# Design for Six Sigma (DFSS) in Software Architectural Design for Small and Medium Enterprises (SMEs) in Thailand

**Anantakul Intarapadung**

*Project Office for Consortium on Doctor of Philosophy Programs, Phranakhon Rajabhat University*
*3 Jangwattana Rd, Bangkhen Bangkok 10220, Thailand*
anantakul@hotmail.com

**Prasong Praneetpolgrang**

*Master of Science Program in Information Technology Graduate School, Sripatum University*
*61 Phaholyothin Rd, Jatujak Bangkok 10900 Thailand*
prasong.pr@spu.ac.th

**Adisak Japurapiree**

*Project Office for Consortium on Doctor of Philosophy Program,Phranakhon Rajabhat University*
*3 Jangwattana Rd, Bangkhen Bangkok 10220, Thailand*
adisak_ja@hotmail.com

## *Abstract*

*This paper describes the design process using Six Sigma for software architectural design and development of web-based computer aided design (CAD) for collaborative design production. Most CAD that is developed from the software industry is not usable because the software can not support the real requirements of the user especially, SMEs users. Thus, design for six sigma (DFSS) can help in capture user requirements before the construction of a framework for design and development of software for Thai SMEs.*

*We present the new methodology for design and development of web-based CAD using quality function deployment (QFD) for determination of SMEs user requirement. We use object-oriented technology for analysis requirement, design and programming. The system architecture is based on the computer support cooperative work (CSCW) model. Using human computer interface (HCI) techniques for development, the user interface system can provide the users with user friendly environment. We incorporate the concept of multi-agent (MA) system that can help in solving conflicts working together with collaborative design. An important factor for successful SMEs is to produce products that can be globally competitive.*

*Our CAD software will be able to meet the specific needs of Thai SMEs which making this software a valuable and accessible tool for the industry.*

**Keywords:** Design for Six Sigma, Computer Aided Design, Computer Support Cooperative Work, Quality Function Deployment.

## 1. Introduction

Presently, most CAD software does not satisfy the user's needs because of the development process, they don't take the exactly user's needs into consideration [1]. We plan to design and develop a web-based CAD system that can support collaborative working. Web-based CAD system provides the designer with the ability to design a product collaboratively with a variety of designers utilizing environment tools. This can use in different positions and roles in the work. The designer can discuss and arrange tasks, and accomplish the specific design task alone or jointly. When the designer works together with agents the process of collaborative work is completed.

In the development of web-based CAD, we utilize the 4 concepts such as (1) quality function deployment (QFD) in Six Sigma [2,3,4], (2) computer supporting cooperative work (CSCW) [5], (3) human-computer interaction (HCI) [6] and (4) multi-agent systems (MAS) [7]. The first step, we take voice of customer or user with QFD. Second, we determine collaborative design with CSCW. Third, a design process that couples the activities of the software architecture with HCI specialists. The process of HCI is determined in 2 steps such as (1)the task of human-computer interaction specialists and culminates in the creation of a prototype of the system. This step is generally achieved via a cyclic process (i.e. a series of prototypes is developed before the final prototype is arrived at). (2) the task of the software engineers, is to build the prototyped system. The last step, we use multi-agent systems (MAS) that can manage work in collaborative design. It is a system composed of several agents, collectively capable of reaching goals that are difficult to achieve by an individual agent or monolithic system. The exact nature of the agents is a matter of some controversy. They are sometimes claimed to be autonomous. Agent is one of the thematic roles: the participant of a situation that carries out an action. A designer, who is authorized to act on behalf of another designer to create a legal relationship with a third party.

For software engineering, once conceived of as a spiral model process, is now generally achieved through an iterative and incremental process. The software engineers create structural scenarios

represented by unified modeling language (UML) [8] which use case diagram, sequence diagrams and class diagram. In this paper, we present a design process software engineering of Web-based CAD. We first introduce a simple web-based CAD and show how we can develop it. The final sections, analyses the effectiveness of design artifacts and relates our work to previous work.

### 1.1 SMEs in Thailand

There is growing evidence that SMEs have become the life-blood of today's global economy. They are the fastest growing segment of major national economies. They provide the majority of new jobs. They are responsible for much of the creativity and innovation that fuel economic progress.

Consider the following facts in Thailand, 99.9 % of all enterprises are SMEs [9]. An important factor for successful SMEs is to produce products that are globally competitive. In order to gain competitive advantage for SMEs, they must produce many types of quality products. Both high quality and innovation are important factors that are used in the production process. Thai SMEs have to maintain their competitive edges in the current global market.

