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ESTABLISHEMENT OF THE CAD SECTION WITHIN THE DIES AND MOULDS CENTER OF KIMM

DP/ROK/86/002/11-53

REPUBLIC OF KOREA

Technical report : CAD/CAM of Press-Tools*

Prepared for the Government of the Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing Agency for the United Nations Development Programme

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Vienna

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* This document has not been edited.

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INTRODUCTION

As one of nine Government Research Institutes KIMM* provides back-up facilities to industry in terms of product testing and the establishment of commercial and quality standards. The Die and Mould Section forms part of the Industrial Technology Centre (ITC), a separate Division within KIMM. The role of the Die and Mould Section within the ITC tends to fall into two categories. On the one hand trying to keep pace with the rapidly advancing CAD/CAM technology, whilst on the other, helping the toolmaking companies to take advantage of these technologies by demonstrating what can be achieved and by making the approach easier to follow for the smaller and not so affluent toolmaking companies.

A fairly well equipped computer facility provides the platform for becoming acquainted with CAD as applied to mouldmaking whilst the vital machine tools for the application to CAM should be in place within the next 12-18 months. Appendix I provides an insight into the computing capacity presently available at ITC.

So far the basic contact with the die and mould industry is via training courses (4 weeks about twice/year), seminars and the very impressive plastic injection mould try-out machinery. The latter is being used extensively by companies who have no moulding facilities of their own but who need to supply sample mouldings before despatching the moulding tool. An increasing amount of CNC machining is being carried out on a 3-axis copy-milling machine. However, this kind of activity will be considerably enhanced when more machine tools, engineering graduates and technicians are made available.

Although it was not clear at first which project was being addressed (11-52) or (11-53) a work schedule was drawn up as shown in Appendix II and, as can be seen, the activity embraces the requirements of both plastic moulds and progressive press-tools. Whilst most aspects of the work schedule have been completed, but not necessarily in line with the time scale, in making a final report, it would be logical to summarise the activities in the order as follows:-

* KIMM(Centre of the Korea Institute of Machinery and Metals)

i) Contact with industry
   a) by making visits to toolmaking companies.
   b) by attention to real problems.

ii) Preparations for a 2-Day Seminar.

iii) Practical work in connection with the CAD of press-tools.
   a) design of a 4-stage progression tool.
   b) introducing the beginning of a CAD approach to press-tool design.
   c) considering the problems of creating National Standards for press-tool components.

iv) Organisation of Fellowships.

v) Conclusions and recommendations.

i) Contact with industry.

For many significant reasons it has not been possible to meet as many people in the toolmaking industry as desirable. Mainly because of travelling and language difficulties it has been possible to visit only seven companies. The names of these are listed below:-

Samsung Electro-Mech. Division.
Seoul CAD Mould & Tool Co.Ltd.
Jae Il Engineering Plastics Co.
Woo Huyn Precision Co.
Han Jin Die & Mould Mfg.Co.
Pung Kook Eng.Co.Ltd.
Dae Sung Engineering Co.Ltd.

Nevertheless, this sample has shown that the make-up of these companies and their attitudes to CAD/CAM are very similar to those of companies in the UK and in Europe. The overall level of technology applied by the Korean toolmaking industry maybe lower than that of its European counterpart, but what it lacks in technology however,

it makes up by a total committment to the product. This is apparent both in management and on the shop floor. The application of CAM appears to be easier to justify because the payback is far easier to evaluate. Moreover, the learning curve for CNC is far shorter and productivity is found to increase far more rapidly with the same workforce.

As in Europe the emphasis on EDM and in particular CNC-EDM in terms of wire-cut and solid-sink is beginning to increase. For example, Samsung Electro-Mechanical Division, with eleven wire-cut machines and nine solid-sink machines clearly finds this the route to off-set the lack of hand skills that are needed to manufacture precision parts for both moulds and press-tools. EDM wire-cut machines are able to run for very long periods without attention and therefore greater productivity is available from this type of equipment. In fact, the same company is also placing a very heavy emphasis on the need for precision grinding. Jig-grinding and CNC form-grinding being very essential for the quality of press-tools that they were producing.

