, and deliver the quality controlled design result in accordance with the schedule, greatly influences the evaluation from the client on the work performance of the design office.

Inspired by the “Learning or Reflective cycle” that Van Aken (2004) presents, (see figure 1.1), the topic on Effective and quality-control management on architectural conceptual design process is chosen for the ICA. An new founded architectural design office, in Shanghai—Tianye office is taken as a study case for the research.

Following “The Regulative cycle for business problem solving” (Van Stiren 1997), the problem mess of current management of Tianye office have been discovered and investigated. Key factors of the problems have been categorized as follows:
1) External and internal communication
2) Database
3) Document management
4) Workflow
5) Quality control

Among them, the former three are related with information system. They are mainly about how to exchange, store, retrieval information; how to manage the version and status of relevant data. The last two are mainly about how to manage the conceptual design process; how to control the quality of design results. Hence, the research goal is defined in two aspects:
1) Develop a management tool to support the project design process in the conceptual design phase between an architectural design office and its client in an effective and quality-control manner.
2) Furthermore, this tool can guide an architectural design office to plan an OAS specifically for the management on the conceptual design process.

To reach the research goal, main questions and sub-questions are raised. Relevant literature resource for reviewing on the topic are selected and studied. Selecting criteria of the literature resource is based on the following aspects:
1) Knowledge of architectural conceptual design phase
2) Theory on organizational change
3) Models on establishing an information system
4) Theory on quality control
Through studying the above mentioned knowledge, theories and models, current situation of Tianye office is analyzed by the following aspects:

1) Organizational analysis on Tianye office
2) Current conceptual design process of Tianye office
3) Work flow of the current conceptual design process
4) Data flow of the current conceptual design process
5) Bottlenecks related with the work flow and data flow of current design process

Following the literature study on above mentioned aspects, and based on combing and analyzing current work procedures of Tianye office, a series of systematic management solutions for Tianye office have been made. In the meanwhile, the Conceptual Design Supporting Tool—CDST is gradually developed.

CDST systematically helps the organization to launch a management reform. It aims to establish an information system. Working together with the system, the design office will be guided on orderly organizing the dynamic changing design process, hence increase its overall work performance—to work in an effective and quality-control manner to produce its competitive design results for its client.

CDST encompasses two parts. One is the CMT(Core management tool), the other is the information system guidance. Regarding the CMT, it contains the OMF (Overall management framework) part and the DSM (Detail supporting manual) part. The OMF part illustrates an overall insight on the management divided by five design stages:

- Stage 1: Project undertaking;
- Stage 2: Project evaluating and arranging;
- Stage 3: Project designing and auditing;
- Stage 4: Product submitting and feedback collecting;
- Stage 5: Project reviewing.

The DSM part explains the influenced parameters and relevant principals on refining the work flow and data flow for each design stage. To design new work flow and data flow for improving the management performance, the seven organizational elements defined by Mckinsey's 7s framework shall be thoughtfully matched and balanced; and the following principals shall be taken into accounts:

1) Principals on designing the new work flow
   - Value of work procedure
   - Context of current bottle necks
   - Uniformity between procedure and competence
   - Balance between effectiveness and quality controllability
2) Principals on designing the data flow
   - Description and logic relationship of data items
   - Data creating method
   - Data retrieval management
   - Data authorization mechanism
   - Data approval method
   - Data version management
3) Principles for quality control
   ◦ Process control
   ◦ Standard formulation

Experiences and suggestions of DSM for each design stage are categorized into the following aspects:
   ◦ Key working contents:
   ◦ Referenced standards and documents for this stage

Considering currently highly developed computer technology, the information system guidance suggests the design office to adopt an office automation system (OAS) on coping with its complex and knowledge-intensive daily work. Relevant types of OAS are introduced and suggestions on selecting the suitable type is given: Based on adopting an existing automation software package, a multitier system with both WAN (Wide Area Network) and LAN (Local area Network) servers, which combines the usage and advantages of C/S (Client server), B/S (Browser server) and SAAS (Software as a service) software techniques can be an ideal method to reinvent a specific OAS for the small and simple structured design office.

Suggestions on planning the OAS are as follows:
1) Clarify the business strategic goal of the design office
2) Make a plan on the OAS implementation
3) Consult an IT software office
4) Analyse current bottle necks during the entire conceptual design process
5) Refine or create new work flow and data flow
6) Select and refine a existing specific software for the OAS
7) Train involved employees on the OAS
8) Pilot project for testing the draft OAS
9) Adjust the improper programs of the OAS
10) Implement the revised OAS with detail operational manual

The features of CDST are showing as follows:
1) It aims to establish a standardization and regularization management system.
2) It suggests adopting an OAS for establishing an Informatization working environment.
3) It emphasizes the involvement of client during the entire design process.
4) It concerns on the flexibility of balancing the efficiency improving on work performance and the quality-control on design results.

Since the CDST is guidance for a design office to establish or redesign a standardized, regularized and informatized management system, and the DSM suggests involving employees into the management reform procedures, the possibility of successfully realizing the system within the design office enjoys strong Mass Basis. Furthermore, based on the Mckinsey’s 7-s framework, according to the changing parameters of the 7-s elements, CDST comes up a way of tuning the reconstructed management system in a dynamic self-adaption manner.
7.2 Further discussions on CDST

Aiming at improving the working efficiency and having the quality of design results controlled, a disorderly managed architectural design office must have made some changes. The changes are mostly related with personal working style. Through the research, it is found that many OAS software companies believe that the best mode to change employees’ current manual working style into an OAS style shall be realized in a top-down manner. They proclaim that employees tend to have inertia on changing their current working style. Especially considering the so-called artistic temperament of architect (they either do not care about the management issues or they keep insisting on their own working style.), to change the working style of an architect is rather a tough task, not to mention the difficulty of changing the working style of the entire office.