### 1.2 Thai Ceramic Factories

In the year 2002, Thai government permitted 813 ceramic factories in Thailand to operate with 47,050 employees and 13,653.2 million baht annual income [9]. The ceramic factories are distributed in all areas of the country as shown in Figure 1. In the north, there are 343 factories, in the central area has 391 factories, and in the northeast has 22 factories. There are 30 factories in the east and the south with 27 factories. Ceramic factories can collaboratively design their products using web-based CAD.

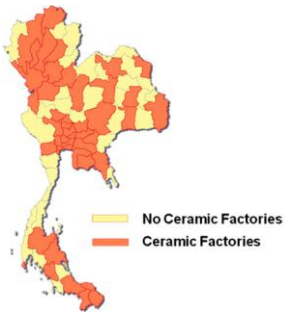


**Figure 1.** Ceramic Factories in Thailand.

### 1.3 Thai Ceramic Design

There are three types of ceramic design as shown in Figure 2. They are natural design, geometrical design and free form design. In Figure 3 has shown some geometrical designs.

**Figure 2.** Ceramic Products.

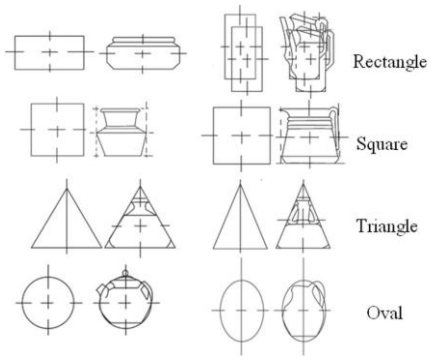


**Figure 3.** Geometrical Design.

## 2. Six Sigma

Six Sigma is one of the most popular quality methods lately. It is the rating that signifies "best in class," with only 3.4 defects per million units or operations (DPMO). Its concept works and results in remarkable and tangible quality improvements when implemented wisely. Today, Six Sigma processes are being executed in a vast array of organizations and in a wide variety of functions.

Six Sigma is more than statistics, while its objectives are to reduce variation and prevent defects; it has also become a management philosophy that includes in its credo the need for fact-based decisions, customer focus, and teamwork [1].

Six Sigma is considered one of the most popular quality methodologies. This paper use Six Sigma for development web-based CAD.

### 2.1 Six Sigma and Spiral Development

Both Six Sigma and spiral development have as one of their fundamental beliefs that improvement is continuous. Once a cycle is complete, whether it is DMAIC (Define, Measure, Analysis, Improve and Control) or analysis, design, construction, testing, and implementation, it begins again as shown in Figure 4.

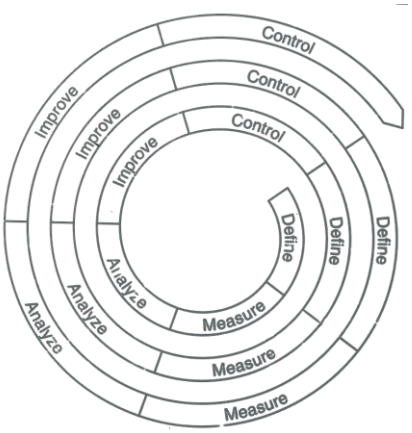


**Figure 4.** Continuous Improvement with Six Sigma.

## 3. Related Work

Tsung - Ling Chang [10] had two research objectives**.** The perception of Six Sigma to identify the critical success factors of a quality system in a small business environment. To develop a framework for small businesses to adopt Six Sigma into their quality system. Their research found 10 critical factors to manage a quality system in a small business environment and identified the applicable framework for Six Sigma implementation.

Peng Song, Min Tang and Jinxiang Dong [11], presented a collaborative model to support their concurrent work and their research found how to construct the web-based CAD system using Web technology. There are three layers in their collaborative design system: client layer, transaction layer and data layer. Two modes for collaborative design are check-in-check-out and direct mode.

Rolando Menchaca, Rolando Quintero, Leandro Balladares and Chadwick Carreto[12] described a set of tools, based on software engineering, HCI techniques and Java technologies, to support the software development process of 3D Web-based collaborative virtual worlds (CVW) populated by non-autonomous interactive entities. Their research found that CVW conceptual model must be extended in order to support autonomous entities (agents). All the collaborations are carried out when the entities are near to each other. All the individuals have the same navigation capacities, that is, they can walk (forward, back, right, left, etc.) in the world.

## 4. Research Methodology

### 4.1 System Architectures for Collaborative Design

Computer Supported Cooperative Work (CSCW) is concerned with the ways in which people work together and with the way in which computer system can be designed to support the collaborative aspects work.

