Too Young for Casting
Too Old for Computers

7 thought-provoking articles

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Preface

The Y2K (Year 2000) would be recorded in history as the point of inflection from conventional manufacturing to knowledge-based economy. Yet, the recent crash of many Internet 'dot-com' companies only proves that information technology is only a means to an end, not an end by itself. Hence the latest brick+click strategy. Many 'traditional' companies are now leveraging their resources through IT and surging forward in the emerging global economy.

These articles explore the influence of information technology on the millennia-old casting technology. They have different underlying themes, ranging from pattern-making and methoding to genetics and cooperatives. These are part of the series written for the Foundry magazine published by M.R. Shah. I am indeed grateful to him and all others who have encouraged us in our efforts to promote computer-aided casting. TYC TOC? It is never too late to learn something new!

Hope you enjoy reading the articles. If you do, please drop me a line at efoundry.iitb@gmail.com.

Prof. B. Ravi

February 2001

Articles

Patterns and Computers

There are similarly different ways of getting a job done - whether it is pattern making or design calculations.

You can make a pattern using: (a) your hands, like a craftsman; (b) basic machines like turning, shaping, milling and drilling; (c) programmable multi-axis multi-tool CNC milling machines; and (d) completely automated rapid prototyping machines.

Design calculations - such as estimating casting weight from a drawing - can be performed using (a) your brains, (b) basic calculators, (c) programmable calculators, or (d) computers.

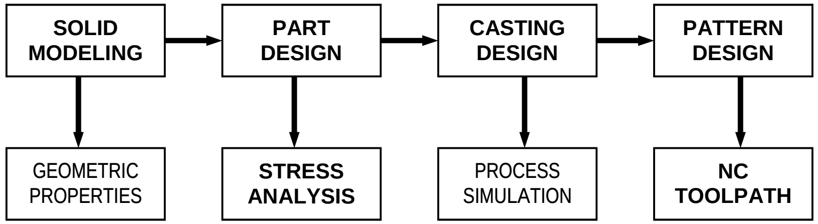
It is interesting to see how the four different ways are similar for both the tasks - in terms of effort, consistency and productivity.

'Manual' methods require continuous personal attention, each piece or calculation may turn out to be 'unique', and the time taken is long even for a trained person.

Basic machines or calculators also require a human operator. The physical or mental effort is lesser (which might make it boring). But the results are more consistent and the productivity is higher.

CNC machines and programmable calculators require skilled operators for the initial programming for a job - cutter paths for a specific pattern or equations for calculating the volume of a specific shape (say, gear wheels). Afterwards, during actual execution of the job, minimal user input or intervention is required. The results are consistent and the productivity is high. The initial effort is however, justified only if the number of jobs is large.

Automated machines can handle new jobs with very little job-specific programming, made possible by the software embedded in them. The main input required for an RP machine or a CAD/CAM program is only the part shape (solid model). A small intricate valve body pattern can be created in a single day (compared to say, one week for a machined one and one month for manual fabrication). Similarly, a CAD program takes seconds to compute the weight of a casting (even an engine block) from its solid model.



As you can see, in this progression from manual to automated systems, the effort is shifting from repetitive job-specific work to single time job-independent work. It may take 100 man-days to manually estimate the weight of 100 parts. On the other hand, you can spend 100 man-days to write a weight calculation program, and ensure automatic, accurate and superfast estimation of weights henceforth.

Of course, creating a comprehensive casting CAD/CAM system not only requires extensive foundry experience, but also an in-depth knowledge of the physical phenomenon involved (melting, filling, cooling, etc.) and advanced software engineering skills. It takes several human-years of research, prototyping, development, validation, industry testing and marketing effort to create a reliable and user-friendly system backed with adequate technical support. All this makes it very expensive, justifiable only if the number of end-users is large.

There are many implications of this progression from manual to automated approach. The ultimate goal of mass customization - making individually unique parts (or small lots) at similar costs as mass produced parts - is getting closer. Small or new companies have a more "level-playing field" now, and can compete with large or well-established ones in terms of quality and lead time also.

