TOSHIBA REVIEW

2007. VOL.62 NO.9

Special Reports

Front-Loading Methods for Accelerating Technological Innovation

Aiming for Innovative Product Development and Manufacturing
YOSHIDA Nobuhiro

Front-Loading Method for Improving Design Process Capabilities
IKEDA Yoshio
With varied and customized needs governing the global market, the expected functions of individual appliances have become diversified, complex, and changeable. The speeding up of development and reduction of costs are therefore important issues along with acceleration of the technological innovations that realize these high-technology appliances.
Toshiba is promoting the innovation of development processes and its acceleration, adopting" front-loading" and" total optimization" as the mottos."Front-loading" refers not only to moving up the schedule or strengthening the upstream processes, but also to obtaining the synergistic effects produced when linking heterogeneous work elements in every corner of the manufacturing department together taking the life cycle of products into consideration, and applying them to the upstream processes of the overall manufacturing as well as to every upstream part of these processes.

Innovation of Design Process for Mechanical Control Systems of Medical Equipment
TANAKA Shigeru / ZAIKI Ryuji / KATO Akira
The importance of the control firmware installed in medical systems has increased to such a degree that its performance, quality, sophistication, and the efficiency of its development have a decisive impact on the value of the product.
As an approach to innovation of the design process for mechanical control systems of medical equipment, Toshiba Medical Systems Corporation has established a verification environment for mechanical control systems using a virtual mechanical simulator at each stage of specifications review, design, and testing. We have applied this system to diagnostic X-ray angiography systems and automated biochemical analyzers, and have obtained concrete results including shorter development periods, the verification of specifications and design at the first stage, and the achievement of verification not influenced by the technical level of the engineers.

Innovation of Firmware Design Process for Air Conditioners
KOIZUMI Tetsuya / KAMBE Takayuki / AKIYAMA Kazuhiko
Residential air conditioners are increasingly required to have value-added functions such as automatic air filter cleaning and air purification in addition to energy-saving performance in basic cooling and heating operations. In this situation, the improvement of product quality and shortening of the overall development time are also necessary for the firmware installed in air conditioners.
Toshiba Carrier Corporation is promoting innovation of the firmware design process for air conditioners. We have focused on the test process, which accounts for the major part of the development process, and have been developing a firmware simulator. This will realize front-loading of the firmware test process for air conditioners.

Hardware Platform Design for Mobile Phones
SHUNDO Kazuyoshi
The diversification of users' needs and increasingly advanced functionality due to the progress of mobile communications technologies have intensified the competitive environment of the cellular phone market. As a result, cellular phone companies have to release a greater variety of models in a more timely fashion than before.
Toshiba has been making efforts to realize a common platform for hardware structures in order to minimize development costs, while at the same time differentiating its cellular phone technologies. We have been focusing on the development of differentiation technologies as well as improvement of development efficiency or shortening of the development period. These targets can be attained through a design methodology that balances standardization by the use of a common structural platform and differentiation by the adoption of attractive design features.

R-CUBE: Toward a High-Level Design Methodology for Large-Scale SoCs
NISHIO Seiichi /AIHARA Masami / TANAKA Toshikazu
Toshiba is actively engaged in the R-CUBE project, the target of which is to dramatically improve the work efficiency of system on chip (SoC) development and reduce the time and human resources required by half through a paradigm shift from register transfer level (RTL)-based design to C language-based design.
We have already constructed a C language-based design methodology and applied it to actual SoC design. We have successfully developed C language-based models of a SoC for digital TVs and demonstrated a simulation speed 1,000 times faster than that of conventional RTL-based models. This has made it possible for SoC software designers to verify and debug their software before an engineering sample chip is fabricated. Consequently, the software verification period after completion of the sample chip has been reduced to one-third of the conventionally required period.

