INTRODUCTION OF OVERSEAS TECHNICAL CENTER

Introduction of FUJITSU TEN SOLUTIONS PHILIPPINES, INC. (FTSP)

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Abstract

Fujitsu Ten Solutions Philippines, Inc. (FTSP) has made creative efforts in terms of process, organization, human resource development, etc., in order to overcome the problems in offshore development such as, language, culture and location. Fujitsu Ten Limited (FTL) has entrusted FTSP with the major design projects that enabled FTSP to expand its business from software development including embedded software, information systems, simulation tools, etc. to hardware design including audio and AV equipment. Thus, FTSP's contribution in the development of Fujitsu Ten's software and hardware products is expected to increase significantly. Also, FTSP conducts the suggestion-styled development, cooperating with Fujitsu Ten group of companies globally.

In 2007, FTSP achieved maturity Level 3 in CMMI[®] (*) that software companies in the world use as an indicator of development model with a goal of realization of higher quality. We introduce our efforts in this article.

(*CMMI is an abbreviation of Capability Maturity Model Integration, and is registered trademarks of Software Engineering Institute (SEI), Carnegie Mellon University.)

Introduction

1.1 Background of Establishment

Fujitsu Ten Solutions Philippines, Inc. (FTSP) was established in 1999 as the first offshore design company development in Fujitsu Ten group of companies, It started as a "software business project department" under Fujitsu Ten Corporation of the Philippines (FTCP) in 1998. The capital of FTSP is composed of 80% of Fujitsu Ten Limited (FTL) and 20% of FTCP, and its office is located in the center of the business area of Ortigas Center, Pasig City, Metro Manila.



Fig.1 Main Entrance Reception

2 Business Outline and Its Introduction

2.1 Business Outline

FTSP began with 32 employees who worked on the development of embedded software and simulation tools of automotive equipment including electronic control, audio and multimedia products. In 2004, we changed "Software" of the corporate name to "Solutions" predicting our business expansion in the future. In 2005, we moved in hardware development and design to combine with software development. This enables FTSP to do business in hardware design of electrical circuits, mechanical parts, etc. of audio-visual (AV) equipment.

In 2006, we started the information system development business. Since then, we have developed the business application software for the global system used in production sites of Fujitsu Ten group of companies.

As of April 2009, FTSP has 375 employees (including 10 Japanese employees) that comprise the development and management departments (refer to **Fig. 2**).



Fig.2 Organizational Structure of FTSP

In the Philippines, the management principles, which came from the combined efforts of labor and management keeps the balanced relationship between both parties. This setup enables the realization of business development and improvement of business quality and productivity. FTSP shows the results by setting up the Labor-Management Council (hereinafter referred to as LMC) and improving the labor environment with total cooperation between labor and management. In 2007, the Department of Trade and Industry of Philippines recognized the LMC's activities and gave FTSP the award of "Model Company" (six companies won the same award in Philippines) in the "category of labor-management cooperation." It is not an exaggeration to say that FTSP has become a leading company by this award. In 2008, FTSP also won the same award in the "category of CSR (Corporate Social Responsibility)."

2.2 Business Introduction

We introduce the business of each department.

2.2.1 Car Infotainment Department (CID)

The CID develops the embedded software for audiovisual (AV) equipment, and support tools and utilities for design efficiency and automatic testing of products.

AV Development Section mainly develops the embedded software for Original Equipment Manufacturer (OEM) and commercial car audio products under the ECLIPSE brand. The CID works on all software development of non-base audio products. From 2007, it has participated in the base software development.

Multimedia Development Section develops the software for screen display and operation, called HMI (<u>Human Machine Interface</u>) of audio equipment with display, sharing the development with FTL. Most of the development process ranging from creation/editing of screen and integration of screen transfer to actual operation verification is implemented by simulator established in PC. The software designed at each department is shared immediately, and its operation can be confirmed without actual equipment. Therefore, the problems in offshore development including the distance and time constraint can be overcome and the development cost is reduced.