It is however, often overlooked that even the latest CAD/CAM systems cannot guarantee competitiveness! It is not the technology itself, but the way it is used that determines a company's prospects - both immediate and long-term.

The patterns made by RP machines look best only after hand finishing. A simulation program can predict internal defects, but requires (the brains of) foundry engineers to decide and input the methoding layout.

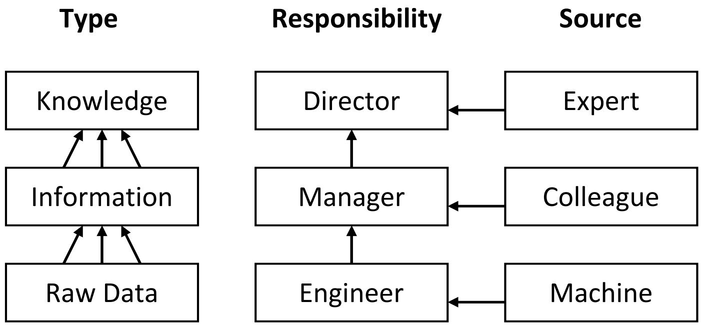
So the best way may be to combine the first and last approaches of getting a job done - acquire the latest systems, then customize them for individual family-of-parts and the best practices in your company.

Does your Co have a KO?

Here is one of my favorite questions at interviews: "What is the difference between data, information and knowledge?"

Most people get the answer right these days. Raw numbers or values comprise data (for example, results of an experiment). Organized data is information (the graph of results). Processed information is knowledge (an equation describing the graph). The data may change from one experiment to another, but the equation describing the phenomenon may remain the same. In other words, as we move up from data to information to knowledge, there is more abstraction (loss of detail) but better overall understanding. It is like climbing a hill to get a better view.

For convenience, we will refer to all three as information: data is low level information and knowledge is high level information. Let us now discuss the 3x2 sources of information (all three levels).



Data can be generated from two sources: recording from machines or observing various activities. In any organization, a HUGE amount of data can be generated; ISO 9000 and similar systems force its systematic recording. It is usually 'owned' by the shop-floor engineers, and they are usually authorized to make minor changes to machine settings if any abnormal data appears (for example, excess moisture in sand).

Information is usually the responsibility of managers: they generate, own and act on information. There are two sources: one vertical and another horizontal. The vertical route is by converting the data obtained from engineers, eliminating unnecessary or redundant data, then sorting and organizing it into easier-to-read formats (for example, the percentage defects discovered at machining stage in the last one week). The horizontal route is from colleagues. Information from both routes can be combined to take better decisions. For example, the information from sand plant and machine shop can be combined to conclude that excess moisture is causing higher gas porosity, and corrective action can be taken.

Knowledge is generated and used for leading the company, by the directors. The vertical source is the information fed by managers. For example, if the porosity problem persists over a long period and is affecting the competitive prospects of the company, the director may decide to install automated controls for the sand plant and/or train the engineers. There is a horizontal source too: from experts, who can lead a director to the same conclusion in usually much less time and cost.

Information technology – computers + communications – has opened up entirely new sources of obtaining and processing information. E-mail and Internet are prominent examples of info-tech, and revolutionizing the way companies do business. Many foundries already have e-mail facility and use it to communicate with buyers and suppliers. Design data (including 2D or 3D drawing files) can be sent as an attachment with an e-mail. Internet has grown so fast (over 250 million users) and it is now so easy and inexpensive to set up a web site that even grocery shops have started taking advantage of this technology. A few foundries have their own web sites, with a profile of their facilities and capabilities targeted at customers, but also useful to other visitors for spotting current trends and conducting benchmarking exercises. Professional organizations provide details of their services and training programmes. Technical and research institutes describe their projects and results. Software companies showcase their products, often allowing free downloading of demo programs. There are even online magazines, where one can read the abstracts of articles and order full versions.