Of the smaller companies, one or two have travelled the same path as KIMM in deciding on the Deltacam Systems Ltd., CAD/CAM package of DUCT. This is not only because it is one of the best packages of software for the toolmaking industry but also due to the dynamic approach which appears to be offered by Fadam Technologie the Korean representative of Deltacam Systems Ltd.

Several of the companies visited were relatively small companies and they were hovering on the edge of CAD/CAM; not quite knowing which way to go and how to justify such a relatively large investment.

It is with companies like this in mind that we have chosen to stage a 2-Day Seminar on various aspects of CAD/CAM. More will be said about preparation for the Seminar in the next section.

During the visits it was very evident that companies wanted to talk about their techniques and about their problems. Some were willing to talk about the results of errors in the mould design and about the steps that had been needed to rectify faults, such as the flow of plastic into the mould cavity. Others were quite keen to talk about EDM techniques; the manufacture of electrodes, acceptable surface conditions and the development and application of new liquid dielectrics. It is apparent that there is good support for Korean-built EDM solid-sinking machines but,

there is also a lot of support for CNC milling machines from Germany and Swiss EDM equipment like the products of Agie and Charmilles, if the budgets will allow.

There have been opportunities to become involved in mould manufacturing problems that have been brought to the Section. But, at the point of seeking help from other sources, of course, the particular job is reaching the urgent stage and therefore, very little time is available to go through the lengthy business of translation to explain what the finer points of the problem really are. This attitude is completely understandable and amplifies the reason why it might have been easier to highlight problems whilst actually making visits to companies.

ii) The Preparation of a 2-Day Seminar.

For reasons given earlier, the Die and Mould section is not at the moment well placed to gain the widescale respect of the industry for the simple reason that it lacks the practical ability to become involved in basic toolmaking problems, not because of CAD CAM technology but as a result of its inexperience in toolmaking. Thus, there is a 'catch 22' situation in which very little progress will be made until the Section can be recognised for its prowess in the toolmaking field.

To reverse this situation everything possible needs to be done to open up the avenues towards the large and small toolmakers alike. This task is constantly under review by the Director and he sees very clearly the need to attract attention towards the present abilities of the Die and Mould Section. One way of achieving this is by means of a seminar and as may be seen by the draft programme in Appendix II it has not been too difficult to choose subject headings and to prepare papers that should help to unravel many of the problems that face large and small companies in the toolmaking industry in making decisions about the use and application of CAD/CAM.

One of the biggest problems occurs at the very beginning of the search for the most suitable CAD/CAM equipment. There are so many routes to follow that it is very difficult to choose the right one. Paper 1 is intended to go along the path towards outlining the areas that can be affected within a company and the main features to look for in the equipment. Some 'do's' and 'don'ts'

help in the decision making and advice on how to set up a benchmark study might just help companies to avoid the easy way of buying a 'bargain' and then thinking about it afterwards.

The separate treatment of the application of CAD and of CAM then follow with some demonstrations of the kind of applications that the Section is now beginning to tackle as part of its day-to-day routine. It is not too difficult for a company to examine the performance of CNC machine tools used in the manufacture of dies and moulds, and to decide that practical and economic benefits are quickly achievable. Thus, the route into CAM is far less difficult than the similar path into CAD. It is not easy to see how a CAD system can be faster than a conventional draughtsman and there are few examples that can be shown where direct benefits have been quickly achieved. In this area there is no doubt that a long learning curve exists and a company has to make the decision to want to travel along this route and to put a great deal of effort into making sure the basic target is always kept in sight. For those who choose to persevere the ultimate benefit is well worthwhile. The two papers on each of these aspects of CAD/CAM are written with the intention of recognising the problems and highlighting the benefits. There will be a break between papers so that some of the interesting examples tackled by the Section research engineers may be demonstrated to the delegates.

The second day of the Seminar is devoted entirely to manufacturing technology and subjects like EDM, CNC milling, grinding and the use of lasers will be discussed in detail.

