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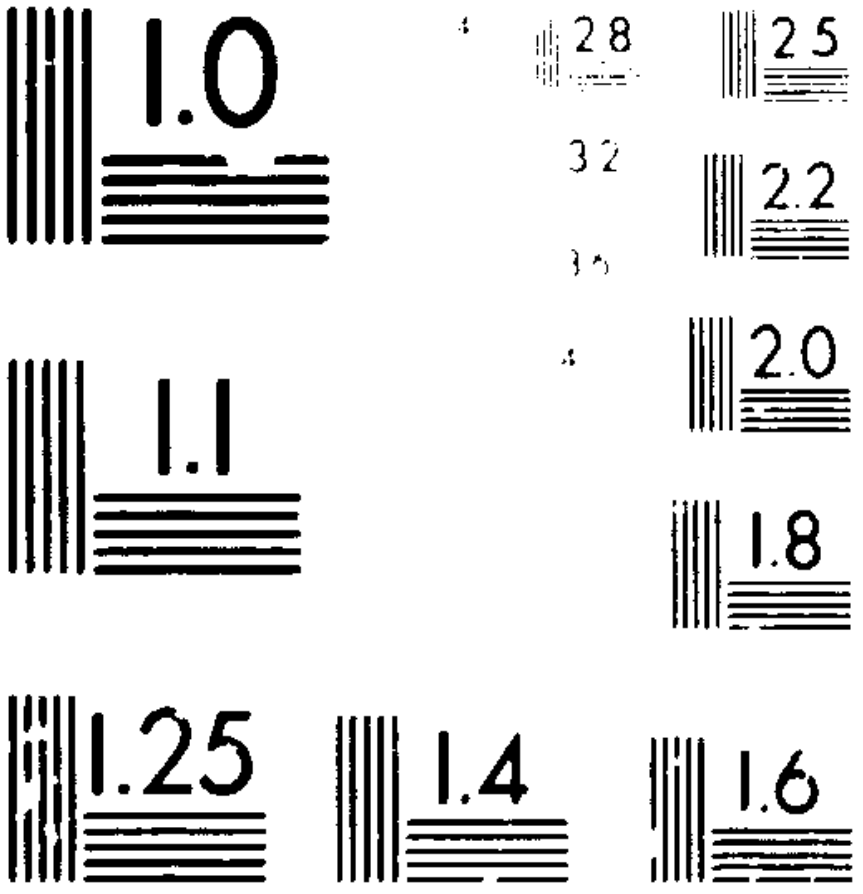

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ON THE APPLICATION OF CAD/CAM IN SHIPBUILDING IN KOREA*

prepared by

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1. Introduction

CAD/CAM is an acronym for "Computer-Aided Design/Computer-Aided manufacturing". The term CAD/CAM refers to the integration of computers into the production process to improve productivity. Just as business computers process numerical data, CAD/CAM system store, retrieve, manipulate and display graphical informations with unsurpassed speed and accuracy.

In this modern world, most of factory have had some contacts with the computer even if these may not be directly concerned with CAD/CAM or manageriral applications. But shipbuilding industry have made best use of the computer compared to other industry, because, as we know, shipbuilding is an international business involving the national governments of the various countries and is intensively competitive. Because of the competitive nature of the industry, it is essential for a shipyard to decide how efficiently it should and could build ships.

This in turn requires careful and continuous examination to improve productivity through technical innovation. Technical innovation means how to apply advanced CAD/CAM techniques in shipbuilding.

As a result we can say "ship technology can much benefit by making wise use of the computer's good features and the computer is not a tool to solve simply all the technical problems but to assist man in solving them easily".

2. Role of computer in shipbuilding

Now we consider the reasons why we should use computer and the role which a computer can play in shipbuilding.

Reasons to use computer are briefly summarized as follows.

1) Intensity of competition
2) Interative nature of the design procedure
3) Link between design and production
4) Use of numerically controlled machines
5) Large calculations
6) Man power shortage
7) Planning and management control
8) Other benefits

It is possible to devide the major roles of computer usage in ship technology into design, production and management application, in accordance with shipbuilding processes.

1) Design Applications
   (a) Detailed Routine Calculation :
   Basic calculation such as hydrostatic, stability, tank calibrations, bending moment and shear force, etc.
   (b) Large Calculation : Structural analysis, evaluation of wave resistance, design of a propeller from theory, surface generation, etc.
   (c) Design System : To link a set of calculations into an integrated system.

2) Production Applications

(a) Programs for construction : Process information to serve the needs of ship construction.

(b) Planning and control : Planning and scheduling of the production processes without creating bottlenecks or major delays.