A Google search exercise with the keyword 'casting' listed more than 141,999 sites [update: over 76,300,000 in 2013]. Some of these are related to concrete casting, casting of movie actors and casting rods for fishing! After some better searching (using keyword combinations such as metal AND casting, foundry OR casting plant, etc.), eliminating obviously irrelevant sites, and then 'visiting' and short-listing remaining sites, we reduced the number to 1000. A typical site has 10-50 pages of information, and links to other useful sites.

No fee is charged for accessing the information in a web site (most of them). However, you need a computer, modem, telephone line, Internet program (available free from Microsoft and Netscape) and access codes (available from VSNL, Satyam, etc. and charged based on hours of use). New users can walk into any Internet Cafe and explore the new world for Rs.50 or even less per hour.

One can start exploring the new world from a portal, which provides sections and search engines to quickly identify and enter an area of your interest. A portal is like an airport from where you can take a flight to any part of the world and reach there in seconds. You can always (usually) come back to the previous or the starting point and try other destinations. Yahoo.com and Indiatimes.com are good examples of portals.

It is however, so easy to get dazzled and get lost in the huge virtual world of information, that a new phrase has been coined: information overload. You may spend several hundred hours and still not see anything of direct interest (say, furnace charge calculation software). To solve this problem, three new technologies have come up: Agents, Data Mining and Vortals. Agents are smart programs, which continuously search the Internet and make a list of sites of interest (as defined by the user). Data-mining involves automatic sorting and filtering a large amount of data (from one or more databases) to provide better information or insights to the user. Vortals are special portals dedicated to a particular domain of interest, providing links and various facilities (such as dedicated search engines, discussion rooms and buyer-supplier interaction) to the visitors. One such vortal for the foundry industry is metalcastingworld.com.

Even a vortal provides access to so much information that it will take several months to browse through it. And this information is constantly updating and evolving, as new organizations put up their web sites and existing ones add more information and links.

Companies need Knowledge Officers to sort through all this information, extract useful knowledge and transmit it to directors, managers and engineers, so that better decisions can be taken faster.

What is the natural progression from data, information and knowledge? Wisdom! How do we acquire and exchange wisdom? Food for thought. Let me leave that to you.

A Balancing Act

A foundry manager told me recently, "If you can run a foundry profitably, you can run anything else."

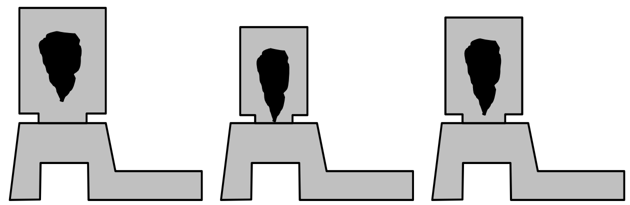
It is no secret that most small and medium jobbing foundries are barely surviving. The margins between input costs (material, energy and labour) and output prices (because of extreme competition) have never shrunk so low. Worse still, foundries are expected to pay their suppliers in advance, but have to wait several weeks for payment after delivery.

To improve profitability and cash flow (with the same facilities, product line and targeted market), the only way appears to be through maximising yield, minimising rejections, and compressing order-to-delivery time.

Theoretically, the maximum yield would be 100% (good castings = metal melted), there would be zero defects, and the order-to-delivery lead-time would equal the actual production time of tooling and castings. In practice, the yield is 50-70%. Additional 10-30% resources are wasted in producing defective castings. Casting development, which accounts for over 60% of lead-time for sample delivery, is unnecessarily long because of several weeks of trials to get the methoding right.

Methoding takes time because, for most of the cases, yield and internal quality are opposing goals. Foundry engineers try to strike a balance between over design (acceptable quality but lower yield) and under design (higher yield but defective castings). However, chasing a perfect balance affects the third goal: the development time.

