The benefits of "ease of use" in CAD/CAM software.

▶ *Introduction*

ISO 9241-11(1998) Guidance on Usability defines usability as:

The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

This white paper considers the case for, and the benefits of, ease of use within CAD/CAM software with particular reference to Sescoi, a leading international vendor of manufacturing software solutions, and its automatic CAM/CAD system WorkNC.

▶ *What is "ease of use"?*

Usability and ease of use are key software attributes, making it possible to complete tasks efficiently and effectively. Factors which come under this umbrella according to Jakob Nielson, Usability Consultant and Ben Shneiderman, a reputed computer science professor, include: -

- Ease of learning
- Intuitive navigation
- How easy the software is to memorize
- Few and non catastrophic errors – reliability

K. Tara Smith, Fellow of the Ergonomics Society added some further factors in the form of 3xA's:-

Adoption – the product exhibits significantly more usability than its competitors' designs - and therefore will be adopted by users,

Adaptability – the product has features that allow it to be adapted or extended to suit a new (unpredicted) task or goal,

Accommodation – The product is designed to accommodate different user populations.

All the above attributes will be discussed in the following sections.

▶ *Why focus on ease of use?*

Over the years, Sescoi's own customer surveys have shown time and time again that users consider "ease of use" to be one of the most important factors, often placing it above functionality and cost, when selecting software.

This is supported up by results from other industries.

The Scientific Generics study showed that 82 per cent of respondents regarded usability as important or very important in their choice of a new set top box for digital television – source: Ofcom report - Ease of use issues with domestic electronic communications equipment. 17th July 2007.

Indications are that the importance of ease of use is common to all industries and that it is one of the most highly ranked factors for choosing new equipment, so it is reasonable to assume that this is equally valid for users of CAD/CAM software.

▶ *Referencing to Sescoi products*

This white paper considers the features of Sescoi's WorkNC CAM/CAD software in relation to ease of use criteria, justified by its position in the CAD/CAM market.

Sescoi's WorkNC CAM/CAD solution holds a leading position in the worldwide moldmaking market according to a 2008 report published by CIMdata – see market share chart below.

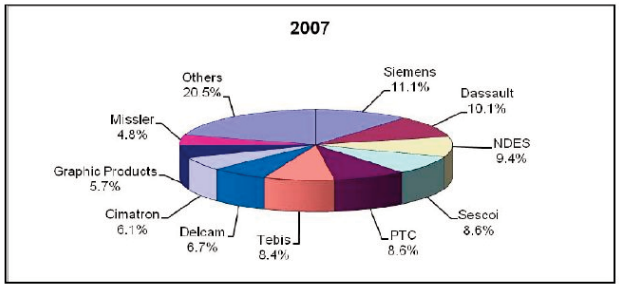


Figure 49—2007 Market Share of Vendors in the Mold, Tool, and Die Market

According to 2005, 2006 and 2007 surveys by the Nikkan Kogyo Newspaper, WorkNC is the CAM system most used by Japanese mold and toolmakers.

The software, which has been on the market for over 20 years, has features which allow it to be used across a wide range of industries including automotive, aerospace, toolmaking, rapid prototyping, medical, sports and leisure goods, domestic products and motorsport. WorkNC Dental launched at the end of 2008 now brings easy to use CAM to the dental sector.

Leading manufacturers using WorkNC includes all well known western automotive OEMs, Aerospatiale,Toshiba, Samsung, the ARRK Group, and Eurocopter. The software is also available in over 10 different languages and is distributed worldwide through a dealer network and through regional offices in France,Germany, Spain, UK, USA, India, Japan and China.

▶ *Impact of ease of use*

Ease of use is therefore clearly a highly important factor for software users.

A short learning curve allows engineers to become productive and achieve a quick return on investment. Intuitive operation and easily memorable navigation allows occasional users to be productive. Additionally, it increases the multi skilling of the workforce, making it possible to train more users both in the office and in the workshop. For CAD/CAM software the ability to use the system on the shop floor can have significant benefits through increasing the productivity of machine operators and raising their job satisfaction levels.

The availability of software in multiple languages and the extensive use of icons increases accessibility, allowing engineers from differing backgrounds to become proficient in its use. Finally, the use of the software across a wide range of industries ensures that it is exposed to many different and demanding applications, demonstrating its adaptability.

▶ *Short learning curve*

A short learning curve ensures that the software is deployed quickly and that it is used by as many people as possible within an organization. It also contributes to how often it is used and where it can be used.