3) Management Applications

(a) Information requirements

(b) Commercial and financial data processing

(c) Material ordering

(d) Stock control

4) Linking of Design - Production - Management

Integration between design, production and management process

As we mentioned above, the computer is now an accepted tool and also has areas in research on problems associated with ship technology.

Research projects under development by several shipbuilding countries may be grouped as follows.

1) Ship structural research

2) Computer graphics application

3) Wave resistance calculation

4) Ship motion studies

5) Developing of large integrated systems

3. Development of CAD/CAM in Shipbuilding

The computer was first used in shipbuilding to perform basic design calculation, such as hydrostatic and stability calculations in the late 1950s. But now we can understand that the computer can do such jobs more effectively and tackle many calculations which could not be done without aids of computers. Of course computer technology has improved immensely over the years.

1) In the late 1950s

The computer application was limited to simple design calculations. A few companies had begun or planned to develop computer aided scaled lofting system for production automation.

2) In the early 1960s

The numerical control technology was used in steel cutting process. At first, lines fairing and shell development were treated by the computer, AUTOKON system that is now ship design and production system had been announced as only lofting system in Norway. Therefore, together with presence of electro-photo marking facility, optical cutting machine, and numerically controlled cutting machine the AUTOKON System had contributed significantly in accomplishing automation in steel cutting process.

3) In the late 1960s

N/C cutting system using paper tapes or magnetic tapes had been used at shipyard. Other computer applications in steel fabircation, frame bending and pipe manufacturing were planned.

Also Japan and European countries started to develop computer aided systems, which has almost same function as AUTOKON.

4) In the early of 1970s

At this time, in fact, VLCC was built and large capacity computer was utilized in this field.
The first International Conference on Computer Application in automation of Shipyard operation and shipbuilding (ICCAS) was held in 1973 in Tokyo. Reviewing those papers presented at the ICCAS, we can understand that computer application technology was of wide distribution to shipbuilding activities such as ship design, steel fabrication and production control.
The CAD/CAM systems which had been practically used in shipbuilding until that time were presented. The typical systems were BRITSHIP from U.K., AUTOKON from Norway, VIKING from Sweden, FORAN from Spain, HIZAC from Japan. From this point of view, the CAD/CAM technology was utilized in such advanced countries, but not in developing countries.

In the practical use of computer, the batch system using large sized computers was popular, but more active application system linking of large sized computers and mini computers, or mini computers and mini computers was under planning.

5) In the late of 1970s and early of 1980s

Appearance of super mini computers and practical use of graphic display had an important influence on CAD/CAM technology.
The systems which had been developed for using large capacity main frame computer, was started to convert super mini computer system and graphics system was applied to the production modules.

From 1980s, the system has been developing towards the integrated system which combines design, production and management modules. In the operation method, emerging from batch method, graphics system is generally used. It means with appearance of more convenient hardware, CAD/CAM system has reached Computer Graphics Aided Engineering Systems.

4. Shipbuilding industry in Korea

The history of Korean shipbuilding goes up to Yi dynasty, in which Admiral Yi built the first iron clad ship, turtle boat. But modern Korean shipbuilding industry started according to the 5 year economic development plan:the modernization program was launched in 1962, practical expansion program was not until 1972, however. As the result, we have now four large sized shipyards, nine medium sized shipyards including two repair yards, which can build up to 10,000 ton class vessel. In 1983, these shipyards built 1,285,000 gross tons total.

5. Introduction of CAD/CAM in Korea

1) Selecting and evaluation of CAD/CAM system

Before embarking on the selection and implementation of CAD/CAM system, it is necessary to have a clear idea of the objectives and the functional fields that are to be achieved by using CAD/CAM. The ranges of functional fields to be applied to are mentioned briefly in section 2.

The objectives may include

- o A better product through improved performance

- o Solving problems which can not be easily tackled without computer
- o Reduced costs through a reduction in man hours
- o A greater capacity
- o Reduced time

The selection of CAD/CAM system for purchase calls for the greatest care so that it will meet the requirements.

Years ago when CAD/CAM systems were first developed, the selection process was simple.

Today the variety and complexity of available systems make such simple selection almost impossible. However one should make a sound choice with minimum risk. One method is to start with a complete list of each systems capabilities and its performances-hardware, software, expandability, general support, installation, documentation, training and vendor's experiences. The evaluation should be based on careful examinations of a complete list, technical presentation and discussion with the vendor, follow-up visit to the vendor and vendor's future plans.

Finally one has to estimate not only the total costs of a proposed system but also the benefits through direct and indirect effects. When the costs and benefits have been estimated, net savings per each system can be calculated and also the invisible savings should be considered.

These are general elements to be cousidered in deciding which system should be implemented.

