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Vehicle CALS --A big challenge to virtual development

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Abstract

Japanese automobile manufacturers have maintained global competitiveness in the past by providing high quality, low cost vehicles. Recently, however, the strength of the yen and a recovering U.S. automobile industry has put the Japanese automobile export market in a precarious position.

Similarly, it is becoming apparent that, as information technology dramatically changes and advances, Japan lags behind in the field of key software and middle-ware technologies. In this environment, re-engineering of business processes in the automobile industry is becoming more important as a method to recover and maintain competitiveness in both the information and automobile industries as Japan moves towards the 21st century.

Consequently, the V-CALS consortium was established in May of this year by five major Japanese car manufactures, parts and die suppliers and other related companies. This enterprising project encompasses conformance testing to achieve virtual vehicle development while striving to merge competition with cooperation. This paper explains the aims of this consortium and gives an outline of the V-CALS project, focusing on the requirements for next-generation PDM, and trial use of STEP, EDI and SGML.

Keywords

Vehicle CALS, digital process, CAD/CAM, PDM, STEP, EDI, SGML

1 INTRODUCTION

Results for 1994 show that Japan's balance of trade in computer software was 259.5 billion yen (2.5 billion dollars) for imports and 13.5 billion for exports--a 19-fold deficit. Approximately three-quarters of the figure for software imports is represented by basic

J. Goossenaerts et al. (eds.), *Information Infrastructure Systems for Manufacturing*

software such as operating systems from the U.S. This is a strong indication that Japan's information industry is lagging behind the world market in general-purpose software. Similarly, there has been strong concern in recent years that the manufacturing industry in Japan is facing "de-industrialization." Specifically, if we look at the percentage of offshore production by the Japanese manufacturing industry in 1995, 80% of color televisions and 70% of VTRs were produced overseas. Predictions are now being made that, by the year 2000, 50% of Japanese vehicles will be produced in overseas countries.(1)

Considering this situation, we believe that it will become more and more difficult for the traditional stalwarts of Japanese economic growth--the information and manufacturing industries--to continue in their present condition to sustain the Japanese economy and employment levels into the 21st century. To avoid further decline in the Japanese information industry, multifaceted policies are required. However, the role of the automobile industry should be based in its technical strength. But we do not want to be just an idle onlooker; we should rise to the challenge from our position in the automobile industry and make all-out efforts in the closing years of this century.

2 WHY IMPORT PERCENTAGES FOR SOFTWARE ARE SO HIGH IN JAPAN

There are a number of reasons for this situation. The first being that most software up until now has been developed for just one company. Many years of low mobility in the Japanese corporate market, spurred on by life-time employment, has led to a different job structure being established in each company. Inevitably what then happens is that a company's information systems department, being well-versed in the internal workings of the company, comes to play the lead role in software development. The job structure itself becomes to represent a company's know-how and competitive strength. It is only natural then that software is created to meet these needs, however, this software ends up lacking versatility and general-purpose qualities.

The second reason is that it is no longer feasible for a company's information systems department to continue to develop advanced, large scale software in this age of radical change in information technology. This change includes the shift from centralized to distributed systems with the advance of client server systems.

The third reason stems from the fact that the Japanese information industry lags behind the world trend in distributed systems and the use of commercial software. The forth reason is a somewhat more intrinsic problem. It can be said that Japan lacks the skills to develop creative software for use through out the world. The final reason derives from the fact that software productivity is not significantly improving, as shown in Table 1, and there are considerable cost benefits in mass production of software. These reasons are helping to establish U.S. software as the de-facto standard, and as a result, pushing the market toward an oligopoly.

We believe that entirely new efforts in the area of information technology are required to sustain Japanese industry into the 21st century. As explained in this paper, it can also be said that new efforts are required to solve the issues presently confronting the Japanese automobile industry itself. A series of activities to solve these issues on an industry-wide level will no

doubt have timely and positive ramifications.

Table 1 Development Trends in the Information Processing Industry

	1955	1965	1975	1985
Industry	1	20	80	320
Machine Performance (hardware)	1	10^2	10^4	10^6
Programmer Productivity	1	2.4	5.6	13.3
System Reliability	1	5	24	120

Source : Art Benjamin Associates Ltd. Cited in Electronics, May 8, 1980, p. 143. "Computer Technology Shifts Emphasis to Software : A Special Report".