Performance Enhancement of Large-Scale Steam Turbines Using CFD
TANUMA Tadashi / SASAKI Takashi / NIIZEKI Yoshiki
Accelerating the speed of performance enhancement is critical to the competitive design of large-scale steam turbines for power generation.
Toshiba has successfully introduced computational fluid dynamics (CFD) into steam turbine design in order to optimize the design within the structural limitations. This approach is playing a key role in the creation of innovative designs for both stationary and rotating blades as well as other flow paths including steam valves, inlets, and outlets of high-pressure (HP), intermediate-pressure (IP), and low-pressure (LP) turbines.

Software Process and Product Technologies for Successful Solution Business
TAKEUCHI Mayumi / HIRAYAMA Hideaki / INOKI Mari
Successful solution business involves the analysis of various requirements and the provision of robust, secure, and easy-to-use software that helps the customer attain the desired business goal. Software process and product technologies are essential for the development of such software. The former type of technologies are used to analyze and design software optimally from the earlier phases of the development life-cycle so as to improve the quality of the software, while the latter type are used to develop software on the basis of reuse technologies.
Toshiba Solutions Corporation has been accelerating the implementation of a front-loading method, leading our solution business to success.

Innovation of Mechatronics Control Software Design Based on Simulation
MOTOHASHI Shoichi / SAKAI Hiroshi / YOSHIDA Mitsunobu
The control software for electromechanical products has become increasingly important, with its performance and quality greatly influencing the competitiveness of the product. It is therefore necessary to improve on the conventional development process by utilizing innovative simulation technologies at each stage from the specifications review to the implementation phase.
InterDesign Technologies, Inc., in cooperation with Toshiba, has developed a virtual mechatronics simulator for control software development. It has reached the practical stage and been applied to the development of various products. A method of control software development using the simulator is one of the key improvement techniques to realize front-loading of the process.

Innovation of Development Processes by New Management Innovation Method: DMADV
SHIRAI Koji / UEDA Yoshifumi / KAMIMURA Junichi
Toshiba group is currently actively promoting innovation activities. These activities are based on management innovation (MI) activities, which were initiated in 1998 but were found to be somewhat lacking for use in development and design sections.
We have newly introduced the" define, measure, analyze, design, validate" (DMADV) method, which promises to provide sufficient support to development and design sections. The deployment of DMADV started in 2006 at the corporate level.
The DMADV method is characterized by preventive measures to ensure that key parameters are not overlooked, so that no retrogression occurs in development and design work. This is assured by systematic extraction, selection, and optimization of the design parameters of the object of development. A number of projects have started to deploy the DMADV method with the aim of disseminating innovation throughout Toshiba group.

Application of Taguchi Quality Engineering for Acceleration of Innovation
OOUCHI Yoshiaki
Toshiba is strongly promoting innovation programs in the development and design sections of its group companies, which Toshiba Electronic Engineering Corporation is supporting with using the latest Taguchi quality engineering techniques. The most recent version of this quality engineering, the Mahalanobis-Taguchi (MT) system, gives effective support to every one of these programs to ensure a successful conclusion.
Taguchi quality engineering plays a leading role in accelerating innovation by means of (1) introduction of the robust design method into computer- aided engineering (CAE), (2) proactive use of the Taguchi method, and (3) introduction of robust design into the" define, measure, analyze, design, validate" (DMADV) method.

Development of Method for Practical Application of Model Checking
IKEDA Nobuyuki / IMAMURA Noriko / TAKADA Satoko
Guaranteeing the security of software is becoming increasingly important as the embedding of software in industrial infrastructure systems continues to expand. This has led to growing expectations on model checking technology as a means of solving this issue. However, there is a lack of sufficient documentation on the successful use of this technology in real cases. In addition, for the successful application of model checking technology, it must be integrated into current development processes, the appropriate training must be conducted, and schemes for its continued usage must be established.
In response to these requirements, Toshiba has combined several behavior models to reduce initial costs and formed a specialized modelchecking team to improve efficiency and accumulate know-how.