The design of web-based CAD, provides the designer the ability to develop the product together in real-time, but not necessary the same places. In the design process, advanced internet technology of sharing data can be accomplished utilizing client-server architectures. As shown in Figure 5, there are three layers in our collaborative design system: client layer, transaction layer and data layer.

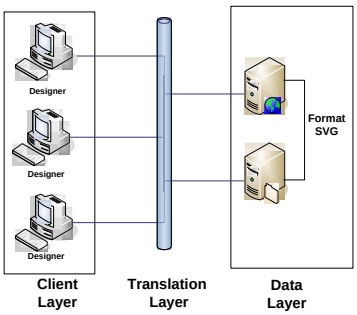


**Figure 5.** The three layers architecture of system design.

(1) Client Layer

The client layer is a set of Java applets, that can be easily downloaded from the server with a web browser and its function is to manage the interaction with the end users.

(2) Transaction Layer

The transaction layer is the center of the whole design system. It is composed of lots of modules about java socket. All the sub-modules in the transaction layer are represented in an object-oriented way.

(3) Data Layer

The data layer is stored CAD Model data format followed by AutoCAD Object ARX 2006 SDK format.

This system architecture for collaborative design enables the designers to access the web-based CAD using a web browser. The browser accesses a server and obtains the collaborative design as shown in Figure 6.

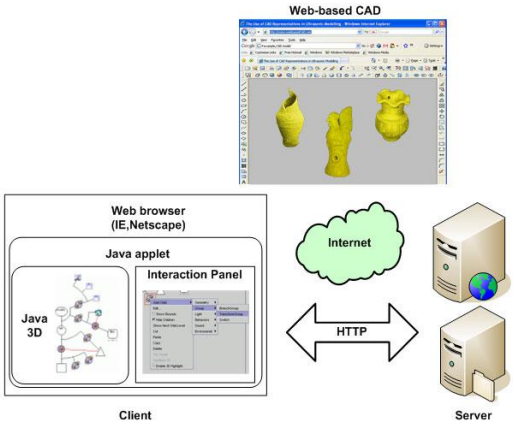


**Figure 6.** The collaborative architecture design.

### 4.2 Software Development Life Cycle

In this research, software development life cycle is used in four stages of developing web-based CAD as shown in Figure 7. This covers the life cycle phases from problem formulation through requirements analysis, design and implementation. There are the followings:

(1) Determination of the requirement. This stage uses the quality function deployment (QFD).

(2) Analysis. This stage focuses on the understanding of the client-server model and designer problems with Use Case Diagram.

(3) Design. The system is organized into subsystems; and objects grouped into tasks with Class Diagram.

(4) Implementation. In this phase, all the specific functionality of the web-based CAD must be implemented (codified) according to the analysis descriptions and the designs obtained in the previous phases.

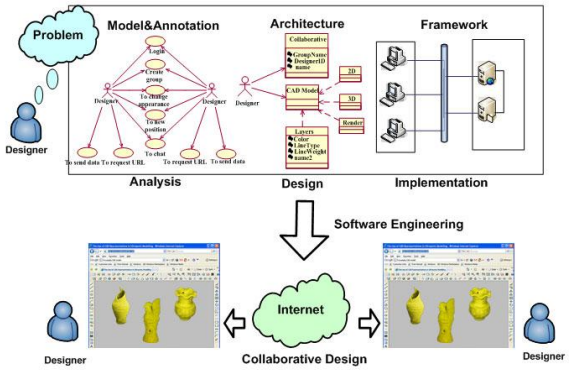


**Figure 7.** Web-based CAD development process.

#### 4.2.1 Design for Six Sigma in Software for SMEs

Design for Six Sigma (DFSS) is a process for translating prioritized user needs into critical parameters for the web-based CAD. DFSS is all about preventing problems and doing the right things at the right time during software development. The detail is as shown in Figure 8.

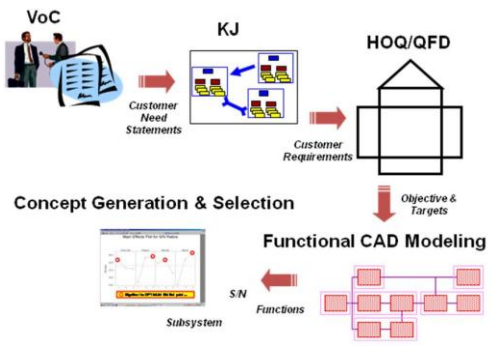


**Figure 8.** DFSS for software development.

In Figure 8, Voice of Customer (VOC) is at the heart of DFSS. *VOC* is gathered by interviewing customers to gather their opinions and needs, and observing product usage in their environment. KJ methods by Jiro Kawakita, a Japanese anthropologist devised these methods to conduct language processing. There are three major steps in the methods of KJ: Image KJ Analysis, Translate Images & Voices into Requirements and Requirements KJ Analysis.