Finally, a questionnaire has been designed with the intention of revealing information on the present attitudes of toolmakers towards CAD/CAM. Hopefully each delegate will agree to complete a questionnaire before leaving the Seminar. Later, the same questionnaire will continue to be used by the Section research engineers when visits are made to new or existing toolmaking contacts In this way it should be possible to build up a constructive picture of the kind of interest there is and in which direction of toolmaking they tend to be pointing.

The Proceedings for the Seminar have been bound and an attractive booklet of about 175 pages will be given to the delegates attending the Seminar.

It should be noted that this Report is being written before the Seminar takes place 6th.-7th December1988. and therefore, comments on the outcome will be made verbally in Seoul before leaving Korea and later at de-briefing in Vienna.

iii) Practical work in connection with the design of press-tools.

As will be shown in the papers on the application of CAD and CAM, although several CAD software packages claim to provide the easy solution to press-tool design problems, most of them rely very heavily on inputs based on some fairly fundamental knowledge of press-tool design. In the hands of an experienced press-tool designer these programs may however, do a great deal to reduce the time it takes to prepare a design. One of the most important features of a CAD program is the provision of a number of data files containing information on all of standard parts and it is this feature that provides the most significant saving of time.

In Korea, very few steps have been taken towards creating standards of the kind required and it is doubtful, even if there is a manufacturer who is large enough to provide the very large stocks of components that would be necessary. Thus there is somewhat of a dilemma in the area of standardisation of die and mould components.

In order to make the first steps along the path however, we have worked together in the preparation of a 4-stage progressive tool for the manufacture of a hypothetical component. Nevertheless, it has served well to focus attention on some fairly basic aspects of press-tool design. In cooperation with one of the research engineers the various cross-sections of this tool have been sketched and we are currently in the process of producing a proper design using DOGS software. The initial steps are being made with great care but progress is quite good.

In addition to the above design work, some very primitive packages are being worked out based on fundamental component data taken from a Japanese catalogue of a company specialising in press-tool component manufacture. By grouping similar components and dealing with them in relation to their actual positions in the plates of a die-set, it is possible to produce simple parametrics (thumb-nail sketches) that can be called up and brought straight to the screen for insertion in a design. This is the manner in which

design speed can be increased significantly. There is still much work to be done in preparing and developing packages of software for inserting the data and for calling it up as required. However, the flow-charts for much of the logic has been written down together with the criteria for making choices when necessary. We will not be able to complete this work before the end of the project but, we hope to find ways of continuing at a later stage.

Of course, the data that needs eventually to go into these packages should be based on Korean manufactured components. It has been suggested that further steps should be taken to encourage companies concerned with the manufacture of press-tools in any way, to get together to begin to discuss this question in order to reach a decision on what should be done. Inevitably, it will take a long time to get moving on this but pressure needs to be applied by Government and/or The National Tool and Die Cooperative.

As will be seen in the next section there is some real scope for continuing this development work via Fellowships.

iv) Organisation of Fellowships.

One of the most pressing needs of the research engineers at the moment is the ability to communicate with Nationals from Europe and from Australia. From a shallow background of English most of the research engineers are very eager to speak in English but, it means that progress is slow and most important conversations need to be conducted through the Director whose command of English is very good.

The possibility of Fellowships means that not only is there the chance of becoming fluent in the language of the country visited but also the transfer of technology will be that much faster and the door for further communication will have been opened.

Several problems need to be faced in the very near future. One is the span of time that remains before the UNIDO contract ends. The other is the release of the personnel at about the same time. The latter will tend to place a very heavy burden on the remaining staff. Provisision is currently being made for at least three Fellowships to be taken up in the very near future; one in Australia, the others in the U.K. Altogether five Fellowships are possible and, if full use is to be made of the UNIDO resources then an extension of the contract to permit the remaining Fellowships should be very seriously considered.

During discussions on this subject several ideas have been suggested, some of which have been favourably received. The main approach has been to allocate finite periods of time with different organisations who will each make a contribution to the overall knowledge gained during the Fellowship. This will avoid the fear that participating companies have of giving away too many of their secrets. Knowing the problems involved in making such arrangements by people who are unknown to each other, I have offered to make the vital connections in the UK and the proposals for Fellowship that are now going forward have been prepared on this basis.