Design of Machine Sound Quality
OHTOMI Koichi / HOSAKA Rika / IWATA Yoshiyuki
Sounds from electric appliances, such as vacuum cleaners, copiers, and so on, cannot be disregarded in the development of quality products. It is not easy to obtain pleasant mechanical sounds, however, especially when electric appliances are designed according to the conventional trial-and-error method.
Toshiba has developed a strategic design methodology to obtain pleasant mechanical sounds, and applied it to actual products. This methodology incorporates two evaluation methods. One is a sensory evaluation method employing the semantic differential (SD) technique, which determines psychological metrics to measure the level of pleasant sound. The other is a physical evaluation method to which Zwicker's sound quality metrics analysis can be applied, which determines physical metrics to measure the level of pleasant sound. Zwicker's analysis determines four metrics of sound quality: loudness, sharpness, roughness, and fluctuation strength. Using these four metrics, physical metrics are statistically defined. Finally, pleasant sound has to be expressed in physical metrics so that mechanical engineers and designers can understand what to do, although pleasant sound is substantially expressed in psychological metrics. Translation work from psychological metrics to physical metrics is therefore required.

ARVE Aspect-Oriented Runtime Verification Environment
SHIN Hiromasa / ENDOH Yusuke / KATAOKA Yoshio
Toshiba has developed a software verification system called the aspect-oriented runtime verification environment (ARVE) to support runtime verification during software development. This system provides a scripting environment to automate observation and analysis tasks in runtime verification. By developing or reusing scripts for ARVE, users can effectively build a runtime verification system to meet their specific objectives.

Innovation in Product Development and CAE
YOSHIDA Hirotoshi / KONDO Yasumasa / YOSHIDA Yuichiro
The utilization of computer-aided engineering (CAE) at the first stage of product design contributes to improvement of product quality and shortening of the development period and costs, while also reducing the need for trial manufacturing and experimentation. As product development has become largely dependent on CAE, the quality of the CAE process has become increasingly significant.
The CAE department of the Toshiba Group has acquired ISO 9001 certification for the CAE process. We have been promoting communication between CAE users through regular meetings to disseminate CAE throughout the group. We are also making strong efforts to assist Toshiba engineers to use CAE at the early stage of product development.

Feature Articles

Ubiquitous Building Automation System
OKAMOTO Hirotaka
Toshiba has applied the ubiquitous concept—anytime, anywhere, for anyone—to the field of building automation. Our ubiquitous building automation system incorporates three technologies: (1) network technology using BACnet, an internationally standardized data communication protocol for building automation and control networks; (2) radio technology, permitting the free arrangement of apparatus; and (3) Web technology, for connection with the Internet or an intranet. These technologies realize a more useful system for facility management personnel as well as building tenants and residents.

TOS^3 ™ (TOS-Cube) Solution for Data Management System Integration in Thermal Power Stations
WATANABE Tsuneo / OTANI Keiko / ICHIKAWA Hiroyuki
Fuel consumption in the field of electric power generation is rising globally, particularly in China, resulting in the need for cost reductions in thermal power station operations. In addition, the integration of information management and sharing of information technology are becoming increasingly important in order to respond to environmental preservation, security, and legal compliance needs.

To meet these requirements, Toshiba has released TOS^3 ™ (TOS-Cube), a solution that integrates the data management system of a thermal power plant to support safe and reliable plant operations and to render technical analysis services.

System Development Method Based on EA and SOA
YOSHIDA Kazuki / TANAKA Seiichiro / UNE Yasuomi
Enterprise architecture (EA) is a method for restructuring business and information systems from the perspective of enterprise-level optimization. Service-oriented architecture (SOA) is a system architecture that makes information systems adaptable to changes in the business environment. In practical situations, the transition from an" as-is" model to a" to-be" model in EA tends to be executed gradually because of various business constraints. If SOA were applied to the development of systems that are going to be restructured, such a gradual transition could be executed more easily. However, a systematic methodology dealing with the development process, from making as-is/to-be models in EA to analysis and design activities based on SOA, has not previously been established.
Toshiba Solutions Corporation has developed an EA-SOA development method with the following two characteristics: (1) the work procedure is defined in detail in each phase of the development process, and (2) know-how is documented in numerous parts of the procedure. The application of this method allows the restructuring of business and information systems to be smoothly executed.

Frontiers of Research & Development

Magnetic Refrigeration Technique without Refrigerants Such As Chlorofl uorocarbons