It is well know that the management style of an office greatly depends on the personal characteristics of the person who is in charge of the office. Probably, this is the reason why they believe in the top-down manner. From this point of view, they even believe that as long as the manager feels satisfied with the new OAS, then all other employees shall follow this system as a compulsory rule.

I only agree part of this idea: the manager does play an important role regarding the system changes. However, he shall play as an organizer on developing the new OAS instead of planning or making the decision on the OAS without the involvement of other employees—mainly architects. I personally hold that the OAS planning procedure shall be mainly a bottom-up mode. That is why I insist that the brainstorm workshop shall always have architects involved in. I believe to reach a common understanding on the working style for the conceptual design process is a key factor that may affect the implementation of CDST, although it takes much more time.

Another interesting topic is related with the DSM part on the 3rd stage. It is about HR allocation. As architectural design is a creative and highly knowledge-intensive job, if the project architect assumes full responsibility on the project design, then how the project architect can reach his/her most efficiently work rhythm, hence the design office may achieve its most efficient HR allocation. Some project architects may likely to work on more than one project, for they might feel boring on sticking to the same task, they would like to refresh their mind on switching to another project design task. Surely, others prefer to work only on one project. They may concentrate on it and offer the design results with its quality better controlled. However, when the design office encounters shorthanded situation, this HR allocation problem will always comes up.

Based on my personal experience, it is suggested that the project architect works more efficiently on two projects than only works on one or more than two. However, this point has not been scientifically studied yet.

7.3 Reflection

With my personal work experiences in several architectural design offices for around 15 years, I have seen too much overwork, too many valueless repeating jobs, too many efforts wasted on checking relevant information, too many hasty interactions between client and design office, etc…Such problems
not only cause inefficient work, lower the quality of design results, but also cause complaints and hence dissatisfaction of employees. Architects gradually slide into lack of enthusiasm and initiative on his work. Under the internal and external pressures, managers hardly feel satisfied on the management performance. However, due to the features of the simple organization, this kind of offices usually have weak supporting staff on management aspect. The heads of the office usually have strong technical background but less knowledge on management. They are busy in coping with both daily business issues and technical design issues, few of them are interested in spending extra time on systematically restructuring and reorganizing the management of the design process. All above, motivates me on investigating the topic of how to improve the work performance on the architectural conceptual design process for the simple structured architectural design offices and taking it as the research topic for my ICA.

After ending the academic training in ADMS, I was seeking the opportunities for the ICA. Due to the economic crisis in the beginning of 2009, it took me great efforts on finding the company, which may be suitable for the research. Finally, I was employed by Tianeye office in Shanghai. Being an actor in the Tianye office executes the research.

The research follows the method of “Learning or Reflective cycle” and “The Regulative cycle for business problem solving”. Specific solutions are designed to solve problems encountered in Tianye office.

Due to the fast-pace work rhythm and the situation that being a researcher, I am also an actor in the office, the implementation of CDST is required to execute concurrently with the design process on it. However, according to the feedback of colleagues, except they need a remind on the changing procedures at the beginning of implementing a new approach, they feel that the normal working rhythm is not disturbed and they tend to get well adjusted on it quickly as it is put into practice one step by one step. By the end of March 2010, colleagues of Tianye office almost learn all the reformed working procedures and are expecting to work together based on the coming computer-based information system.

However, as the “Evolutionary model” of organizational change theory describes: Change happens because the environment demands change for survival. The main assumption underlying this model is that change is dependent on circumstances, situational variables, and the environment faced by each organization (Morgan, 1986). Tianye office really made a big change—the conceptual design will not be the main business of the office, but the construction design. This tough decision was made due to the governmental policy changing on the real estate development market since the beginning of 2010. Mr. Ning Zhang gradually cut down the human resource on conceptual design business, and switched to enroll new employees on the construction design business. Influenced by this decision, the implementation on establishing a computer-based OAS for the conceptual design phase is hence terminated, although some efforts have already been taken.

After ending my labor contract with Tianye office, and having passed the 2-months trial period in Steinberg architects, Shanghai office, I was considering the management performance of the new office and taking Steinberg Architects, Shanghai office as a scenario to test the CDST. So far a proposal for developing an OAS for the Steinberg architects, Shanghai office, has been accomplished. An initiative
discussion on this implementation with the associate principal has been made. According to Henry Zeng, this is a comprehensive and complex job. Whether to develop the OAS for Shanghai office depends on the development of office size and the business loads in future. Considering current problems that Shanghai office encounters, he will keep developing the OAS in mind. In his opinion, before implementing the OAS, to have the system operated also by manual approaches for a certain period is necessary.
8. Appendix