Some of the sources of direct and indirect contact in the UK may be listed as follows :

i) Deltacam Systems Limited. (Positive help assurred)

ii) A.M.T.R.I. Advanced Manufacturing Technology Research Institute.
Director; L.Lord. Heavily committed to CAD/CAM

iii) University of Dundee. Department of Prod.Eng.
Prof.R.K.D.Hon. Heavily committed to CAD/CAM
In touch with EDM diesinking, wire cutting and CMM.
Has computer installation and software compatibility with AIM.

iv) Cranfield Institute of Technology.
Many sources of expertise in applied computing and in the design of precision machinery.

v) Sheet Metal Industries (Institute)
Contacts with many companies in Press-Tool field.

vi) Camtek Limited. Software Specialist company.
Originators of PEPS II. very experienced in the applicatior of CAM.

vii) G.T.M.A. Gauge and Toolmakers Association.
Director: A.R.Smith. Has links with all UK toolmaking companies.

viii) University of Hull.
Dr.A.Matthews. Known most particularly for work on Ti.Ni. coatings out well into expert system computer architecture.

ix) CAD Centre. Camoridge.
Central resource of CAD Software.

x) Cheshire Precision Shapes Limited.
P.J.C.Gough. EDM technology. Application of CAD/CAM.

xi) Technical High School, Aachen.
Prof.Dr.Ing.G.Menges. Specialist in plastic moulding. This is one of the best European centres cooperating with industry on many different subjects on many different levels. It is likely that a contact here could lead to many other introductions.

xii) Agie S.A. EDM technology contacts in UK and in Switzerland.

There are several other UK University Engineering Depts. that are very strong in CAD/CAM. These may be listed as follows:-

Camoridge.
U.M.I.S.T. (Manchester)
Leeds.
Birmingham.
Warwick.

v) Conclusions and Recommendations.

Being attached to the Die and Mould Section of KIMM for a period of eight weeks is a relatively short period of time in which to make a reasonable appraisal of the work that is being done for the Korean toolmaking industry. However, during a very pleasant period of cooperation it has been possible to make a number of observations which may be summarised as follows:-

i) Perhaps the first major observation is the lack of resources. Manpower, engineering graduates and technicians, up-to-date die and mould making machinery are all in short supply. Although plans are now going through to introduce much more new plant it will be some time before this is installed and running. A much greater interaction with the toolmaking industry is necessary if the section is to grow as a result of its own resources. This will come only as a direct result of gaining credibility with the toolmakers. This interaction needs to be started as soon as possible.

ii) The tendancy to wait for all parts of the CAD/CAM facility to be proficient in tool design and manufacture before making large-

scale cooperation with the toolmaking industry is not altogether a wise one. In taking CAD/CAM to the industry it would be far better to learn with the industry by working jointly on tool design and manufacturing projects. The confidence of both sides increases much more quickly in joint operations.

iii) At the moment the industry comes to the die and mould section when it needs help to do some of the tasks that it is unable to do itself because of its own lack of technology and equipment. With new equipment there would be increased cooperation almost automatically. However, just as there is almost continuous use of the plastic injection moulding try-out presses the section should endeavour to ensure that the machine tools are used on the same scale. One of the ways in which industrial interest would be increased is by a greater emphasis on EDM, both solid sink and wire-cut. The latter in particular, is not used by the industry to the extent that it should be because machines are expensive and sub-contract prices are also very high. The EDM machines in the present budget should be brought forward in advance of some of the other equipment. There is no doubt that the use of wire-cut machines would not only generate useful revenue but it would automatically provide a close link with the manufacturers of press-tools.

A minor point that might also be considered is that two Fanuc machines could be purchased for the price of a Swiss machine. Most toolmakers in Europe are satisfied with the accuracy of the Japanese machines.

iv) Internal and external communications will be improved considerably when some of the research engineers have completed the Fellowship programmes that have now been organised. The plans that have been made will ensure the best of English language and also very good technology. It is hoped that UNIDO will be able to agree to these plans as quickly as possible.