#### 4.2.1.1 Voice of Customer (VOC)

To begin this process, first select the customer to interview. Interview customers asking who, what and where about web-based CAD requirements.

#### 4.2.1.2 KJ Analysis

Use KJ Analysis to translate customer voices into needs, rank & prioritize customer needs, and validate & prioritize needs with the customers.

In this research, we name the customers as SMEs users. Also, we demonstrate the DFSS flow chart as in Figure 9.

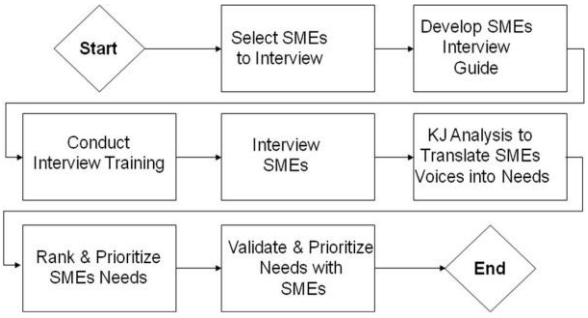


**Figure 9.** DFSS Flow Chart.

Based on KJ Analysis, we select SMEs users to interview at Siam Celadon ceramic factory in Chaengmai, Thailand. The detail is shown in Table 1.

**Table 1**. Translation Worksheet

| **Translation Worksheet** | **Number** ***001*** <br> **Name** ***SIAM CELADON*** |
|---|---|
| **Customer Voice:** <br> It would be nice to be able to design a product together with the customer. <br> Without customer design input, a product is produced without customer satisfaction. This results in re-design work, increase in production time and decrease in customer satisfaction. | |
| **Any KJ Images:** <br> Web-based CAD for designing products collaboratively | |
| **Key Items:** | **Customer Requirement(s)/Needs(s):** |
| - Web-based <br> - Chat <br> - Web-based CAD | - Designer can design products from web. <br> - Designer can communicate with the customer and satisfy their needs. <br> - Designer and customer can design their products collaboratively. |

#### 4.2.1.3 Quality Function Deployment (QFD)

Quality function deployment (QFD)[14] refers to both (1) determination of what will satisfy the user and (2) translation of user desire into the target design. The QFD concept is applied to web-based CAD in order to capture user requirement as shown in Figure 10.

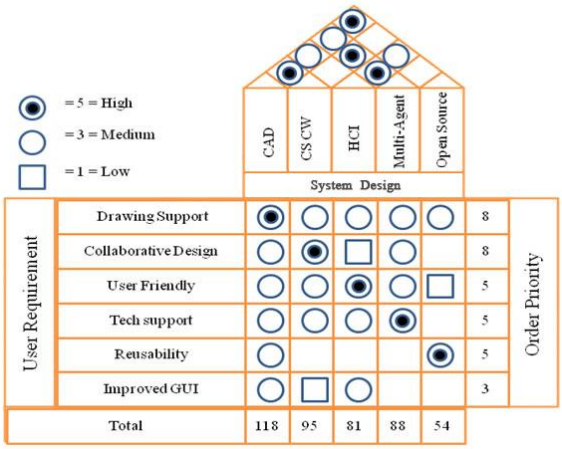


**Figure 10.** Quality Function Deployment.

### 4.3 Use Case Diagram

In this phase, we use analysis techniques and UML tools. A use-case diagram shows a number of external actors and their connection use case the web-based system. We represent the functionalities of our web-based CAD and the actors in the use case diagram are shown in Figure 11.

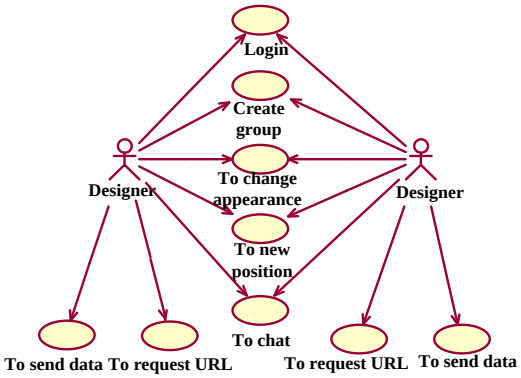


**Figure 11.** Use Case Diagram of web-based CAD.

### 4.4 Class Diagram

A class diagram is a model type, specifically a static model type, which describes the static view of web-based CAD system. The web-based CAD architecture is used in the design process. We update the scheme with the class diagram. We present the diagrams of classes for the collaborative design components as shown in Figure 12.