What is usually overlooked, is that a perfectly balanced design is also undesirable. This is the case of borderline optimization, in which the methoding is just correct to get a good casting under normal and controlled conditions. Such a design is sensitive to changes in process variables. This means that even minor and expected variation in metal composition or pouring temperature produce sudden and often unexpected increase in the level of defects, from the first to last casting poured in a batch, or from morning to evening shift or even from one season to another.



The correct goal is to ship maximum good castings from the existing melting capacity in the shortest possible time. To achieve this, the foundry engineer should tilt the balance by slightly over designing the casting, so it is sufficiently robust against expected process variations. For this purpose, let us introduce the concept of robustness factor RF = over design parameter / optimal design parameter.

For example, let the optimum thickness of ingates for a particular casting (minimum size without producing cold shuts) is 10 mm at the normal pouring temperature of 1700 C and 12 mm at the pouring temperature of 1600 C. If the expected pouring temperature at the end of pouring a batch is 1650 C, then the foundry engineer should select 11 mm ingates, and we say that the applied RF for ingate size is 11/10=1.1.

The correct RF will depend on the automation level, worker discipline and customer requirements. Thus a critical component produced in a semi-automated foundry will require higher RF than a non-critical component produced in a highly automated foundry.

Applying the correct RF will lead to higher and more consistent quality without any significant fall in yield. Moreover, the same RF can be applied to any other casting of similar geometry, metal, process and customer requirements, to achieve equally consistent quality.

If it sounds too good to be true, where is the catch?

The catch is that determining the optimal value of each design parameter itself requires a series of trials (especially for new castings) at normal operating conditions. Determining the correct value of RF for each design parameter requires even more trials (at expected limits of operating conditions). The material, energy and labour costs for so many trials would not be acceptable to even well-to-do foundries.

Computer simulation overcomes the above problem. Simulation programs enable a user to quickly change design parameters, set process variables, simulate casting process, predict casting quality and automatically record the entire exercise. Small and medium foundries, which may not be able to afford such programs (costing several thousand dollars), can opt for simulation services. The charge for optimizing a casting (by simulating say ten times, each with varying design parameters) is usually comparable to a few months' salary of a foundry worker, and could be completed in 1-2 weeks.

Of course, the foundry manager will now have to balance the cost of current yield and quality against the cost of optimization by simulation.

In future, the programs will be able to suggest initial values of design parameters, accept user-defined limits of process variables, and automatically carry out simulation runs to determine the optimal as well as robust values of design parameters. The entire process will be web-enabled, so foundries in even remote locations will be able to access them. Researchers are already implementing such systems.

Will this take away the excitement of pouring a casting and waiting anxiously for the cut sections? Not really. With the large number of unconquered variables in a foundry, there is always a surprise round the corner!

The Casting Genome

On June 26, 2000 scientists in London and Washington announced that the first draft of the human genome is complete, an achievement compared to the invention of the wheel and landing of the man on moon.

The human body contains 100 trillion cells. The nucleus of each cell contains 46 chromosomes (23 inherited from each parent). Each chromosome looks like a double spiral staircase structure with thousands of genes located at fixed positions like beads on a string. A gene is the basic unit of hereditary information. It contains thousands of packets of instructions or codons for synthesizing the 20 different amino acids, which in turn make up proteins – the building blocks of life. Each codon is defined by three 'letters' from the DNA alphabet: A, T, C, G (Adenine, Thymine, Cytosine and Guanine).

In all, the 46 chromosomes contain about 100,000 different types of genes defined by about 1 billion codons, which make up the human genetic map or genome. Deciphering these codes and mapping their location on the chromosomes is a 15-year initiative – the Human Genome Project, which started in 1990 and involves over 1000 scientists in 50 countries, with a budget of over US$500 million by US Government alone (excluding private funding). The Project will be completed ahead of schedule, by 2003, by leveraging information technology for processing the results.