From WorkNC's launch in 1987 Sescoi has consistently focused on ease of use, reflected by the simple menu of machining commands. These provide a means of picking a sequence of operations which will automatically cut a part without gouging the surface and without wasted air cutting movements out of the material. In the intervening years since the launch of the software, this capability has been refined through the increased accuracy of stock and rest models and improved smoothness in the toolpath.

For similar parts, programming can be greatly simplified by reusing sequences of operations and tools. These can be reapplied to new geometry which will reduce programming time to a few minutes, and ensure that the same methods are being used, contributing greatly to consistent finished part quality. Mr. Kitayama of Tatematsu Japan explained the benefits, ***"WorkNC's automatic programming was very attractive for us. Previously, finishing an inner panel mold took an average of 14 days – we were able to reduce that time by 20-30 hours."***

WorkNC also includes extensive and detailed help functions and user manuals. For after sales support, the company supplies a help desk staffed by experienced engineers as well as online control of the customer's computer enabling queries to be resolved remotely.

Training can usually be completed in three days so that the customer can be productive immediately. Andy Bond of Wolverhampton based Hewmor Products said, ***"I saw WorkNC at one of our customer's factories. We had it here on trial, and with just a half day of training, we were machining parts. We didn't want to give it back!"***

▶ *Intuitive operation*

By being intuitive, software becomes accessible to more users. It also alleviates the requirement to remember complex commands and enables it to be used by people of all skill levels. Intuitive operation contributes to the speed of learning and to the satisfaction levels of users.

WorkNC makes extensive use of icons and menu trees, so that it is possible to navigate a complete project from one screen and select commands from identifiable buttons. WorkNC G3, the latest generation of WorkNC, has been enhanced by the introduction of a single ergonomic interface. This combines the geometry creation and manipulation, part analysis, cutter path creation, and toolpath verification into a single environment. The advantage for the user is that changes to the geometry, editing of the toolpath, and geometry picking and analysis tasks can all be completed as work progresses, without changing environments. Arranging these operations so that they can be completed from one screen enables engineers to quickly understand how the software works and to use it without reference to manuals or help topics.

Adam Roby of CAD-CAM Solutions in the UK, where WorkNC and WorkNC-CAD are used in the workshop, said, ***"Additions, such as run off surfaces necessary for manufacture, are all completed on the shop floor in WorkNC, which is very beneficial for the company."***

▶ *Easy to memorize*

Simplifying and unifying the interface reduces the number of tasks the user needs to remember. Furthermore, building intelligent machining functions into the software cuts down on the number of decisions which need to be made. For families of parts, WorkNC can eliminate these operations totally by reapplying predefined toolpaths to the new component. Inside the software, technology for smooth cutter entry and exit and corner transitions reduces the effort required to achieve a successful toolpath. These are just a few instances of the expertise built into the software, all of which greatly reduce the number of actions required to program a part and hence, reduce the operations which need to be memorized by the user.

Gerhard Ammon, Moldmaking Team Leader, Playmobil Germany, commented, ***"WorkNC opened***

up new possibilities, allowing us to achieve more than we had ever anticipated. Ease of use has resulted in faster training, and we have succeeded in greatly increasing our electrode production rates using the software. An additional big plus for us is the stability and reliability of WorkNC."

▶ Reliability

For engineers to have confidence in a CAD/CAM system, the CNC code created by the system needs to be reliable. Parts cut by the system can involve many operations and expensive materials, so errors can be extremely costly. WorkNC is inherently very reliable, and each new release is subjected to an extensive beta testing program before it is released for general use. Toolpaths within the system are continually being refined, so they all have a long history of practical testing and use. Further verification can also be completed by checking the toolpath for interference with the cutter, the tool holder and the machine tool itself. With the introduction of 5-axis machining these safeguards have become even more important. Within WorkNC, 5-axis movements are checked against the limits of the machine tool, automatically adding retract and unwinding movements to rotary axes should the limits be reached.

Kevin Baker, Design Model Manager for Bentley Motors UK, said, *"We have four ITP machines with CMM and machining capability which have the capacity to machine both sides of four full sized vehicles simultaneously. We chose WorkNC for its ease of use and flexibility."*

He added, *"Four modelers in the Styling Studio use the two WorkNC seats. Its ease of use makes their tasks much simpler and they have absolute confidence in the results it produces."*

▶ Adoption

For CAD/CAM software to be adopted within an organization, as well as being easy to learn and memorize it must also have the functionality to carry out the various tasks demanded by the customer. WorkNC has powerful algorithms for roughing parts quickly from solid material and additionally finishing and picking out fine detail to produce a fully completed part.