8.1 Abbreviation index

<table>
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<tr>
<th>A</th>
<th>ADMS</th>
<th>Architecture design and management system</th>
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<tbody>
<tr>
<td></td>
<td>AIA</td>
<td>American Institute of Architects</td>
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<tr>
<td>B</td>
<td>BPMN</td>
<td>Business process modeling notation</td>
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<td></td>
<td>B/S</td>
<td>Browser server, also known as Web-based</td>
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<td>C</td>
<td>CCA</td>
<td>Conditional commitment agreement</td>
</tr>
<tr>
<td></td>
<td>CDST</td>
<td>Conceptual design supporting tool</td>
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<tr>
<td></td>
<td>CMT</td>
<td>Core management tool</td>
</tr>
<tr>
<td></td>
<td>C/S</td>
<td>Client server</td>
</tr>
<tr>
<td>D</td>
<td>DQI</td>
<td>Design Quality Indicator</td>
</tr>
<tr>
<td></td>
<td>DSM</td>
<td>Detail supporting manual</td>
</tr>
<tr>
<td>H</td>
<td>HR</td>
<td>Human resource</td>
</tr>
<tr>
<td></td>
<td>HRM</td>
<td>Human resource management</td>
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<tr>
<td>I</td>
<td>IPMA</td>
<td>International Project Management Association</td>
</tr>
<tr>
<td></td>
<td>ICA</td>
<td>In-company assignment</td>
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<tr>
<td></td>
<td>IT</td>
<td>Information technology</td>
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<tr>
<td></td>
<td>ISO</td>
<td>Quality standard issued by International Organization for Standardization</td>
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<tr>
<td>L</td>
<td>LAN</td>
<td>Local area network</td>
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<tr>
<td>O</td>
<td>OAS</td>
<td>Office automation system</td>
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<tr>
<td></td>
<td>OMF</td>
<td>Overall management framework</td>
</tr>
<tr>
<td>P</td>
<td>PMI</td>
<td>Project Management Institute</td>
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<td></td>
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<tr>
<td>R</td>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>S</td>
<td>SAAS</td>
<td>Software as a service</td>
</tr>
<tr>
<td></td>
<td>SSADM</td>
<td>Structured Systems Analysis and Design Method</td>
</tr>
<tr>
<td>W</td>
<td>WAN</td>
<td>Wide Area Network</td>
</tr>
</tbody>
</table>
8.2 Interviews and meetings

8.2.1 Interview with Ning Zhang (Director of Tianye office)
DATE: March 2 2009
Address: Tianye Shanghai office

1) How about the history of Tianye office?
Ning Zhang: Tianye Lingyi office was founded in 2001 in Lingyi, Shan Dong Province, after I worked for a local design institute for over 15 years. We met the good opportunity of real estate developing age. Traditional working style of local design institute can’t meet the increasing demand from local building market. And I seized the chance to survive and develop. As for Tianye Shanghai office, it was set up in the end of 2007. Those days, local clients demanded higher expectations from the developed area, such as Shanghai, Beijing and Shenzhen etc…Strongly feeling the competitive stress, I made the decision to set up an office in Shanghai.

2) What is the major business of Tianye office?
Ning Zhang: As you have already known, we mainly dealt with architectural design on civil projects. Employees in Shandong province are good at solving technique problems for the design; they are mainly working for construction design phase. Due to the vision limited within local situations, they are not good at developing creative concept for conceptual design phase. And that is why I set up Tianye Shanghai office. I hope the architects hired in Shanghai would be competitive on architectural conceptual design.

3) How do you exploit the business market?
Ning Zhang: Working in local building market for years, Tianye Lingyi office had already made some achievements. We won competitions and got several rewards from local government. On top of that, we made friends with our clients. Tianye Lingyi office had gained its reputation in local area on technical services. This would be a fortune for Tianye Shanghai office to undertake new projects. In addition, a marketing department in Tianye Shanghai office has been set up, relevant reward system has been formulated for undertaking new project.

4) What is the business vision do you set up for the Tianye office?
Ning Zhang: Shanghai is a globalization and internalization city of the world. I hope Tianye Shanghai office may gradually step into a higher level in the architectural design industry comparing to peers. We shall be fully competitive in the design market of Lingyi area not only by offering good services to client, but also impressing them by creative design ability. And in a certain years, we shall be competitive in the design market of developed area, like Shanghai, Beijing and capital cities of other provinces.

5) What are the business strategies of Tianye Shanghai office. How do you plan for them?
Ning Zhang: Tianye Shanghai office is totally a new office set up in Shanghai, all employees are hired in Shanghai human resource market. Although only 1 year is passing by, we have learned a lot from the market. To achieve the vision mentioned before is not a easy process. The situation is that, to undertake a project in local area, for instance, Lingyi, we are not competing with local design institute any more, but the design offices from Shanghai, Beijing or even foreign countries. There are no obvious
advantages of Tianye Shanghai office at all. I hold that to set up an office in Shanghai is more than to survive in future, but to accumulate competitive advantages for future.

Speaking of the business strategies, I would like to emphasize two aspects: Firstly, we shall survive to maintain the normal operation of the office. No matter how lower level of profits the project is, we shall earn the maintaining expense. When the time that we get sufficient capital comes, we may choose the projects that we are interested, and may bring us reputation, hence to step into the positive cycle of being a reputed architectural design office. Secondly, we shall establish an effective management system that helps to accumulate any competitive advantages for Tianye Shanghai office.

6) What are the strengths of current Tianye office?
Ning Zhang: As I have mentioned, Tianye Lingyi office is good at construction design phase. they are familiar with national building code and local regulations. They can support Shanghai office in these two aspects. Another important aspect is that I have personally gained a stable clients group in Lingyi area. As for Tianye Shanghai office, I am intended to establish a creative environment for talented architects. Project opportunities will be offered to them, they are encouraged to directly present their design concepts to clients.

7) What are the current problems regarding the management of Tianye office?
Ning Zhang: Because Tianye Shanghai office has been only operated for one year, the organizational structure is instable and incomplete. Team spirit has not been formed within the organization. Management system for human resource and project design process are not well-organized. It happens several times that we hardly submitted our design achievement when the deadline is due. The working procedures seem to be mess. Employees sometimes worked day and night; while sometimes seem to have nothing to do. I heard complaints from both project architect and assistant architect. The most important problem is that the quality of submitted design results seems to be not competitive with other design offices. Clients felt not satisfied with most of our design submissions. On the other hand, it is hard to evaluate the working performance of employees.