There are several basic recommendations that should be made and these may be summarised as follows:-

i) There should be much more scope for joint-ventures with toolmaking companies. It is not easy to organise this kind of close cooperation, but ways should be found for putting together projects which are of common interest to a number of companies and for whom the Die and Mould section can work towards a solution. One success will lead to another and so on.

ii) One of the sources of possible projects is likely to arise from the CAD packages that the section will develop in the near future. For these it will be necessary to persuade toolmakers, large and small, to begin to adopt standards for press-tool and mould components. The Government Dept. of Trade and Industry should encourage industry and AIMM to work together towards this goal so that some very significant technical and commercial benefits can be found.

iii) The training of the young men that will be coming to the industry and to AIMM is of vital importance, particularly as the attraction of engineering continues to diminish. Ways must be found of encouraging cooperation between industry and academia to make sure that young men are encouraged to join the toolmaking industry.

iv) Because of the problems that have been experienced in trying from long-range to organise a programme of development, the time-scale has fallen well behind that which was originally planned. It is recommended therefore that UNIDO consider very seriously extending the duration for a further year in order to obtain the benefits which now appear to be materialising.

Finally, I would like to place on record my sincere thanks to the Director and his staff of research engineers for their cooperation and help during the past two months. It has been a very great pleasure to work with them and now that the contact has been made I will be very pleased to act as a personal link with the UK helping further progress in any way that I can.

APPENDIX I

KIMM's CAD/CAM SYSTEM

1. Processor

   - VAX 8250 mini computer with 16 Megabytes main memory , 1 Gigabytes on line disk storage and magnetic tape drive unit.

2. Peripherals

   - Graphic display terminals : TEK 4111 , TEK 4209
   - Plotter : Hewlett Packard model 7586B
   - Alphanumeric terminal,printer and IBM/PC

3. Operating system

   - Sophisticated operating system (VAX/VMS V4.5A)
   - High level languages : FORTRAN,BASIC,PASCAL,C Language

4. CAD/CAM/CAE Softwares

   * CAD Softwares
     - 2D draughting (DOGS from PAFEC Ltd., UK)
     - 3D wire frame modelling (DOGS 3D from PAFEC Ltd., UK)
     - 3D solid modelling (BOXER from PAFEC Ltd., UK)

   * CAM Softwares
     - 3D surface modeller and NC maching (DUCT from Deltacam Systems Ltd., UK)
     - Postprocessor for NC machine (from Deltacam Systems Ltd., UK)

   * CAE Softwares
     - Finite element analysis (PAFEC-FE/PIGS from PAFEC Ltd., UK)
     - Plastic injection molding analysis (MOLDFLOW/MOLDTEMP from MOLDFLOW Pty Ltd., Australia)

Schedule of work. APPENDIX II.

UNIDO Project: DP/ROM/86/002/11-52/31.96 (11-53)

Consultant: P.J.C.Gough.

Date: 27.10.88.

Duties:

1. Recommend the best applicable software and hardware of CAD/CAM system for progressive dies.

2. Advise the local engineers in designing progressive dies using the CAD system.

3. Recommend Universities, Research Institutes and industrial companies for Fellowship.

4. Visit local factories and identify critical problems in which the application of CAD/CAM may significantly increase productivity.

In relation to the duties outlined above the schedule of work is proposed as follows:

1. The choice of a CAD/CAM system is rather similar to that of choosing a motor car. Once the amount of money to be spent has been approved, it is then a question of deciding only on the make or model, and how many desirable features may be obtained for that investment. This is not the case concerning the CAD/CAM system installed at NIMM, Die and Mould Section because hardware and software have already been chosen. The choice of the DECVAX computer, Tektronix Terminals and the associated plotter and printer, together with the software packages, DUCT, DOGS, MOLDFLOW, ETC., is a good one which will keep pace with present progress permitting expansion in the future. Thus, there is very little scope for introducing further packages of hardware and software into the system immediately, unless they will enhance the existing system or perhaps, provide less powerful and consequently less costly systems that might be more acceptable examples to the smaller toolrooms.