Simultaneous 5-axis machining is becoming increasingly common, especially in aerospace applications. Traditionally, these toolpaths have been difficult to program, requiring highly skilled engineers to achieve reliable and acceptable results. However, with the increase in the number of 5-axis machine tools and recognition of the benefits, which include the use of shorter and more rigid tools, elimination of extra operations such as die sinking, and the improvement of surface finish, an easier way of programming has become essential.

WorkNC's Auto 5 toolpath automatically translates 3-axis toolpaths into 5-axis, bringing the technology within the reach of every company, greatly simplifying the process through intelligent and automatic toolpath analysis.

CERPI France has been successful in the aerospace industry with help from WorkNC. Louis Ristic from the company explained, *"The advent of 5-axis machining in WorkNC has been a great step forward for us because we now have all the functionality to enable us to create high performance 5-axis machining programs. Because it is so easy to use we have cut programming times by a factor of 4 or 5. Furthermore, we are able to model part geometry and machining center kinematics to simulate and validate our programs on the screen before manufacture. This provides increased security, renders testing unnecessary, and lets us run machines unsupervised throughout the night, which is especially useful for jobs with long cycle times, such as those for Airbus."*

▶ *Adaptability*

CAD/CAM is used in a hugely varied range of industries including rapid prototyping, aerospace, automotive, motorsport, recreational goods, dental and in the medical sector. Within each of these industries, new machinery and technology is continuously being introduced. WorkNC offers special routines to meet particular requirements, but is also flexible enough to be used by adapting standard routines and through toolpath editing.

Volker Wesseloh, responsible for WorkNC at 3D-Schilling Germany said, ***"Using WorkNC I create toolpaths for more than 25 electrodes per day at all levels of complexity."***

Dr. Martin Schilling, Managing Director, added, ***"The very simple ones are ready in a few minutes, whereas previously they needed up to half an hour. For 3D-Schilling, WorkNC provides automatic NC tool paths for its tool, mold and pattern manufacture directly from CAD surface models and solid models. No matter how complex the part to be machined, the user simply enters the milling strategies, tools, tolerances, machining allowances, depths of cut and distances between paths. WorkNC then automatically calculates a collision free toolpath."***

Kegelmann Technik Germany uses WorkNC to program its F. Zimmermann Layer Milling Center, used for rapid prototyping. The machine operates by successively milling plastic or aluminum plates. After each machining pass, a new plate is bonded to the previous one ready for the next machining pass, combining the advantages of generative rapid prototyping processes with conventional milling. The company now has 5 seats of WorkNC after a collaborative program between the company, the machine manufacturer and Sescoi.

Stephan Kegelmann enthused,***"I was impressed by the zest for innovation at Sescoi, whose development team are always slightly ahead of the game and devote a great deal of energy to progressive projects."***