Tool Section develops the tools to improve the design efficiency of car AV products. Since 2006, it has collaborated with in-house hardware design department and other subsidiaries of Fujitsu Ten.

Quality Support (QS) Section evaluates the software developed in the CID before its release to customers within Fujitsu Ten group of companies. In the evaluation, the basic software performance test of products is based on the specifications. The QS section applies the quality engineering principles such as Pairwise/Orthogonal Array testing, etc. to implement an efficient and effective evaluation method. In 2008, the section began the static verification (Source Code Inspection) of software developed in the CID and FTL. The section detects the critical defects of software and thus contributes to the improvement of the quality of Fujitsu Ten products.

2.2.2 Hardware Design Department (HDD)

The hardware design of car audio has a long history in the Philippines. In 1995, FTCP started the development of a cassette tuner for the Philippine market. After that, FTCP undertook the development of commercial products for places other than the Philippines and the development of OEM audio. In February 2005, hardware design in FTCP was transferred to FTSP to form the current HDD.

Currently, the HDD was commissioned by the engineering departments in FTL to develop the electrical and mechanical design of audio products. HDD focuses on the development of the non-base models, but also has systems to cover most of the development processes ranging from the conceptual design until mass production.

HDD aims in the future to be an independent design and development center in the ASEAN region. This includes the expansion of the number of development models and audio development that aims for the higher technological level that will become the platform for the "Global Development Expansion Program" of FTL. Therefore, the close cooperation among Fujitsu Ten group of companies within the ASEAN region is required. To start this activity, HDD actively pursues the establishment of the "ASEAN Technical Network System" and the "ASEAN Local Procurement Promotion System." In 2008, outside of the ASEAN region, HDD combined the Europe-specific technology of Fujitsu Ten (Europe) GmbH (FTEG) and the technology of mass production model of FTSP and achieved a new prototype development of audio module with the cooperation of both companies.

HDD also aggressively conducts early introduction of new system (CATIA of mechanical 3D-CAD, Mecia of electrical CAD, etc.) to improve its members' design development skills. HDD introduced "Mecia" to the mass production design on a trial basis earlier than FTL, cooperating with Information System Group of FTL. The usability of "simultaneous parallel design function" is Mecia's feature that was demonstrated by HDD. 2.2.3 Automotive Electronics Department (AED)

The AED develops the embedded software for automotive electronic control device of the powertrain and security control, and develops the development support tool including the parser, CAPAS, (Computer Aided Program Analysis System), simulator for system development evaluation, CRAMAS, (Computer Aided Multi Analysis System), etc.

In the embedded software development, the testing and design works are conducted. The testing accounts for 80% of the embedded software development. Errors must not be built into the design and at the same time the overlooked errors must be avoided in the testing. The AED sets the high goal of zero overlooked defects and makes efforts to ensure the quality.

For example, in the unit testing, AED verifies whether the required specification is satisfied or not by

executing all program in all modules. AED improved the systemization to analyze the control specification (logically break down to a minimum testing unit) and applies the testing method specified for each unit (prescribed test sequence including boundary-value inspection and condition estimation). In integration and system testing AED promotes the systemization using the same method with unit testing to obtain the stable quality that is not dependent on the skills of the person in charge of the testing.

Currently, the number of members in charge of unit testing of powertrain and security field is twice as many as that of FTL. This makes AED an indispensable partner for FTL. Also in 2008, AED began the unit and integration design in the powertrain field to expand its business.

In the field of development support tool, the AED has significantly contributed to the improvement of quality and productivity of embedded software by promoting the development of management database of CRAMAS, CAPAS, and mass production design information, and by expanding the range to support the mass production process.

Since 2007, the AED has expanded the process that the FTSP undertakes, and has developed new tools in cooperation with FTL, aiming for "centralization of tool development field" as a solution for reducing the tool development cost and ensuring the development personnel of FTL. Specifically, the AED conducts the spiral development, using SILS-related tool (Software In the Loop Simulation), M-CAPAS (static verification tool of model base development), etc. that would reform the mass production process, to extract the user's needs and verify them.