Under this heading therefore, it would be more appropriate to provide guide-lines helping those who are about to make decisions concerning the purchase of CAD/CAM systems. To cover this requirement

a paper will be prepared setting out the approach to making the correct choice of CAD/CAM system suitable for the smaller companies who have not yet taken the first steps towards purchasing a CAD/CAM system. The paper will review the essential aspects to consider with the preparation of a 'benchmark', so that a proper evaluation may be made of different CAD/CAM systems. Copies of the paper may be passed on to the prospective purchaser of CAD/CAM equipment so that he is able to make his own logical evaluation. Alternatively, the paper may be used as a basis for guidance by AIMM engineers to help make the evaluation on behalf of small tool-makers seeking to be helped.

Allocation of time: 10 days.

2. The best experience of CAD in relation to press-tool design is to be obtained by using the available system to design press-tools for components that already exist. It is hardly likely that we can work comfortably with a company who is expecting design results quickly, although it might be more beneficial to have the support of a small press-tool company who is already preparing press-tool designs using conventional methods. Nevertheless, we should begin in several different ways as follows:

i) It is essential to have at the disposal of a designer a data base containing all of the basic standard components that are used in the construction of progressive press-tools. The first step therefore, will be to give advice and help to select these components from current catalogues and to specify the most common range of sizes in current practise.

ii) In considering the basic design of progressive tools it is necessary to plan the layout of the die-plate based on the sequence of operations that will be needed to produce the component. This procedure will involve decisions with regard to the geometry of the shape and with the location of the strip as it passes through the tool. We shall begin to take practical steps using the computer to develop a basic press-tool design procedure.

iii) Using drawings of components that have already been made, we shall try to use the CAD system to design suitable press-tools calable of producing these components. We shall probably be able to consider 2 or 3 examples in the time available.

Allocation of time: 18 days.

3. There would be a great deal of benefit for KIMM if it could take advantage of the direct help that could be obtained from the U.K. Universities, Research Institutes and companies involved in toolmaking. The difficulty however, is likely to be whether personnel can be released for sufficient periods of time to take advantage of these benefits.

It is understood that six months is about the longest period for which staff could be released and that they would need to be released serially in order to minimise the disruption to the die and mould section. Nevertheless, there should be very little to prevent one or more people staying in the U.K. for six months and arrangements could be made fairly rapidly so that a plan could be implemented early in 1989.

It will also be possible to provide a list of names, addresses and contacts in the U.K. which should give good starting points for on-going technical links in the CAD/CAM field and with U.K. toolmaking companies.

Allocation of time: 2 days.

4. Because of the need to remain competitive many toolrooms are quickly recognising the need to use CNC machine tools; milling, EDM solid-sink, EDM wirecutting, form-grinding and so on. Thus, many of those companies who can afford this kind of equipment are already working in CAM. However, it is more difficult to show them how further significant benefits may be achieved by the use of CAD. The efficiency in the use of CAD needs to be very high in order to justify the investment when designs for complicated moulds and press-tools can be produced in relatively short times using traditional drawing board techniques. Furthermore, a basic disadvantage in the manufacture of moulds and press-tools is that they are nearly always unique (one-off) and therefore, stored data is seldom useful for another tool unless the tool is to be repeated at some time in the future.

Whereas it would not be timely, neither is there sufficient time available to make a broad survey of the CAD/CAM requirements of the Korean toolmaking industry. However, it would be extremely useful in preparing for the future to collect information on the way each company is planning to take advantage of the application of CAD/CAM systems.

To cover this basic requirement a questionnaire will be prepared so that it can be completed during further visits to companies in order to make a real assessment of the kind of performance they expect of a CAD/CAM system. At the same time the opportunity can be used to find applications for which the use of CAD/CAM might significantly increase productivity.

The results fed back over a period of time from such a survey will do much to provide a basis on which further CAD software may be developed in the future. Furthermore, a questionnaire may be completed each time a visit is made to a fresh toolmaking company. In this way a useful background of information can be collected and monitored.