8) How do you rank above mentioned problems, according to the importance and urgency for the development of Tianye office?
Ning Zhang: This is a good question. To discuss this question, we may accordingly arrange our work this year. The first issue should be human resource. How can we attract talented architects and keep them staying with the development of Tianye Shanghai office. How shall we motivate them, simulate their initiative and creativity on work? I think we shall set up a policy on this aspect. The second issue is about establishing a management system on design process. The important point is to have the quality of design submissions improved and controlled. Orderly organizing and arranging limited human resource to meet the requirements of heavy workload is another important aspect.

I imagine that an office automation system would be helpful for us to manage either the human resource aspect or the project conceptual design process, as one of my friends in Zhenzhou did for his own office. He is one of my classmates of MBA program in Beijing. His office is a trading office dealing with import and export business. You shall visit him in case we are about to set up this automation system. I hope these issues are related with your In-company Assignment, and you may take them as your research topic.
8.2.2 Interviews with colleagues of Tianye office

- **Questionnaire**
  
  A. **Section A – Organization**
  
  A-1 What is the shared value of Tianye office, how do you recognize it?
  
  A-2 How do you understand the organizational structure of Tianye office?
  
  A-3 What kind of systems do you know that team members shall follow during the conceptual design process in Tianye office?

  B. **Section B – Problems and suggestions**

  B-1 What factors do you think that currently influence the working efficiency during the conceptual design process?

  B-2 What will you suggest to improve the working efficiency?

  B-3 How do you think about the quality of design result? What kind of quality standard do you think that the design result shall meet?

Based on Mckinsey's 7-s model, the section A of the questionnaire is designed to investigate the organizational situation of Tianye office. The section B is designed to the topic of working efficiency and quality of design result. 3 project architects and 3 assistant architects have been selected to join this interview. Please see the table shown next page.
<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
<th>Interviewee</th>
<th>Section A (About organization)</th>
<th>Section B (About current problems and suggestions)</th>
</tr>
</thead>
</table>
| 2009.4.30  | Le Liang       | I think the shared value is based on our profession. We shall have our unique design philosophy and have it guided our design work. | I don’t care about the organizational structure as long as it does not affect my work on the design process. | Do you mean the system for processing a design task? If it is, I want to emphasize one aspect: the people who make the design shall assume full responsibilities. I mean the architect shall play the most important role on the design process. This shall be the most important system. The others are all minor.  
A precisely defined project brief is an essential prerequisite to work efficiently.  
A member’s skill on architectural design is another important aspect for working efficiently.  
Formulate a sample document on the project brief for collecting necessary design requirements.  
Keep team members regularly training on relevant knowledge, which related with the ongoing project or design techniques.  
To me, the quality of a design is most related with the creative ideas, solutions planned for the project.  
The satisfaction of client could be one of the conditions that the design result shall meet. |
| 2009.4.30  | Project architect | Each project architect shall have enough power to realize his personal design concept, and I concern it as the shared value of our office. | I hold the architectural design department is the core unit of Nianyi office, the other departments shall serve for it to achieve better design result. | Establish an information system for project design process and keep data stored, retrieved, modified, approved, etc. in an orderly manner.  
Formulate competencies for the post of project architect and hire qualified architect.  
Assign design tasks in accordance to the ability and current workload of each team member.  
The quality of design result is helpful to evaluate work performance of a design team.  
Basically, the quality of design result shall meet the requirement of the project brief collected from client.  
In my point of view, good quality shall surpass the expectations of client in terms of aesthetic and practical value created for the project. |
| 2009.4.13  | Yinpang Wang   | Offer satisfied service to client and get our work paid also in a satisfied manner. | Yes, I know the structure by our employee manual, and I think it is a common style. Everyone has a general view on his position, responsibilities and whom he shall report to. | I don’t know exactly on what special systems that we shall follow. To my point of view, the design result shall meet the requirement of building code is essential system that we have to obey.  
A friendly relationship with client is an important factor to keep working smoothly and efficiently.  
A mutual agreed standard on design result and drawing habits is helpful for team members to work collaboratively and hence efficiently.  
Improve communicational skills of each project architect and keep client timely involved in the design process.  
Formulate a quality standard on the design result.  
The quality of design result represents the skill level of our office.  
In my opinion, the quality of design result shall firstly meet the requirement of national building code. Then, to meet the client’s expectations. |
| 2009.4.15  | Hualong Heu    | Create a friendly working atmosphere and make a qualified design result to impress client | I hold the organizational section of our employer’s goal, I understand the system better on our office, and know how to perform in the design department. | I don’t know what kind of system that existing in our office, and I only know that project architect arranges the design tasks to me, and I finish them according to his/her requirements.  
To reduce the frequency of design changes and establish a��识 sharing system  
A knowledge sharing system is helpful for efficiently checking reference resource.  
Control the design changes  
The quality standard for design result can be a guideline, which may regulate our daily work.  
For an assistant architect, I think the helpful of his/her work shall meet the requirement of the project architect. |
| 2009.4.15  | Assistant architect | I believe the best offer to client shall encompass good service and good design work. They are the shared value of our office to exploit design market. | It is clear to me. And I understand the best on our department. As for others, I don’t think to know well on them are so important. | Initiative and position of team members are essential to run a project in an efficient manner.  
An unified technical standard on production is necessary to work collaboratively and hence effectively.  
Organizing public activities to cultivate team spirit.  
Formulate unified technical standard to regularize drawing habits.  
The quality standard shall meet both national code and client’s requirements. |
| 2009.4.15  | Huaihong Zhu   | Everyone in the office shall work with initiative and highly team spirit to produce the design work which may represent the capability of our office. | I understand the structure. It shows a general managerial relationship of all staffs. | I don’t know much of it. In my opinion, the system for organizing the design process is necessary. For we may know how the project is running, what phase it is on, instead of only doing tasks arranged by project architect.  
Attitude and skill of team members, especially for project architect are the most important factors to run a project efficiently.  
An information sharing system and knowledge sharing system are helpful to accelerate working rhythm for a design team.  
Establish an appropriate Human Resource management system to select and motivate team members.  
The quality of design result is essential for us to developing and growing.  
Since we are engaged in a service industry, in my opinion, the most important aspect of quality standard shall be the satisfaction of client. |
8.2.3 Meeting with Guanghui Li (Director of Yuanheng office, one of Mr. Ning Zhang’s friends, who has already adopted OAS for his office)