The results will revolutionize prediction, diagnosis and treatment of diseases. Some diseases, which will emerge much later in life, can be predicted from the genetic map of a baby's cells even before its birth. Criminal investigations will get a boost from genetic fingerprinting techniques. Insurance agencies may start charging higher premiums for persons who have genes linked to life-threatening diseases. There will be a rush to identify the genes responsible for 'High-IQ' or 'Anti-Aging' characteristics, and to introduce genetic alteration methods for producing babies with specific desirable characteristics.

Group Technology is not new to engineers. Yet, there has been no concerted effort to define a complete and universal 'genetic map' of castings. Will a Casting Genome Project open up new ways to understand and eliminate casting defects? Or else, allow higher costs for product designs that are inherently susceptible to defects? Will it help in fingerprinting, matching and retrieving the project data of a similar casting successfully produced earlier, to quickly prescribe a good first process plan? Will it help foundries in identifying their core competencies, and altering their product line to dramatically improve competitiveness and profitability?

A Application Group	**D** Dimensional stability	**I** Internal soundness	**S** Surface condition
M Metal Group	**A** Alloy family or standard	**P** Purity level (wrt standard)	**E** Enhancement by treatment
G Geometry Group	**W** Weight and size of part	**T** Thickness (min, max, avg)	**H** Holes type & number
P Process Group	**M** Mold type & preparation	**C** Core type & preparation	**F** Filling condition

To answer these questions, let us devise a simple coding system for the casting genome. We will define 4 groups (chromosomes), and 12 basic characteristics (genes). Each gene may be defined by hundreds of parameters (codons).

The 4 chromosomes can be: Application, Metal, Geometry and Process, or simply, A, M, G and P. The 12 basic genes can be: D, I, S, A, P, E, W, T, H, M, C, F as described in the table. The gene M (Mold type) will have about 100 codons related to mold material composition (bentonite, moisture, etc.), properties (grain size, bulk density, etc.) and mold-making process parameters (temperature, squeeze pressure, etc.).

The complete sequence of all codons makes up the casting genome. The actual values of codons for a particular casting define its micro-level fingerprint. We can also derive a macro-level signature by assigning an attribute to each basic gene. For example, the gene M can take attributes G, S, I, F, P, D translating to Green sand, Shell, Investment, Full mold, Permanent mold and Diecasting respectively, each associated with specific values of the codons contained in M.

The first use of the casting genome is in quality assurance. This involves listing various genes (codon sets) and linking them with possible defects. For example, the codon set [(application: internal soundness: radiography level), (metal: aluminum family: composition), (geometry: wall thickness: maximum), (process: mold type: thermal conductivity)] can be defined as a gene linked to shrinkage porosity defects. Based on such knowledge, the genetic signature of a new casting can be checked to detect the presence of defect-causing genes and issue early warning signals if necessary.

The second use is in productivity and yield improvement. This requires classifying castings into families depending on their genetic signatures, and associating each family with a standard process planning solution (mold-making, core-making, feeding, gating, pouring and finishing). Each family can also be associated with standardized calculations for cost and time estimation. This provides a systematic way to preserve the past experience of senior casting engineers.

The third application of the casting genome is in business development. The genetic signatures of successful products (high customer satisfaction) can be analyzed to identify a set of common genes, defining the core competence of a foundry. Comparing the genetic signatures of current products with those of a successful competitor will provide a better insight in benchmarking exercises. The results of the above two exercises (core competence genes and genetic signatures of a competitor's products) will help in fine-tuning the product line to improve the competitive edge of a foundry.

Considering just 5 possible attributes for each of the 12 basic genes, there are 512 or over 244 million different casting signatures! Eliminating the combinations that do not occur in practice (such as pressure die casting of steel), and with some planning and mutual understanding, each foundry can specialize in a particular family of castings, with zero competition! This will encourage the foundry to invest in better facilities, qualified personnel and focussed R&D related to the chosen family of castings, yielding long term benefits to customers.

The human genetic structure continuously evolves through mutations, triggered by environment and experience, making subsequent generations more capable and adaptable. The casting genome may well contain the seeds of the foundry industry's future, waiting to be discovered!