In the future, FTSP will educate analysts who can extract the user's requirements accurately to advance the further centralization of development, and will make efforts to contribute to FTL as a system integrator.

2.2.4 Information Systems Development (ISD)

In 1996 and still part of FTCP, ISD has developed and introduced business operation systems for overseas factories. Presently, in collaborative development with the Information System Group of FTL, it plays a vital role in introducing this system to factories in China (Tianjin and Wuxi), Thailand, and Mexico as well as in FTCP, in achieving the visualization and operational efficiency.

Also ISD strengthens the support after implementation of the system and promptly responds to the system troubles arising at overseas production factories and requests for improvement over the phone or by virtual network computing. For major upgrade of the system, the members of ISD go to the overseas production factories and give a thorough response ranging from introduction preparation to infrastructure set-up and establishment of operation. As for the functional improvement, the ISD reflects 500 cases of major/minor improvements per year, and improves the system to respond to user's requirements accurately and promptly.

The introduction of the high productivity development tool (MAGIC: MAGIC Software Enterprises), which realizes a statement-less environment by original framework, enables an extremely-small group (23 developers) in the development of a mission-critical system to carry out the development, upgrade the infrastructure, assist the introduction, and provide the support. On the quality side, compared with the previous year, the outflow of defects was reduced by 60% or more by process improvement and test process establishment that conform to CMMI® by which the CID and AED got certified in 2007.

Since October 2008, as a part of new business development, the ISD has undertaken the system improvement project of "APROS" that is PDM (<u>Product Data</u> <u>Management</u>) system of Fujitsu Ten used by the engineering design departments of FTL. In this project, ISD realizes the collaborative development with FTL by "sharing of program source between sites." Also in a FTL-led "next-generation mission-critical system concept," ISD is greatly expected to contribute to the overseas production system.

In the future, the ISD will positively acquire new technology including the data linkage between overseas subsidiaries to promote the information utilization in group view, and will continue to contribute to the information system development of Fujitsu Ten group of companies.

3 Efforts in Offshore Development

As the first company of offshore development in Fujitsu Ten group, FTSP greatly contributes not only to reduce the development cost but also to solve the shortage of development resources through the project development. In this article, we introduce how we have worked and developed human resources in offshore.

3.1 Philosophy of Quality Assurance and CMMI® Model

To succeed in an offshore development, visualization and standardization of the development process is important as well as provision of software with stable quality to the consigners. This leads to "own-process completion" that Fujitsu Ten group pursues.

In 2005, having a philosophy of "the quality of a system or product is built-in during its development process," we adopted CMMI® as a global standard and a yardstick among the leading software companies to evaluate the degree of attainment of our philosophy.

We promoted the activity thru <u>Software Engineering</u> <u>Process Group</u> (SEPG) that develops the process, and Software Quality Assurance (SQA) that monitors the compliance to the standard and audits the deliverable. This activity became prevalent in FTSP by providing CMMI[®] education for each level to make members conscious of the importance of the process, and by having project leaders or higher level people experience SQA for three months in quality assurance department to bridge As a result, we officially achieved maturity level 3 in CMMI[®] (standard process is defined and managed) in all software developments of the CID and AED in July 2007. In the automotive-related industries, there are few companies that have achieved the maturity level 3.

(Refer to the following website of SEI (<u>S</u>oftware <u>Engineering Institute.</u>) http://sas.sei.cmu.edu/parts.aspx)

The establishment of the standard process allows us to sample the data of process and quality data quantitatively. We control the process by using these data as a feedback in the project monitoring and process improvement. Specifically, we assess the correlation between review manhours and number of defects and use it in the quality gate pass before proceeding to the next process.

Although quality of software is being improved yearly to answer the expectation of FTL, it is necessary to reduce the volatility in quality, analyze the data statistically evaluate, the process, and improve the process maturity.

Also we pursue the creation of an organizational structure that allows predicting the quality of a project, and preventing and avoiding risks. These activities will lead to the achievement of CMMI[®] level 5 (state of quality is stable when process is optimized) in the near future.