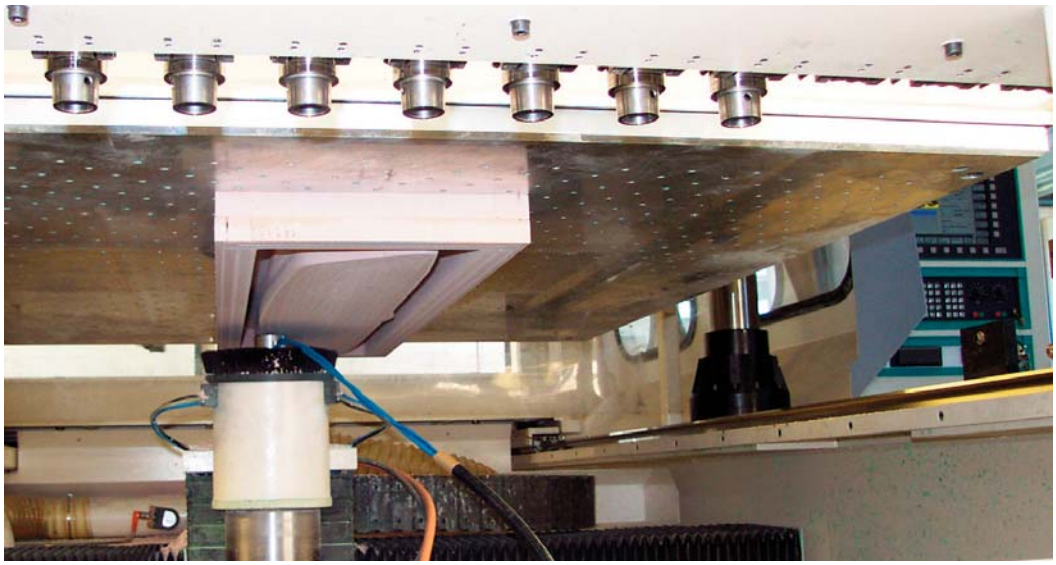
▶ *Accommodation*

For maximum ease of use CAD/CAM software has to accommodate the needs of all types of user. As well as being available in more than 10 languages, Sescoi has direct support for WorkNC through its dealer network as well as through local offices. This enables engineers to speak to support staff in their own time zone and in their own language. Local knowledge of industry, culture and working practices provides companies with backup which suits their individual needs, and ensures that they will get the best return on their investment.

The single user interface now available in WorkNC G3 helps engineers to understand how to operate the system and encourages intuitive operation of the system by the use of icons and a tree navigational structure. Not only does this speed up each task, but it makes the programming sequence easy to memorize. Engineers of all skill levels can benefit from the ease of use features to become more efficient, making it easier for them to produce high quality finished products in the shortest time and with the least amount of effort.

As requirements change, Sescoi listens to its customers, introducing new technology and making improvements which reflect changing technology.

Canadian company Bélisle takes full advantage of Sescoi's software support and has benefited from the continual flow of software enhancements. Frédérick Jean said, ***"We have a good relationship with the support team, and have seen some of our suggestions implemented in new WorkNC releases."***



▶ *Conclusion*

For CAD/CAM software to meet all the requirements of ease of use set out in the 'Why focus on ease of use' section at the start of this paper, a multi faceted approach is necessary.

Sescoi's WorkNC system meets the requirements through attention to the human interface, which has been redesigned in WorkNC G3 for even simpler and more intuitive operation ensuring that it is adopted as widely as possible within an organization.

Automation of the operations and integration of technology reduces the number of decisions which need to be made, which in turn makes the software easy to memorize and learn, and hence available to more members of a company's workforce.

By working with customers and machine tool manufacturers and combing this with Sescoi's experience across a wide range of industries, the software has become highly adaptable. Additionally, Sescoi is willing to develop special applications for individual customers.

Reliability and fitness for purpose are key factors in ease of use. Over the years, Sescoi has paid particular attention to generating safe toolpaths which are thoroughly tested before release. New and enhanced cutting routines have been developed to meet the changing requirements of industry such as high speed and 5-axis machining. Toolpath verification and collision avoidance further add to the confidence of users, while special applications such as Auto 5 and Feature Recognition build intelligence into the system.

Multilingual availability and local representation caters for the individual demands of engineers across the globe. The WorkNC G3 interface adds to the usability of the system making it more accessible to engineers whatever their skill level or background.

Many surveys have shown that ease of use is probably the most important factor when choosing a CAD/CAM system. Selecting good software which is easy to use will give companies a significant boost in productivity and reduce costs by encouraging multi-skilling of the workforce, speeding up tasks, and promoting the use of the most appropriate technology. The result will be a rapid return on investment and a significant increase in profitability.

▶ *Contributors and sources*

Sescoi International SAS
Blvd General de Gaulle, BP 75, 71009 Macon Cedex, France Tel.: +33 385 216621 Fax: +33 385 21662
info@sescoi.fr
www.sescoi.com/us

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Tatematsu Mould Works Co. Ltd.
Inazawa-shi, Aichi Prefecture Japan

Hewmor Products Ltd - Unit D4 Hilton Road, Hilton Trading Estate Lanesfield, Wolverhampton, West Midlands, WV4 6DW, UK

Playmobil - Geobra Brandstätter GmbH & Co. KG, Zirndorf, Germany

Bentley Motors Limited
Pyms Lane, Crewe, Cheshire, CW1 3PL, England

3D-Schilling GmbH
Alexander-Puschkin-Str. 8. 99713, Oberspier. Germany

CAD-CAM Solutions (UK) Ltd - Unit F, Colonnade Point, Central Boulevard, Pro Logis Park, Coventry, UK.

Kegelmann Technik GmbH - Gutenbergstraße 15
D-63110 Rodgau-Jügesheim Germany

Bélisle Industries Inc
Saint-Jean-de-Dieu, Quebec, Canada