The Real Competition

It happened again. A medium-size foundry acquired a CAD/CAM system and hired a fresh engineer to develop their castings on computer. Within six months, the engineer left and joined one of the new ‘dot-com’ companies.

There is little doubt that the ‘dot-com’ phenomenon is taking its toll on the engineering industry. Many small company owners have found it more profitable to shut down their units and hire out the space to a software company or a training institute.

The ‘hardcore’ industry veterans contend that the software phenomenon is just a passing phase and are sticking to their jobs. Their argument is that someone has to produce the actual goods, and after a shakeout, those who remain will emerge as the winners. They point to the recent crash of pure dot-com stocks to support their stand.

Unfortunately, the veterans are waiting and watching and retiring. Meanwhile, very few youngsters are willing to remain in their jobs, learn from their seniors and step into their shoes. There is no one to grasp and carry forward the torch of a company’s valuable knowledge accumulated over years, often gained after costly mistakes. In a few more years, every batch of fresh engineers will be repeating the same old mistakes again and again.

There is an immediate need to attract and retain bright young engineers in the casting industry. How? By making the jobs more attractive and satisfying than those in other sectors, the main competition being the software companies.

That leads us to the question: what is so attractive about the software jobs?

If you ask the youngsters, the working environment attracts them most. When one thinks of a software company, one visualizes air-conditioned rooms, spotlessly clean tables and background music (also add comfortable chairs, coffee vending machines and table-tennis corners). Compare that with the picture of a hot, dirty and noisy foundry.

An equally important factor is the salary. A typical engineering graduate (even one with no exposure to computers), is offered at least 25% higher ‘take-home’ salary in software companies compared to engineering companies. Add promising perks (company-sponsored picnics and birthday parties), not to mention seductive stock options (stay long enough and you might become an owner) and opportunities for overseas travel.

The third is the job satisfaction that comes from mentally challenging tasks, learning opportunities and responsibility. Also, the appreciation of the supervisor or customer for a quality job completed in time and as per budget.

How can the casting industry compete with software industry on the above three fronts?

A foundry job can definitely compete on the job satisfaction front – there is perhaps nothing as challenging and satisfying as pouring molten metal into a mold to create a usable shape. Handling hundreds of uncontrollable factors and the occasional unexpected problems keep foundry engineers on their toes and makes every day a new day.

On the salary front, take this wisdom from the software sector – a good programmer is worth ten average programmers. Replace ‘programmer’ with ‘engineer’ and the wisdom should hold good for casting sector as well. In other words, one good engineer at double the salary might be more productive than two average engineers. Indeed, the CAD/CAM divisions in a few engineering companies have recently created differential salary structures to attract and retain good engineers. And some of those perks (like picnics) don’t really cost that much to a company.

That leads us to the first front – a challenging job with a good salary may not offset a poor working environment. Or look at it this way: if the working environment is satisfactory, an employee may not go through the hassle of job-change just for a slightly higher pay! But this is the most difficult front to crack because it involves a change of culture and management.

What can the foundries do to improve the working environment? How difficult is it?

Let us start by getting rid of junk – unnecessary items – which we hope to use some day. The best criteria to identify junk: anything that has not been used even once in the last one year (make it two years if you are really fussy). Even experts of Feng Chui – the Chinese science of balancing life energies – claim that 50% of our problems will be solved by removing clutter, since it blocks the free flow of energy.

Next, clean and paint. Hire a dozen regular cleaners, if necessary. Then, add more lights and make the workplace brighter. Later, think of enclosures, devices and standard procedures to minimize dust and eliminate its accumulation on equipment and shop-floor. Aim for zero dust. There is a diecasting unit in Japan (ask Johann Emmenegger of Fondarex, Switzerland, who visited the company), which is as clean as an Intensive Care Unit, and the operators actually wear white suits at work.

The immediate effect of a clean and bright work place will be on morale. Engineers will like their work, stay longer (on their own) and complain less. The equipment maintenance costs will obviously reduce. Over a period of time, the overall quality of castings will improve, even without help from any consultants.