In addition, we obtained the certification of ISO/TS16949:2002 in 2006, as a remote location of FTCP.

3.2 Development of Human Resources 3.2.1 SUMO Concept

Generally, Filipinos have a high motivation for selfrealization, so an enriching education system and clear career plan will keep and improve their motivation.

The basic idea of the human resources development in FTSP is "staff growth = company's target achievement," and to realize the early contribution to the company, thorough trainings are given to the employees as a business investment to improve their skills. We clearly demonstrate the medium/long-term career development plan to staff, using the skill matrix and training road map to promote the continuous career growth.

Aiming for SUMO (<u>Skill Up Management Oriented</u>), we pursue the educational system to develop with trinity (Fig. 3) of "total education (introducing technology), department education (supplementing technology), selflearning (sharing technology)." We coach subordinates using "handed-down education," focusing on in-house trainers to enhance and expand the training effectiveness. Simultaneously, this gives a chance to the trainers for self-fulfillment and leads to an enhanced training content and highly-motivated training.

As of the end of 2008, in-house training course includes 33 courses such as UML, C++, etc. with 40 registered trainers. In the future, we will enrich the educational curriculum focusing on the development of midlevel employees.



Fig.3 Educational Concept

3.2.2 Japanese Language Teaching and In-house Recognition System of Japanese Language

The importance of Japanese language is increasing with the business expansion of FTSP.

Previously, we gave education focusing on daily reading and writing to pass the Japanese language proficiency test (JLPT) that is used widely abroad. But now we shifted the main emphasis to "Japanese-language ability to be used in practical business" that focuses on the assumed scene and necessary terms in the operation with FTL, and established in-house Japanese language certification system. In Philippines, there is no leading Japanese software development company that has an original Japanese language certification system.

In 2007, we started the lessons based on our original FTSP training material, and we confirm the achievement level by the bi-annual certification examination. Moreover, based on the SUMO concept, the senior-level person makes use of his own experience to teach the beginner-level persons. In 2008, we introduced this Japanese language certification system in the new employee training, and set it as criteria for employment regularization. In job requirements, we defined the Japanese language level and clarified its importance.

As of 2008, 88 members (beginner), 16 members (basic), and 1 member (intermediate) were certified, and this comprises 31% of all designers.



In 2006, as an improvement activity for hardware design environment, we started to make efforts toward automation for design evaluation of audio products, capitalizing on FTSP's strengths that can realize the collaboration of hardware and software easily. First of all, we started the development project of a system to automatically evaluate the radio performance and sound characteristics (curve data) that are the basic functions of audio products. The HDD worked on the creation of specification and actual equipment verification of system, and the CID worked on the development of software to control the measuring equipment and applicable system. This led to the completion of basic system of APES within a period of one (1) year. Introduction of APES allowed the automation of items that have been measured manually, and improved efficiency by up to 70%. We have expanded the functions to achieve the complete automation to evaluate the design of audio products by 2011.

We started to propose this system as a solution for design efficiency not for cost reduction by offshore development to FUJITSU TEN RESEARCH&DEVELOP-MENT (Tianjin) LTD. (FTRT), and now this system is used in the design departments of FTL and design sites in FUJITSU TEN (THAILAND) COMPANY LIMITED (FTTL).

This proposal led to the discovery of needs for a tool to improve efficiency that each site required, and we obtained the business of development of the diagnosis record data acquisition analysis tool (D-TRACER) for audio equipment for 2009 model from FUJITSU TEN TECHNICAL CENTER, USA, INC. (FTTC).

In addition, the Field Audio System Test (FAST) tool has the function to record the measurement data of video and radio simultaneously so that the designers can evaluate the state of site easily even while they are at development workbench. Thus, FTSP's new business has been expanded by the proposal of solutions based on the independent development.