2) Mode of import and status of systems

As mentioned before, the histroy of modernized shipyards which

may use CAD/CAM system is so short that the advanced, sophisticated technology cannot be applicable easly. When we made plan to apply CAD/CAM technology to shipbuilding in 1974, we could not consider all aspects which should be reviewed in order to implement CAD/CAM systems effectively.

After a feasibility study, we simply rearched that it was not possible to develop such system by ourselves and one of the CAD/CAM systems which aleady had been developed by advanced shipbuilding countries should be purchased as soon as possible. The feasibility study was carried out jointly by shipyards, related research institute and the goverment. Eventually we rearched a conclusion that an appropriate system should be purchased from abroad jointly among the organizations which were interested in. Thereafter the goals were set up so that the purchased system would be modified to fit the Korean shipbuilding practice and finally should become rooted. This means that the system should have expandabilities to meet our requirements.

In accordance with above strategy we tried to import a specific system for use in all Korean shipyards. As the result two basic naval architectural calculation and hull production systems and one preliminary ship design system have been purchased. These system, from the beginning, have been implemented, modified through the scheme which was already decided. Four large sized shipyards have installed the system at their own computers respectively, but medium sized shipyards which have not had their own capabilities in both hardware and technical personnel utilize the system with aids of the research institute which maintains the system data base. Because of different circumstances in each yard one

hull design system and one piping design and production system have been imported by one shipyard separately.

The shipbuilding CAD/CAM systems which have been imported are listed in table 1.

Table 1. Major CAD/CAM systems using in Korea

System	Country	Year purchased	Remark
. VIKING and SEAKING	Sweden	1975	Jointly purchased
. HICAS-P	Japan	1977	Only one yard purchased
. FORAN	Spain	1978	Only one yard purchased
. AUTOKON and PRELIKON	Norway	1981	Jointly purchased
. SHIPMODEL/PROCAL	Norway	1982	Jointly purchased

6. Application experience of the CAD/CAM systems

It can be easily understood, as shown in the table 1, that application period of the every imported system is not long enough to discuss in detail. My intention is to describe the experience on the functional fields rather than the system respectively.

1) Basic design calculation systems

The systems in this field have been imported together with the hull design and production system. For this reason we can not get rid of duplication of importation. While using these system practially much modification was made to meet shipyards requirement and new modules have been added to the system. As the result,

these systems are more functional and convenient than the original systems.

2) Hull design and production systems

The imported CAD/CAM system was very large sized and the package can be operated by batch mode and graphics mode. Functionally this system consists of three parts—shell treatment, steel structure drawing and cutting plan generation. The shell treatment includes hull form fairing, shell plate development, jig hight calculation and template generation. The steel structure drawing module can make contruction profile plan and other steel structure plan. The cutting plan module generates steel piece drawing and nesting plan.

As the result of application to practical hull production, there are no big problems arosen, but many small troubles threw disigners into confusions sometimes. We found many unreasonable problems in the graphics system. The major problem was disconnection of the steel structure database and the cutting plan database. At present, the vendor announces that this handicap can be fully covered by new graphics system. Even if the shipbuilding technology advances very slow, in fact it is true that the computer technology-hardware and software-progresses very rapidly. Although we possess a computer aided system and use well in practical production, we are stimulated to purchase new developments which are much convenient, more speedy and much attractive. We cannot afford to buy these new ones every time.

Based on the system purchased and our application experience,

we started to develop plan to make systems more convinient and effective, which probably will accommodate new computer hardware.

3) Piping design and production system

HICAS-P system was imported from Japan. This system is able to handle the activities from pipe arrangement phase to piece drawing, but we haven't fully utilized the automatic piping design module.

4) Preliminary ship design system

Resently we purchased SHIPMODEL/PROCAL system for preliminary ship design from the Ship Research Institute of Norway(MSFI). This system can be applied to 4 types of ships—tanker, bulk carrier, general cargo ship, container ship. With this system designers are able to obtain rough geometry of ship, preliminary estimation of ships' performance, building costs and operating costs.

7. Conclusion

In this paper genernal aspects of CAD/CAM system in shipbuilding and application experience of the system in Korean shipbuilding industry have been mentioned. The trends of the CAD/CAM system is toward an integrated system which combines ship design, production, and management. It means that the system is getting larger and the operating mode is to be changed from batch to graphics system. Reviewing the system development progress at present, practical application of advanced systems to shipyards will come within two or three years.

As the result of good cooperation among the related organizations in Korea, the large shipyards are making wise use of the system and the

medium sized shipyards are gaining easy access to the system installed in the research institute.

If the developing countries like Korea, have intentions to develop these kinds of system with their own efforts, it may not be practical and economical. I think it is reasonable to purchase an appropriate system and then, understand, and eventually modify the system. For the purpose of doing this way, the goverment, shipyards and related organization such as computer center or research institute should work together from the beginning and then jointly purchase, use the system cooperatively.