**Meeting Date:** Dec.29.2009 morning 9:10-12:00

**Meeting address:** Meeting room Yuan Heng Office

**Participation:**
Yuanheng Office: GuangHui Li, ZhanFeng Hou,
Tianye Office: JiangTao Shen, ling Zhou

**Content:** Discussion on R&D of OAS of Tianye Office and collaboration intention between Tianye and Yuanheng office.

1. Firstly, Jiangtao Shen clarified the intention for this business trip to Zhengzhou: Discussion on the R&D of OAS for Tianye Office; discussion on the feasibility of collaboration on developing the OAS with Yuanheng Office.

2. Considering the management situation of Tianye office, Jiangtao Shen stated that the purpose for developing the OAS is to raise working efficiency and control design quality. The followings are some initial application ideas for this OAS.

1) Automatically generate weekly workload list for each employee. Collecting daily (weekly, monthly, yearly) work record for each employee in real time manner. For example, if click a icon of an employee’s name, manager could check the record of his (her) workload. Hence, he may decide how to arrange the human resource allocation for a new design task. According to the workload of each employee, manager could analyze the human resource allocation on different project. It helps to build an evaluation system to estimate the possible workload for a new task. Moreover, regarding to a certain task, it may help to evaluate employee’s working performance according to an average statistic data of workload standard.

2) Establish a database system for information exchanging. Change current situation that each employee save files separately by different computer. It helps to raise efficiency of checking files and store files in a sharing manner. Within the database, a knowledge platform shall be set up for collecting dispersive resource gathered by each member. It helps to improve efficiency of checking reference resource, which related with design task.

3) Establish a quality control based management system for the design process. It can automatically remind the design team to follow the standard work-flow for each project. Set up executive standard for each step. Through the standard of each work flow, the design quality is able to be controlled phase by phase.

4) Jiangtao Shen introduced plan for the R&D of the OAS and discussed feasibility of the plan with Director Li.
5) Regarding R&D for the OAS of Tianye Office, Director Li suggested that:

- Make sure what is the demand of Tianye office, then formulate the requirement brief to guide development of the OAS.
- Set up a complete R&D plan. For example: one is the plan for IT. Including IP address and MAC address etc. It's better that each department has its own IP scope; another is the plan for hardware system, it's better to have a coding regulation to arrange all the hardware facilities.
- Start to collect and analyze all the work-flow of Tianye office. To see what are the key factors that influence work efficiency in course of each phase. Including collecting the attribute of all the relevant software, hardwires, books and all the other reference resources that designers currently using now.

3. Director Li showed us the OAS of Yuanheng office. It has been developed for 4 years and is still under developing now. This OAS includes personal office module, book management module, asset management module, personal work record module, work flow module etc.

4. Jiangtao Shen discussed with director Li on the collaboration of developing the OAS for Tianye office. Director Li positively agreed on supporting Tianye office. Afterwards, both parties should co-organize a research team for the development. After Tianye office finishes the requirement brief on the OAS, a further discussion between Tianye and Yuanheng will be hold.

8.3 Investigation on existing Office automation software packages

With the fast development of information technology and management knowledge, more and more office automation software packages are developed and sold in current market. According to the service style that the OAS provided, the following packages are selected for both research and purchase targets for Tianye office: Share point suite; ZOHO Work Online suite; Integrated management system for design institute; Quan Cheng I-OA.

8.3.1 Introduction on Selected existing office automation software packages

1. Share point suite
(http://www.microsoft.com/china)--------- It is a software company with worldwide influence on many fields

- Company intro:
Microsoft Corporation is established on April 4, 1975. It is a public multinational corporation headquartered in Redmond, Washington, USA that develops, manufactures, licenses, and supports a wide range of products and services predominantly related to computing through its various product divisions.

- Software intro:
It is a software platform developed by Microsoft for collaboration and web publishing combined under a single server. These capabilities include developing web sites, portals, intranets, content management
systems, search engines, wikis, blogs, and other tools for business intelligence. As Microsoft put it: “The Business Collaboration Platform for the Enterprise and the Internet”

2. ZOHO Work Online suite
(http://www.ZOHO.com) Specialized in developing informationization for small offices

✧ Company intro:
ZOHO is established by Sridhar Vembu, founder and CEO of ZOHO Corp. in 1996.

✧ Software intro:
ZOHO.com is a comprehensive suite of award-winning on-line business applications. Customers use ZOHO.com to run their business processes, manage their information and be more productive while at the office or on the go, without having to worry about expensive or outdated hardware or software.

3. Integrated management system for design institute
(http://www.goodwayssoft.com) local Software company specialized in developing management software for engineering design offices.

✧ Company intro:
Shanghai Jin Hui Software Co., Ltd. is a software companies which focuses on the engineering survey, design, consulting, construction and provides industry information management systems and solutions, it's a native software company, founded in 1996 and headquartered in Shanghai.

✧ Software intro:
Based on C/S structure, each computer shall install client software, and each employee shall log in to run the system. It covers not only management for project design process, but many functional modules for office management.

4. Quan Cheng I-OA
(http://www.eqccd.com) local Software company specialized in informationization for small offices of all kinds of industries
✧ Company intro:
Established in 2000, QUANCHENG Business Data Co., Ltd. is a network software supplier, which is specialized in providing network application management software for domestic enterprises.