4.2 Strategic Audio Project for ASEAN

One of the significant results of FTSP in 2007 and 2008 was "strategic audio project for ASEAN" that was developed mainly by the HDD. In this project, we organized the project team consisting of the young engineers of electrical circuit design, mechanical design, and software design, regardless of their departments, and we completed the whole process ranging from development planning to design and prototype manufacturing in FTSP. Also we greatly contributed to the establishment of new networks, including the cooperation with Fujitsu Ten Group of companies in ASEAN region and with local suppliers for the local procurement of parts.

In this project, we carried out the planning with a concept of "low-cost and compact audio," looking years ahead and with out-of-the-box thinking. As a result, we developed "deck-less audio" that is equipped with the digital interface with the new music media such as USB (Universal Serial Bus) memory and SD (Secure Digital) card, thereby removing the CD deck mechanism.

This "deck-less audio" achieved the downsizing by 58% (volume) and 45% (weight) relative to the existing CD tuner, and also achieved the reduction of parts by 45% and of cost by 30%. This figures show the contribution to the environmental protection as well as to the company's profit.



Fig.5 Audio without Deck Mechanism

After we informed the overseas subsidiaries of Fujitsu Ten group as well as FTL about the achievement of "strategic audio project for ASEAN," we made a presentation as a concept model at an exhibition for customers held in ASEAN region and Australia in 2008 and we impressed our customers.

Now we continue the promotion to commercialize this "strategic audio project for ASEAN" so that it will not end up as just a concept model. Furthermore, we have launched an initiative of "next-generation strategic model" to continue our quest for new functions, technology, and market.

4.3 Efforts toward Test Driven Development

In the development of a design support tool of the AED, FTSP tries and verifies the latest programming method and software evaluation method. In 2008, the AED applied the <u>Test Driven Development</u> (hereinafter referred to as TDD), which recently attracted attention in the IT field to the actual project.

In the TDD, the designers create the test case and then implement the code to pass the test. Repetition of this procedure completes the program, so it is called "test driven development." Like DRBFM (Design Review Based on Failure Mode), the TDD is a method to improve the efficiency of development by extracting the unclear points of specifications or problems for design to reduce the setback in the development process.

As shown in **Fig. 6**, we combined the TDD with existing process and applied it to three projects in the development of mass production support tool.



Fig.6 Test Driven Development

As a result of this application, we reduced the manhour of code implementation by 10%, the man-hour of system inspection by 25%, and total man-hour by 20%. Also after we informed FTSP and FTL about this achievement, the introduction of the TDD is increasing as an effective development method.

5

Conclusion

We are aiming to be a company that can deliver high performance consistently and pursue the thorough quality and productivity by the business concept integrating with Fujitsu Ten group of companies. It may be said that "solution" is a "value," but just holding this solution in FTSP would not be valuable. The added value is increased and "value chain" is formed by proposing and sharing the solution with the Fujitsu Ten group of companies. Setting this as the business vision, FTSP will work toward the establishment of its position as a "global solution company" that is at the core of the "value chain."

Profiles of Writers



Akira IKEZOE

Entered the company in 1982. Since then, has engaged in the software development for powertrain control. Now President of FTSP, appointed in July 2005.



Rommel P. TUAZON Entered FTCP in 1998. Transferred to FTSP in 1999. Since then, has engaged in the software development for powertrain control. Currendly the Section Manager of the AED.





Hisashi FUJII

Entered the company in 1991. Since then, has engaged in the electrical circuit design and development of car audio. Assigned at FTCP in September 2004, and then transferred to FTSP. Currently the Department Manager of the HDD.

Philip S. TENORIO

Entered FTCP in 1998. Transferred to FTSP in 1999. Since then, has engaged in the software development for car audio development support tool. Currently the Section Manager of CID Tool Section.





Catalino GAYOSA III

Entered FTCP in 1997. Transferred to FTSP in 1999. Since then, has engaged in the software development of the development support tool for automotive multimedia product. Currently the Section Manager of Quality Assurance Section and the CID Quality Support Section.

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Entered FTSP in 2005. Since then, has engaged in the electrical circuit design and development of car audio. Currently assigned at HDD.

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