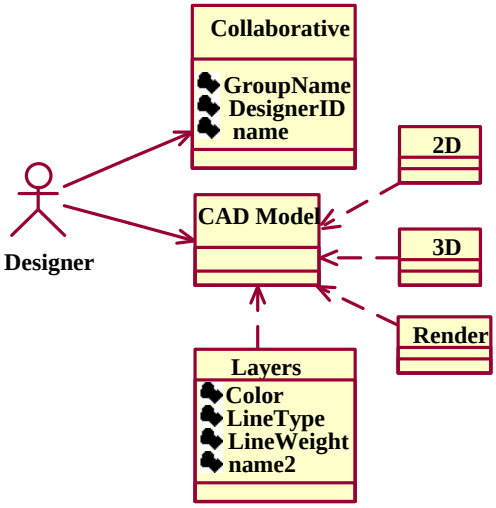


**Figure 12.** Class diagram of web-based CAD.

### 4.5 Implementation

For web-based technology, we use client-server architecture to receive and send data with hypertext transfer protocol (http). For computer language that runs on client/server, we use java applet. Life cycle of web-based CAD is shown in Figure 13.

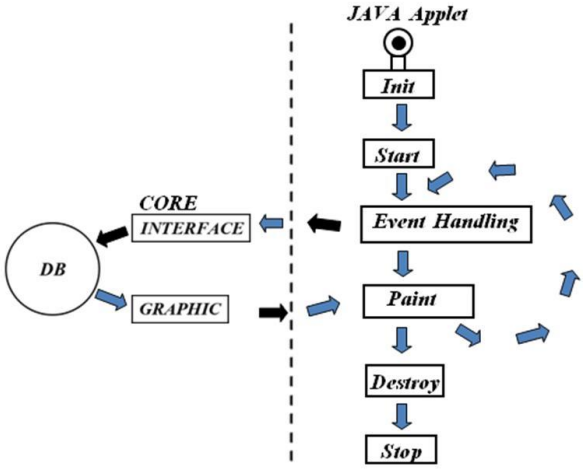


**Figure 13.** Communication between Java Applets with Core Program.

#### 4.5.1 Java Applet

A Java applet is an applet delivered in the form of Java byte code. Java applets can run in a Web browser using a java virtual machine (JVM), or in Sun's Applet Viewer, a standalone tool for testing applets. Java applets are usually written in the Java programming language but they can also be written in other languages that compile to Java byte code such as Jython. Applets are used to provide interactive features to web applications that cannot be provided by HTML. Since Java's byte code is platform independent, Java applets can be executed by browsers for many platforms, including Windows, Unix, Mac OS and Linux. There are open source

tools like applet2app which can be used to convert an applet to a standalone Java application/Windows executable/Linux executable. This has the advantage of running a Java applet in offline mode without the need for internet browser software.

### 4.5.2 Java TCP/UDP Socket Applet

The applets allows us to select the type of communication protocol that we wish to use, TCP or UDP. Transmission control protocol (TCP) is a connection oriented protocol that first establishes a connection to the remote server, to form what is known as a "Virtual Circuit". The circuit is removed when communication has finished, the setting up and bringing down of the connection involves additional message passing overhead, but once connected a reliable stream of data can be transferred. User datagram protocol (UDP) sends out a packet of information (datagram) and relies on the communication provider or network to deliver the message. An analogy can be made to the postal service. This method incurs less overhead but packet delivered is considered unreliable and NOT guaranteed. The services accessed are provided by server applications written in java applet using sockets.

A socket is a software abstraction for an input or output medium of communication. So a socket is a communication channel that enables us to transfer data through a certain port and communication taking place through multiple sockets on a port. This paper used Java socket applet for support collaborative design.

## 4.6 Storing CAD Model into AutoCAD

CAD model is stored using AutoCAD in the Drawing Interchange Format (DXF). DXF consists of 7 sections: header, tables, blocks, classes, object, and entities. EOF is used at the end of the file. In example as shown in Figure 14, a drawing can be stored in DXF format as shown in Table 2.