✧ Software Intro:
Design of QUANCHENG's product is based on .NET environment and B/S (Browser/Server) model. It integrates office management system, which is characterized by united platform, collaborative application. This system is not only practical, but extensible as well. Its functionality could be expanded by simply selecting a desired developed module. The goal of this system aims at building a low cost, low risk and high efficiency office automation system.

8.3.2 Comparison on the selected software packages (Data collected until Aug. 2010)
The comparable aspects of above mentioned software packages are set as follows:
Requirements for hardware and other software systems (How to arrange the system with all computers in the office)
- Features and functionalities (what kind of function that it offers)
- Costs (The estimate budget for the desired system)
- User interface and usability (Is it easy for users to operate?)
- Flexibility (Is it flexible for adapting changes demanded in future?)

8.3.2.1 Requirements for hardware and software

- Share point suite
  1) Hardware requirements
     - Processor
       64-bit, four cores
     - RAM
       4 GB for developer or evaluation use
       8 GB for production use in a single server
     - Hard disk
       80 GB for system drive. Sufficient space is needed for the base installation and sufficient space for diagnostics such as logging, debugging, creating memory dumps, and so on. For production use, additional free disk space for day-to-day operations is needed. Maintain twice as much free space as you have RAM for production environments.
     - Database server in a farm
     - Single server with built-in database
     - Front-end Web servers and application servers in a farm
     - Client computer
  2) Software requirements
     - Windows XP
     - Win Svr Std 2008R2 CHNS OLP NL
     - Win Svr CAL 2008 CHNS OLP NL DvcCAL
     - SQL Svr Std 2008R2 CHNS OLP NL
     - Share Point Svr 2010 CHNS OLP NL
     - Share PointStdCAL 2010 CHNS OLP NL DvcCAL

- ZOHO Work Online suite
  BAIHUI has built up all the network infrastructure and software, hardware operating platform which information needed for business companies, and is responsible for all pre-and-post-implementation maintenance, there is no need for the enterprise to purchase hardware, software, without construction of rooms, just like turn on the tap then we can use water, according to their need to rent software services. Enterprises only provide the network environment and install the router can be achieved.

- Integrated management system for design institute
  1) Hardware requirements
Recommended server: HP DL380-G6
Product Type: DL380G6 491325-AA1 Standard 1 Intel Xeon
Processor cpu: E5520 (2.26 GHz, 8MB (1 x 8MB) 3 cache, 80W, HT, Turbo 1/1/2/2), 6 GB (3 x 2 GB) PC3-10600R (DDR3-1333)
Storage Type DIMM, HP Smart Array P410i/256MB,
2 dual-port NC382i Gigabit LAN: supports 8 SFF, the largest expansion to 16, an optional optical drive; a 460W hot plug power supply, 2U rack. (2)
HDD: HP 300GB 10K 6G 2.5 SAS DP HDD (11)
Drive: DVD ROM DRIVE SATASLIM (1); HP 460W HE 12V Hotplg AC Pwr Supply Kit (1)

2) Software requirements:
Windows XP
Integrated management system for design institute

Quan Cheng I-OA
1) Hardware requirements
Processor: Intel Xeon X Series IntelXeon E series clocked at 3.0G or above
CPU number: 4
Memory: 4-16G
Hard driver: more than 300G
LAN: Dual 100M/1000M adaptive
Referenced server:
HP / ProLiant ML3 series (basic requirements)
HP / ProLiant ML7 Series
IBM System x5 series (higher required)
Network:
Between server and client needs 100M normal and stable network connection, the server needs to connect to external internet.

2) Software requirements:
OS: Window XPsp2 + IE6 (IE7, IE8)

8.3.2.2 Features and Functionalities
Share point suite
Regarding the features and functionalities of Share point suite, there are six major aspects showing as follows:
1) Sites
SharePoint 2010 Sites provides a single infrastructure for all your business Web sites. Share documents with colleagues, manage projects with partners, and publish information to customers.

2) Communities
SharePoint 2010 Communities delivers great collaboration tools—and a single platform to manage them. Make it easy for people to share ideas and work together the way they want.

3) Composites
SharePoint 2010 Composites offers tools and components for creating do-it-yourself business solutions. Build no-code solutions to rapidly respond to business needs.

4) Content
SharePoint 2010 Content makes content management easy. Set up compliance measures “behind the scenes”—with features like document types, retention policies, and automatic content sorting—and then let people work naturally in Microsoft Office.

5) Insights
SharePoint 2010 Insights gives everyone access to the information in databases, reports, and business applications. Help people locate the information they need to make good decisions.

6) Search
SharePoint 2010 Search cuts through the clutter. A unique combination of relevance, refinement, and social cues helps people find the information and contacts they need to get their jobs done.

● **ZOHO Work Online suite**

There are mainly three functional groups offered by ZOHO Work Online suite:

1) Collaboration Applications
2) Collaboration Applications
3) Productivity Applications

The detailed functional modules are shown as the following diagram.
- **Integrated management system for design institute**
  This system categorized the functionalities into the following eight modules:
  1) Market operators
  2) Design management
  3) Collaborative design management
  4) Project management
  5) Working management
  6) Human resource management
  7) Quality technology management
  8) Document management

- **Quan Cheng I-OA**
  There are 10 functional modules which have been developed by Quan Cheng I-OA in an all-purpose manner:
  1) Work platform
  2) Personal work
  3) Project workflow
  4) Share information
  5) Administration
  6) Client management
  7) Knowledge base
  8) Workflow management
  9) Budget
  10) System setting