The best way of influencing those toolmakers who have not yet invested in CAD/CAM or, those who have, and have done so unwisely, is by means of a seminar aimed at covering all of the important aspects of the selection and application of a CAD/CAM system. It would be timely and useful therefore, to plan a Two-Day Seminar during the first week in December, probably Tuesday and Wednesday, 6th., and 7th., December respectively. More time will be devoted to preparing a programme but initially it could be based generally as follows:

Two-Day Seminar.

Selection and Application of CAD/CAM
To Toolmaking.

Paper I	Selection of CAD/CAM system Hardware and Software.
Paper II	Application of CAD. Practical Demonstrations.
Paper III	Application of CAM.
Paper IV	EDM Solid Sink and Wire-cut.
Paper V	CNC Milling, Grinding and Laser Technology.
	Discussion and completion of Questionnaire.

Individual papers on each of the subjects given can be reproduced and distributed to each of the delegates attending the Seminar. As far as possible the papers will be written to cover the manufacture of plastic moulds as well as progressive stamping tools.

Allocation of time: 25 Days.

5. A final report will be prepared summarising the outcome of cooperation with the Industrial Technology Centre personnel. It will summarise also very briefly, the observations and discussions made from visits to a broad cross-section of Korean toolmakers. It will conclude with a list of recommendations based on the above observations.

Allocation of time: 5 Days.

APPENDIX III

Questionnaire for Seminar.

1. a) Name and address of Company. .....
.....
.....
b) Name of person to contact. .....
c) Telephone number..... Department.....
d) Number of toolmakers..... Number of designers.....

2. Type of toolmaking carried out.
a) Plastic moulding.....
b) Press-tool making.....
c) Pressure die-casting.....
d) Fine blanking.....
e) Other please specify.....

3. Type of conventional machine tools available. — approx. No. of each.
a) Turning. .....
b) Milling. .....
c) Grinding. .....
d) Jig boring. .....
e) EDM Solid sink. .....

4. Type of CNC machine Tools available. — approx. no. of each.
a) Turning. .....
b) Milling. .....
c) Grinding. .....
d) Jig boring. .....
e) EDM Solid sink. .....
f) EDM wire-cut. .....

5. Current method of programming CNC machine tools.
a) Manual .....
b) Dedicated system. .....
c) CAD/CAM system. .....

6. If your Company has one or more CAD/CAM systems please specify:-
a) Hardware.
i) .....
ii) .....
iii) .....
iv) .....
b) Software. i) .....
ii) .....
iii) .....
iv) .....

7. If your Company has no CAD/CAM system at present but contemplates installing a system at some time in the future. Which factor presents the biggest problem in reaching a decision.

a) Deciding on which system.....
b) Unable to evaluate the benefit of CAD. .....
c) No suitable staff available. .....
d) Vendors not sufficiently knowledgable about your products. .....
e) Unable to afford a learning period. .....
f) Justifying the capital investment. .....

8. If your Company does not intend to consider CAD/CAM as an essential part of its toolmaking future, on which basis does it reach this conclusion.

a) Type of work does not require high technology.....
b) Not enough time to consider possibilities. .....
c) No one available qualified enough to begin investigation. .....
d) Unable to see benefits over existing methods. .....
e) Only sub-contract work undertaken. .....

9. Would your Company consider the application of CAD/CAM if this became the only way in which sub-toolmaking could be undertaken.

Yes. .....
No. .....

10. If your Company is able to obtain CAD/CAM experience by utilising the computing facilities available and the CNC machine tools being brought together by AIMM Die and Mould Section, would your Company regard this as the best way to explore future methods of tool design and manufacture.

Yes. .....
No. .....

11. Can you identify the area of technology that would provide you with the most significant help in the design and manufacture of tools.

.....
.....
.....
.....
.....
.....

12. Does your Company normally find it difficult to engage the right kind of skills.

a) Toolmaking design and manufacturing experience. Yes. ..... No. .....

b) Experienced toolmakers with a desire to advance into CAD/CAM. Yes. ..... No. .....

13. If more training facilities were available would your Company be able to take advantage of them. Yes. ..... No. .....

14. What other factors not mentioned in this questionnaire would you consider relevant. Please specify.

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