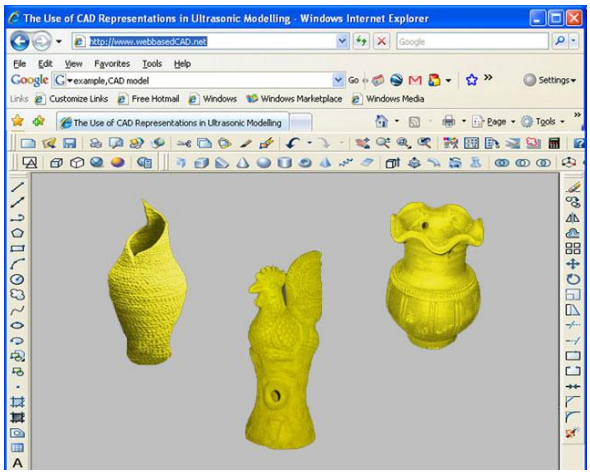


**Figure 14**. Ceramic production consists of a number of design elements.

**Table 2**. Partial DXF Format.

| |
|---|
| 0 |
| SECTION |
| 2 |
| HEADER |
| 9 |
| …… |
| CLASS |
| 1 |
| SOLID_BACKGROUND |
| 2 |
| …… |
| 3dView |
| 70 |
| … |
| Solid line |
| 72 |
| … |
| 0 |
| BLOCK_RECORD |
| 5 |
| 3B |
| 100 |
| AcDbSymbolTableRecord |
| 100 |
| … |
| ENDSEC |
| 0 |
| EOF |

### 4.6.1 Object ARX 2006 SDK Format

The Object ARX2006 SDK format is a tagged data representation of all the information contained in an AutoCAD drawing file. Tagged data means that each data element in the file is preceded by an integer number that is called a group code. A group code's value indicates what type of data element follows. This value also indicates the meaning of a data element for a given object (or record) type. Virtually all user-specified information in a drawing file can be represented in DXF format. As shown in Figure 15, create or editor component of entity, which must passing by DB factory. Block tables have role for collection entity only one. The tables section contains several tables, each of which can contain a variable number of entries. These codes are also used by AutoLISP and ObjectARX applications in entity definition lists.

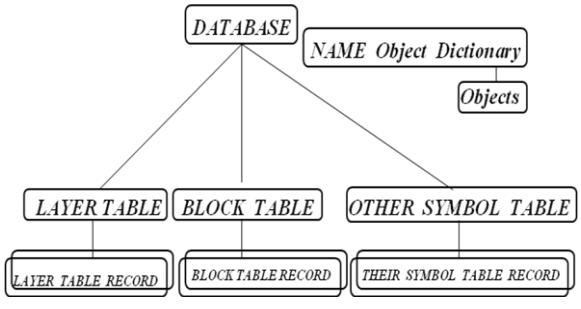


**Figure 15**. ObjectARX Developer's Guide**.**

### 4.6.2 Java Applet with Database Entity

Create class for entity informal by object-oriented programming (OOP) and use properties OOP in inheritance as shown in Table 2.

**Table 2.** AutoCAD ObjectARX 2006 inheritance

```
AcRxObject
|_AcDbObject
|_AcDbEntity
|_AcDbText
| |_AcDbAttribute
| |_AcDbAttributeDefinition
|
|_AcDbBlockBegin
|_AcDbBlockEnd
|_AcDbSequenceEnd
|_AcDbBlockReference
| |_AcDbMInsertBlock
|
|_AcDbVertex
| |_AcDb2dVertex
| |_AcDb3dPolylineVertex
| |_AcDbPolygonMeshVertex
| |_AcDbPolyFaceMeshVertex
| |_AcDbFaceRecord
|
|_AcDbCurve
| |_AcDb2dPolyline
| |_AcDb3dPolyline
| |_AcDbArc
| |_AcDbCircle
| |_AcDbLine
|
|_AcDbPoint
|_AcDbFace
|_AcDbPolyFaceMesh
|_AcDbPolygonMesh
|_AcDbTrace
|_AcDbSolid
|_AcDbShape
|_AcDbViewport
```

From the Table 2 ,we can write java applet as shown in Table 3.