### 8.3.2.3 Cost
All quote price is specifically offered by software companies for Tianye office. Due to the reason that the development on the OAS for Tianye office was being suspended, the quote price from each software company is still staying in the first-round status. “Share point suite” and “Integrated management system for design institute” need extra Hardware improvement. The cost for this part is showing as follows:

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Price (CNY)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Processor E5520 (2 unit) Price</td>
<td>¥38,640</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HDD HP 300GB 10K 6G 2.5 SAS DP HDD (11 unit)</td>
<td>¥38,940</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Driver HP 460W HE 12V Hotplg AC Pwr Supply Kit (1 unit)</td>
<td>¥1140</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total price</td>
<td>¥78,720</td>
<td></td>
</tr>
</tbody>
</table>
Share point suite

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Price (CNY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Service on developing specific Share-point system (period : 4 months)</td>
<td>¥240,000</td>
</tr>
<tr>
<td></td>
<td>Developing phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Introductory phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testing phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Field trial phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training phase</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Technical maintenance (Free for first year)</td>
<td>¥0</td>
</tr>
<tr>
<td>3</td>
<td>Share Point Svr 2010 (Software cost)</td>
<td>¥45,000</td>
</tr>
<tr>
<td>4</td>
<td>SQL Svr Std 2008 R2 (Software cost)</td>
<td>¥29,990</td>
</tr>
<tr>
<td>5</td>
<td>Win Svr Std 2008 R2 (Software cost)</td>
<td>¥6,550</td>
</tr>
<tr>
<td></td>
<td>Total price</td>
<td>¥321,540</td>
</tr>
</tbody>
</table>

ZOHO Work Online suite
ZOHO Shanghai office separated the quote price into two parts, one is the modules that Tianye office shall rent; the other is the service that they are about to offer.

1) Part of renting Product modules

<table>
<thead>
<tr>
<th>Product (Module)</th>
<th>User</th>
<th>Unit price</th>
<th>Sum (RMB)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>BaiHui Office Portal</td>
<td>5</td>
<td>¥299 1user / year</td>
<td>¥4,485</td>
<td>For Director, vice director and HR department</td>
</tr>
<tr>
<td>BaiHui CRM</td>
<td>5</td>
<td>¥7,500 1user / year</td>
<td>¥22,500</td>
<td>For Director, vice director and marketing department</td>
</tr>
<tr>
<td>BaiHui Creator</td>
<td></td>
<td>¥9,720 35user / year</td>
<td>¥29,160</td>
<td>For chief architect and all design departments</td>
</tr>
<tr>
<td>Lump sum</td>
<td></td>
<td></td>
<td>¥56,145</td>
<td></td>
</tr>
</tbody>
</table>
2) Part of Service program

<table>
<thead>
<tr>
<th>Service program</th>
<th>Time(hours)</th>
<th>Sum (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Requirement research</td>
<td>24</td>
<td>37,500</td>
</tr>
<tr>
<td>2. Data processing</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3. Creator modules development</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>4. Data import</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5. System assembling</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>6. Staff training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The key user training</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>8. System administrator training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. System trials then Q &amp; A</td>
<td>Free</td>
<td></td>
</tr>
</tbody>
</table>

3) Total cost

<table>
<thead>
<tr>
<th>Total price</th>
<th>Product Programme (Order1)</th>
<th>¥50,530/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>service programme (order2)</td>
<td>¥37,500/year</td>
</tr>
<tr>
<td></td>
<td>Lump sum</td>
<td>¥88,030/year</td>
</tr>
</tbody>
</table>

- Integrated management system for design institute

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Price (CNY)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Human Resource Management</td>
<td>¥20,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Office Automation Management (OA)</td>
<td>¥30,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Marketing Management</td>
<td>¥20,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Design Project Management</td>
<td>¥80,000</td>
<td>Authorization for extra user: ¥220 / year per user for free upgrade and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>maintenance services</td>
</tr>
<tr>
<td>5</td>
<td>Data Archives</td>
<td>¥20,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Extra customization service</td>
<td>¥50,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>System assembling and training</td>
<td>Free</td>
<td></td>
</tr>
</tbody>
</table>
### Quan Cheng I-OA

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Price (CNY)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Requirement research</td>
<td>¥10,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Customization services (based on current standardized functional modules)</td>
<td>¥20,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Full integration of functional components embedded systems, which could support mobile, Unicom, Telecom SMS</td>
<td>¥2600</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&quot;QUANCHENG I-OA&quot; / 30 user within one year</td>
<td>¥4800</td>
<td>Authorization for extra user: ¥220 yuan / year per user for free upgrade and maintenance services</td>
</tr>
<tr>
<td>5</td>
<td>User training</td>
<td>Free</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Statistical analysis of data</td>
<td>¥8600 / set</td>
<td></td>
</tr>
</tbody>
</table>

**Total price** for First year **¥67,300**

**Maintenance and upgrade price for the second year costs** **¥1200**

### User interface and usability

1. **Share point suite**
   1) Information communication aspect:
   Share point is designed based on Microsoft Office SharePoint Server. It also provides personalized portal and team portal. Basic modules comprise custom layout, appearance, content, updated news, information, tasks and schedule etc.
   2) Data archiving aspect:
   According to Tianye’s project documents archiving regulations, share point provides documents management module and advanced search function (more search operations to select multiple conditions). Hot Top (most Hot Documents TOP10) and the user contribution (knowledge sharing reward certificate) are some additional tools for documents review.
   3) Administrative aspects:
   Although there is no existing HR or PA... modules providing by share point, the technicians from Microsoft cooperation proclaimed that relevant modules existing in current market could be easily embedded within share point system.
   4) Project management aspects:
   Regarding design workflow, Share point system is easy to realize a step-by-step and process-controlled workflow.