3 ISSUES RELATED TO AUTOMOBILE DEVELOPMENT AND INFORMATION SYSTEMS

3.1 Present status of CAD/CAM in the automobile industry and related issues--focusing on the situation at Nissan

The automobile industry has been working towards practical application of CAD/CAM. At Nissan Motors, we have pushed ahead with computer applications in a variety of vehicle development and production preparation fields, including styling design and die processing for body development. We have also constructed a progressive job structure using digital information. These efforts have greatly contributed to shorter development periods and improved quality. The outcome of this being an increase in the exchange of CAD data between Nissan and its overseas offices, and related manufacturers. However, exchanges between different systems have not always been successful, causing considerable problems in recent years. In response to this problem, a working group to standardize exchange of CAD data was established three years ago within the Japan Automobile Manufacturers Association, also know as JAMA, in an effort to at least perform correct data exchange between automobile-related companies. This group has studied IGES and STEP exchange standards. Through these activities, work has nearly been completed on an industry-wide interpretation of IGES standards, as well as the development and modification of data exchange functions for commercial and individually-developed software based on this interpretation. Presently, focus has shifted to technical studies on STEP exchange standards, and with the cooperation of Europe and the United States, work is centering on AP214 with the aim of early standardization of the data required in the vehicle development process.

3.2 Demand for a shorter development period for new vehicles

Another major issue facing the automobile industry is how to respond to the strong demand for a reduction in the time it takes to develop a new vehicle. During the 1980's, the Japanese automobile industry required an average of two-and-a-half years from model approval to commencement of production. However, in the last couple of years, intense competition and

drastic changes in the market have resulted in strong calls for a reduction in this development period, with new vehicles presently being developed within a period of twenty months. This reduction has done little to quell demands, and intense competition in the Japanese domestic market has renewed calls for an even further reduction in development time. To answer these calls, it has become essential to push ahead with concurrent engineering, as well as use "digital processes" to develop new vehicles.

Not only is it important that the information industry builds up competitive strength in the international market, it is vital for the automobile industry that the development process is digitized to the highest level in order to support concurrent engineering, as well as the more effective use of CAD/CAM/CAE as essential tools in the development of new vehicles.

4 ESTABLISHMENT OF THE CALS RESEARCH PARTNERSHIP

With the conclusion of the Cold War, the U.S. government has changed its technical policies away from defense research and development to the development of advanced technology for social welfare. For many years the U.S. has been the overwhelming world leader in the field of advanced computers and communications, even after focus shifted to social welfare projects. Europe and the EU are also conducting activities to strengthen infrastructure for industrial technology. The Japanese Ministry of International Trade and Industry, fearing that Japan would fall further behind the rest of the world, established Nippon CALS Research Partnership (NCALS) in July of last year with the cooperation of the private sector. Initially it was decided that this consortium would target fields related to electric power industry, and aim to conduct conformance research on Electronic Commerce (EC). At the same time, a number of industries were preparing the groundwork on which to conduct similar research, and in May this year, it was decided that the Vehicles CALS Consortium, V-CALS, would be established by five major Japanese automobile manufacturers with the cooperation of die and other related suppliers, and information companies. V-CALS will attempt to solve the issues that are inherent to the automobile industry, as well as formulate ways to deal with the problems confronting the information and manufacturing industries in Japan.

5 OUTLINE OF V-CALS

5.1 Aims

V-CALS aims to achieve a digital process, encompassing new vehicle development through to production preparation, whereby development is conducted using digital data such as CAD data and documents, instead of approving designs on the basis of hand-written blueprints and materials, or creating prototypes to investigate design. For this reason, the following activities will be conducted:

1) clarification of prevailing problems and issues;

2) clarification of the common information system platform specifications and the essential requirements to solve these problems, and conduct conformance research on next-generation information systems and new job structures for the fields concerned.(2)

5.2 Construction of V-CALS

Four working groups (WG1~WG4) will be set-up and the following conformance research conducted.