**Table 3.** Java Inheritance

```
// java applet
// dbmain.h
public class ADESK_NO_VTABLE AcDbEntity extend
AcDbObject {
publicACDB_DECLARE_MEMBERS(AcDbEntity);
virtual ~AcDbEntity();
protected AcDbEntity();
}
class ADESK_NO_VTABLE AcRxObject {
public:
   virtual ~AcRxObject();
   static AcRxClass*  desc();
   static AcRxObject*   cast(const AcRxObject * inPtr);
   AcRxObject*  x(AcRxClass* protocolClass) const;
   AcRxObject* queryX(AcRxClass* protocolClass);
   virtual AcRxClass*       isA() const;
   virtual AcRxObject*      clone() const;
virtual protected:AcRxObject();
};
/*Performance note: it might not make sense to make
virtual method inline, but dtors are an exception to the
rule.  Derived objects dtors will call this dtor explicitly,
so inlining works.
*/
inline AcRxObject::~AcRxObject(){ }
```

## 5. Preliminary Results

Web-based CAD can be developed for Thai ceramic SMEs to reduce production cost, increase design, production capability and competiveness in the local and international market.

Web-based CAD using the computer support collaborative work (CSCW) model can support collaborative design by group designer.

New methodology for design and development of web-based CAD can use quality function deployment (QFD) for capture requirement for SMEs users and development.

All SMEs will be able to use this method to develop software and improve production by themselves. Some examples of Web-based CAD are shown in Figure 16 and Figure 17.

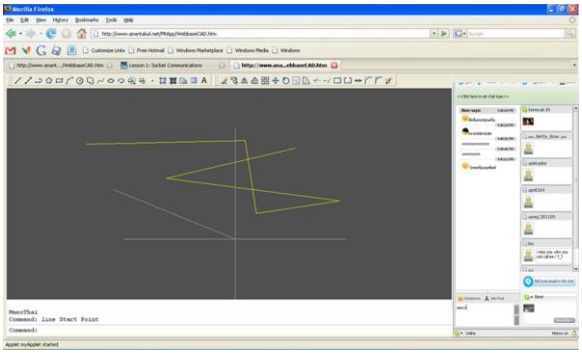

**Figure 16**. A web-based CAD feature.

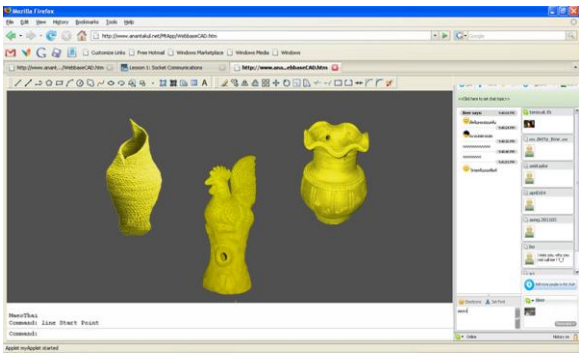

**Figure 17**. A web-based CAD for Thai SMEs.

## 6. Conclusion

Based on the determination of users, we decided to develop web-based CAD for Thai SMEs using the quality function deployment (QFD) of Six Sigma. Web-based CAD can be successfully developed to

support the user's needs in a user-friendly environment, easily accessed from the web and help to be globally competitive.

We aim to achieve a web-based CAD that can support collaborative design for ceramic factories as well as other SMEs. For our future work, we plan to develop java applets so that the designers can save the files and develop the data format into SVG format.

## 7. References


[1] Christine B.Tayntor, ***Six Sigma Software Development***, 2nd Edition, Auerbach Publication, 2007.

[2] M. Xie, T. N. Goh, and K. C. Tan, ***Advanced QFD Applications***, ASQ Quality Press, 2003.

[3] Jack B. ReVelle, John W. Moran, and Charles A. Cox, ***The QFD Handbook***, John Wiley & Sons Inc, 1998.

[4] John Terninko, ***Step-by-Step QFD: Customer-Driven Product Design***, Second Edition, CRC Press, 1997.

[5] Gangadhar Konduri and Anantha Chandrakasan, **"*A Framework for Collaborative and Distributed Web-based Design,*"** Proceedings of the 36th ACM/IEEE Conference on Design Automation (DAC '99), pp.898-903, 1999.

[6] A. Pirhonen, H. Isomaki, C. Roast and P. Saariluoma (Eds), **Future *Interaction Design***, Springer-Verlag London Limited, 2005.

[7] Yi-Sheng and Ren-Hou Li, ***"A Multi-Agent Based New Cooperation Method in CSCD,"*** The 8th International Conference on Computer Supported Cooperative Work in Design Proceedings, pp.241-243, 2004.

[8] Hans-Erix Erixsson and Magnus Penker, ***UML Toolkit***, Wiley Computer Publishing, 1998.

[9] Office of Small and Medium Enterprises Promotion (OSMEP) in Bangkok, Thailand, 2006.

[10] Tsung-Ling Chang, **"Six Sigma: A Framework for Small Medium-Size Enterprise to Achieve Total Quality,"** PhD dissertation, Cleveland State University, U.S.A., 2002.