2. **Integrated management system for design institute**
This system is developed based on SOA (service-oriented architecture) structure. JINHUI offers various plug-in components that may easily reorganized and unified to a target system. However, all those components developed are accustomed to big-sized design institute, namely they need to be redesigned before running in the small offices—like Tianye Shanghai office.

● Quan Cheng I-OA
1) Communication aspect:
Besides operating internal OA system within TianYe office, QuanCheng will build a portal site which has certain links with the OA system and helps to have a better external communication channel with either client or government officials.

2) Data archiving aspect:
Following TianYe's archive and backup system, QuanCheng will establish a digital data-base and unify standard for the flow of archive and backup.

3) Administrative aspect:
Based on TianYe's demand on HR and PA, QuanCheng will refine certain existing modules and design an interconnecting with the portal.

4) Project management:
Through "QC-form" smart tool, QuanCheng offers a flexible and visional DIY (Do It Yourself) method on coping with dynamic changing workflow. Furthermore, this system combines Calendar and Instant messenger. It helps to build a clear information platform and timely transfer right information to right people.

5) Data Analysis:
QuanCheng helps to establish a logical data analysis system. Manager may check relevant statistical analysis hence to make a better decision.

● ZOHO Work Online suite
1) Communication aspect:
ZOHO offers a sample portal for each user. User may take it as a start point to establish their own website. However, associability of some data shall be redesigned by background compiling.

2) Data archiving aspect:
ZOHO offers internal data storage server and an FTP connection so that Tianye's employees may quickly open and save their digital work documents.

3) Administrative aspect:
ZOHO office modules, provide a commonly used basic function for small office. It's worth to mention that ZOHO has already developed a very matured HR modules. And ZOHO can revise the calculation rules of employees' salary system to meet Tianye’s requirement.
4) Project management: “ZOHO Creator” could be used for the entire project process management; ZOHO technicians will support Tianye to compile relevant modules. Regarding design workflow, Share point system is easy to realize a step-by-step and process-controlled workflow.

8.3.2.5 Flexibility

● Share point suite
Using relevant Micro-software, (such as: InfoPath and SharePoint Designer...) for SharePoint customization. Microsoft SharePoint Designer 2010 and InfoPath enables user to easily customize SharePoint list, view and workflow. On top of that, SharePoint Designer enables user to create and refine their portal.

● ZOHO Work Online suite
ZOHO creator module provides flexibility on strong self-editing function. System can be self-customized by users according to their latest demands. ZOHO offers training course to client.

● Integrated management system for design institute
Plug-in components are easily arranged, maintained and made a functional extension. While change one of those components, TianYe's people may still use other functional modules. However, all those changes have to be done by professionals from JINHUI office.

● Quan Cheng I-OA
QuanCheng offers “QC-form” smart tool. It is a work flow editing technology, which is based on the design of user-defined forms; it provides a better extensibility on project management.

8.3.2.6 Summary

✧ Requirements for hardware and other software systems
Comparing the four OAS packages, the Share point suite and Integrated management system for design institute demand almost equal on the hardware aspect. The Share point suite also demands the most on the software aspects. ZOHO Work On-line suite and the Quan Cheng I-OA demand the least on both aspects. In order to speed up the data storage and retrieval, both ZOHO Work On-line suite and Quan Cheng I-OA suggest setting up a specific local data server for dealing with the daily work on graphic images.

✧ Features and functionalities
Only the Integrated management system for design institute is specifically designed for the project management of an architectural design office, the others need secondary developments. However, as it is developed for the big-sized design institute rather than for the small offices, whether it meets the specific requirements of a specific small architectural design office is still need to be investigated.

✧ Costs
According to the comparison, Share point suite and the Integrated management system for design institute are kind of disposable investment style—needs a big investment at the beginning, while the others are renting style—a small amount of money paid at the beginning may get the OAS run and keep
updating by instant online service. According to the data listed above, if a small office, like Tianye shanghai office, adopts the renting style, it needs around 4-6 years to reach the amount of the cost of the disposable style.

✧ User interface and usability
On the condition of following the specific system requirements, all of the four OAS packages show well-performed user interface and usability. Among them the Integrated management system for design institute shows the fastest execution speed for the work of dealing with graphic images.

✧ Flexibility
Both of them emphasize on the aspect of flexibility. Through different approaches offered by each of them, the flexibility of adapting changes for future demand is easy to realize. According to my personal understand, the Integrated management system for design institute tends to be more difficult to implement, as the improved changes on current software can only be carried by JIN HUI software company rather than by users. For the other three packages, to a certain extent, users can reprogram the current software by mastering the usage of tools provided by each of them,
9. Literature references


[7]. AIA: The Architect’s Handbook of Professional Practice, the fourteenth edition


Internet:
- AIA (American Institute of Architects)
  http://www.aia.org/
- SSADM (Structured Systems Analysis and Design Method)
  http://www.comp.glam.ac.uk/pages/staff/tdhutchings/chapter4.html
- Managing Barriers to Business Reengineering Success
  http://www.prosci.com/w_5.htm
- BPMN (Business Process Modeling Notation)
  http://www.bpmn.org/
- IPMA (International Project Management Association)
  http://ipma.ch/resources/
- PMI (Project Management Institute)
  http://www.pmi.org/
- DQI (Design Quality Indicator)
  http://www.dqi.org.uk/
- ISO (International Organization for Standardization)
  http://www.iso.org/iso/iso_9001_2008
- DFD (Data Flow Diagram)
3TU.School for Technological Design, Stan Ackermans Institute offers two-year postgraduate technological designer programmes. This institute is a joint initiative of the three technological universities of the Netherlands: Delft University of Technology, Eindhoven University of Technology and University of Twente. For more information please visit: www.3tu.nl/sai.