- Testing will be conducted on a digital process using the technology presently available, and requirements will be clarified.
- Research will be conducted on the tools (PDM) required to achieve the next-generation digital process for future activities.

Working group two to working group four will establish the standards that will form the foundations of the digital process, and will development and assess translators. More specifically, working group two will put vehicle application protocol AP214 to practical use in STEP; working group three will research ways to practically apply EDI, namely the automobile industry standard EDI for receiving and placing parts orders for mass production activities; while working group four will prepare automotive maintenance manuals using SGML, and database information on regulations in each country.

Figure 1 shows the connection between all the related functions of these working groups. Likewise, Figure 2 shows the structure of the V-CALS Consortium.

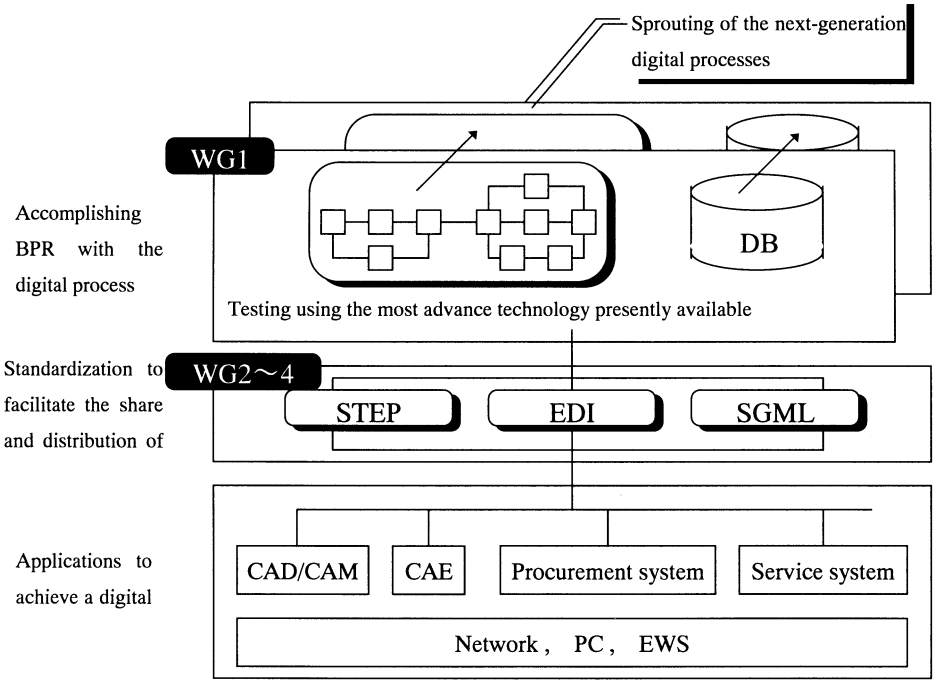

Figure 1 Functions of V-CALS

5.3 The activities of each working group

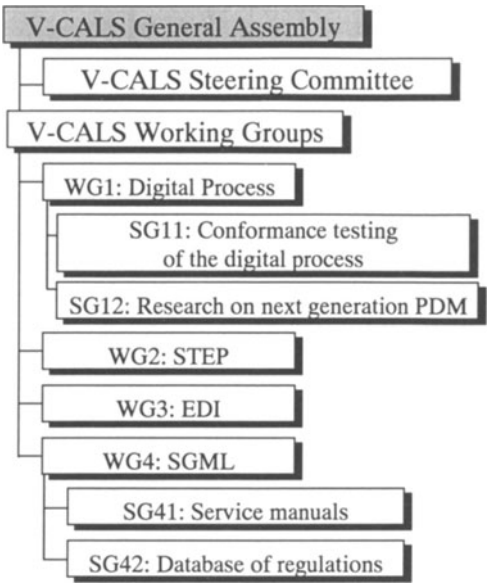

Figure 2 Organization of V-CALS

1) Working group one
This group is divided into two subgroups (SG11, SG12).
<SG11>
This subgroup will conduct testing on digitalization of products and process management, as well as concurrent development using the most sophisticated information systems available. This testing will substantiate the feasibility of digital processes, and highlight the problems and issues associated with the CALS technology required to achieve these digital processes.
<SG12>
This group will research next-generation PDM or product data management. PDM here means the set-up whereby a database manages all the data required for product development, including CAD data, specifications, parts lists and technical data.