[11] Peng Song, Min Tang and Jinxiang Dong, **"*Collaborative Model for Concurrent Product Design,*"** State Key Lab of CALMCG, AI Institute, Zhejiang University, Hangzhou, P.R. China, 2002.

[12] Rolando Menchaca, Rolando Quintero, Leandro Balladares and Chadwick Carreto, ***"Software Engineering, HCI Techniques and Java Technology Joined to Develop Web-Based 3DCollaborative Virtual Environments,"*** Proceedings of The 2005 Latin American Conference on Human-computer Interaction, 2005.

[13] Duska Rosenberg and Chris Hutchison, ***Design Issues in CSCW***, Springer-Verlay, 1994.

[14] Jay Heizer and Barry Render, ***Operation Management***, Pearson Prentiece Hall, 2004.

[15] Andrew Wallis, Zsolt Haag and Richard Foley, **"*A Multi-Agent Framework for Distributed Collaborative Design,*"** Enabling Technologies: Infrastructure for Collaborative Enterprises, Proceedings, 7th IEEE International Workshops (WET ICEapos'98), volume, Issue, 17-19 Jun 1998, pp: 282 – 287, 1998.

[16] Breyfogle. F.W., ***Implementing Six Sigma: Smater Solutions Using Statistical Methods,***Wiley-Interscience, 1999.

[17] Janus S. Liang and Pan Wen Wei,***"A Web-Based 3D Virtual Technology for Developing Product Information Framework,"*** The 8th International Conference on Computer Supported Cooperative Work in Design Proceedings, at the Cleveland State University, pp. 373-380, 2003.

[18] Wynne Hsu and Irene M Y Woon, ***"Current Research in the Concept Design of Mechanical Products, Computer-Aided Design,"*** Vol. 30, 377-389, 1998.

[19] S.R. God, A. Gupta, G.J.Kim, R.D. Sriram and A. Wong, ***"An object-oriented representation for Product and design process,"*** Computer-Aided Design Vol. 30, No. 7, 489-501, 1998.

[20] Francis L. Chan, Mark D. Spiller and A. Richard Newton, **"*WELD – An Environment for Web-Based Electronic Design,*"** Proceedings of the 35th Annual Conference on Design Automation, June 15-19, San Francisco, CA USA, pp. 146-151, 1998.

[21] Hemang Levana, Amit Khetawat, Franc Brglez, Krzyszto, Krzyszt of Kozminski, ***"Excutiveable Workflow: A Paradiam for Collaborative Design on Internet,"*** Proceedings of the 34th Annual Conference on Design Automation, 1997.

[22] Jansen B.,Vercalsteren A.Vito,**"*Eco-Kit: Web-based Eco Design Toolbox for SMEs,*"** The Flemish Institute for Technological Research, 2002.

[23] Marcello Dalpasso, Alessandro Bogliolo and Luca Benini, ***"Specification and Validation of Distributed IP-Based Designs with JavaCAD,"*** Proceedings of The Conference on Design Automation and Test in Europe (DATE '99),1999.

[24] Dahai Liu, ***" Web Design Using a Quality Function Deployment Methodology,"*** The Graduate College at the University of Nebraska, 2002.

[25] Zhiyong Chang, Rong Mo, Haicheng Yahg and Jie Zhao,***"A Hybrid Mode Collaborative Design System on the Internet,"*** The 8th International Conference on Computer Supported Cooperative Work in Design Proceedings, pp.267-270, 2003.

[26] Yi Yin, ***"Application of XML in Computer Supported Collaborative Design Systems,"*** Proceedings of The 5th ACM Workshop on Role-based Access Control (RBAC '00), pp.132-135, 2000.

[27] Yi-Sheng and Ren-Hou Li, **"*A Multi-Agent Based New Cooperation Method in CSCD,*"** The 8th International Conference on Computer Supported Cooperative Work in Design Proceedings, pp.241-243, 2004.

[28] Yanning Xu, Xiangxu Meng, Weiwei Liu and Hui Xiang, ***"A Collaborative Virtual Environment for Real Time Assembly Design,"*** The Proceedings of The 2006 ACM International Conference on Virtual Reality Continuum and ITs Applications VRCIA '06, pp. 373-376, 2006.

[29] Hemang Levana, Amit Khetawat, Franc Brglez, Krzyszto Kozminski, ***"Excutiveable Workflow: A Paradiam for Collaborative Design on Internet,"*** Proceedings of the 34th Annual Conference on Design Automation, 1997.