The PDM requirements in the automobile industry are virtually limitless, and include:

- a huge number of parts, somewhere in the millions, and a massive volume of information used when assembling these parts on a solid model;
- a huge number of companies and people related to this industry;
- and the development and production activities being conducted on a worldwide scale.

This subgroup will develop a next-generation PDM that can handle all these requirements, and determine the appropriate information system platform.

2) Working group two
This group will

- support efforts to standardize STEP;
- research actual installation of STEP standards, and conduct conformance testing;
- and examine application rules for product model data.

These activities will focus especially on AP214.

3) Working group three
This group aims to create an electronic parts procurement system, and push ahead with the practical application of the JAMA-EDI standard already established by JAMA. To achieve

these aims, industry-wide support software will be developed, and problems will be amended by way of conformance testing.

4) Working group four
This working group is also divided into two subgroups(SG41, SG42).
<SG41>
This subgroup aims to standardize data and make it more "open" through use of SGML in an effort to create electronic service manuals. Attempts to standardize the information contained in service manuals of the five major domestic automobile manufacturers will enable automotive servicing companies and affiliated dealers to retrieve and refer to this information via public circuit networks or the Internet. This subgroup will determine the information system required to achieve this, and clarify the operational issues that must be solved.
<SG42>
This subgroup conducts conformance testing on construction and practical use of vehicle regulation database. In this test, world main regulations (MVSS, ECE, EC, ADR, etc.) are stored in both Japanese and English languages using SGML format. This subgroup will clarify the issues on construction, utilization and operation of regulation database, for the purpose of easier and more efficient exchange of information.

5.4 Results

The following results can be anticipated from the activities to be conducted in this project.
1) The following will be the returns shared with the manufacturing industry:

- common tools for STEP/AP203 translator;
- know-how on applying CALS technology to the process of creating 3D structures;
- and process management tools and technology common to the automobile and manufacturing industries.

2) The following are the returns specific to the automobile industry:

- know-how on application technology for the development/production preparation process using CALS technology;
- technical data for refining ISO standards, including STEP/AP214;
- technology for the preparation of electronic service manuals, parts catalogs and other materials specific to automobiles;
- and know-how and basic technology for establishing a database network operation center.

5.5 Schedule

The first phase of conformance research on the digital process will be conducted until the end of March 1998, with efforts to revolve around development of element technologies. Based on the results of this research, the second phase--development of required technologies--will

be commenced from April 1998.

6 CONCLUSION

V-CALS will attempt to reduce the technical problems associated with information systems and computers, and work out ways to reform work methods by presenting the requirements necessary to achieve a digital process, as well as extract measures to fulfill these requirements through virtual development and conformance testing of virtual companies. Through these activities, we would like to contribute to:

- the development of new middle-ware for use throughout the world from the year 2010;
- help sustain the competitiveness of the automobile industry;
- and collaborate with Europe & the U.S on the creation of common platforms and standardization efforts.

The consortium brings together a variety of different corporations. As a result, there is inherent difficulties with tackling common issues. However, we have come to the point where we must do something more than just compete. It is considered that activities that successfully combine competition with cooperation are of the utmost importance to the fields mentioned here today. However, we are also convinced that these activities are not only important to Japan in the 21st century, but also to the environmental preservation of the shared resources of this earth, and the well-being of all mankind.

The combined strength of many people will make this project a big success.

7 REFERENCES

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8 BIOGRAPHY

Toshiaki Mase received the B.S degree in mechanical engineering from Kyoto University. He was employed by Nissan Motor Co. LTD. in 1967. He has been working in the area of computer technology and engineering systems development for more than 25years. He managed the projects for developing Nissan and parts venders CAD/CAM systems, database systems and styling CAD/CAM system. He was senior manager of body design department in 1990. He is currently general manager of Engineering Systems Department Information Systems Division. He is chairman of V-CALS consortium steering committee.