After all, it is not just computers, which work better (if they continue to work at all) in a clean environment. As the software industry has shown, everything else being equal, it is the people who define the competitive edge of a company and help in maintaining it. It is worth getting the best people and keeping them happy at work.

Start ‘Operation Happiness’ by removing all junk, even that dirty board proclaiming ‘Cleanliness is Godliness’. If the foundry is cleaned up and everyone wants to keep it that way, you wouldn’t need it again.

Too Young for Casting

Too Old for Computers

At middle age, casting engineers are neither here nor there. Realization dawns – that it will take many more years of painstaking experience to get a grip on the manufacturing process. On the other hand, learning anything new – for example, tools that might make our work faster and easier – seems increasingly difficult: no time, no enthusiasm! In other words, by the time we know how much we don't know about casting, it is too late. And catching up with the breathtaking advances in other fields, especially information technology, often leaves us breathless.

Three years back, I bought a digital diary, but could never use it. It is essentially a calculator with additional functionality. It contains a calendar and clock (with alarm), and can store addresses and schedules. Text is entered by pressing tiny alphabetical buttons. But the usefulness of a digital diary is somewhat offset by its difficulty of use (small keys are inconvenient, even for a person with average sized fingers) and poor reliability – everything is lost if the tiny batteries are disconnected or lose power.

Last year, I got a PDA (Personal Digital Assistant), and it quickly became an indispensable companion. It allows digital text to be entered by scribbling on a 'pad' and can be connected to a computer for backing up the contents. What's more, new functions, programs and even e-text (quotations, dictionaries and novels) can be downloaded from the Internet. The cost and ease-of-use of a PDA is similar to a mobile phone. Indeed, PDAs and mobile phones are merging, making it possible to communicate in any manner (voice or e-mail) with any other device (phone or computer) without physical connections.

New technologies not only have to be useful and affordable enough, but also reliable and user-friendly enough.

That brings us to a million-rupee question: will casting design and analysis programs find mass acceptance (among even small and medium foundries) or remain the exclusive luxury of only large companies?

We know that simulation programs are useful for reducing rejections and improving yield. With a ten-year development history behind them, they are now reliable enough for engineering purposes. Time or project-based license mechanisms remove the financial barrier for small and medium foundries. Thus the key factor influencing the widespread use of software programs is their ease-of-use by an average foundry engineer. The increasing difficulty in attracting and retaining young engineers (thanks to other attractive career options), makes this factor even more important.

To find an answer to the above question, we carried out a unique experiment over the last few months. We conducted computer hands-on workshops in different parts of the country: Hyderabad, Coimbatore, Pune, Vadodara, Bangalore, Chennai, Satara, Delhi and Karad. The morning sessions included lectures on the basics of computer-aided design and analysis of castings. Then each team of 2-3 participants was provided a separate computer loaded with casting software. A few minutes were devoted to learn how to move a mouse – the single most difficult first step for a complete novice. This was followed by a one-hour session of step-by-step guidance on how to start the program, import a 3D part file, visualize the part, compute its properties, identify the feeder location, determine its dimensions, create a feeder model, simulate casting solidification, analyze the results and improve the feeder design. After the guided session, one hour was provided for practicing the program user interface. Finally, the participants were asked to determine the best solution (no internal defects with maximum yield) for a simple casting model.

The participants came from a variety of companies related to casting: engineering OEMs, foundries, pattern and die-makers, material and equipment suppliers, consultants and engineering teachers. The foundries covered different metals (both ferrous and non-ferrous), processes (sand, investment, gravity and pressure die casting), capacity (small to large) and level of automation. Some of the workshops were in-house (for a single organization) and others were of open type. There was no age or qualification barrier.

One of the participants, 62, retired as manager but retained as a consultant by his foundry; one of those who had never used a computer before, was as excited as a child with a new toy.

The final results were even more amazing. We found that most senior engineers took more time for pressing the 'buttons' on the screen. But they took less time for deciding the correct sequence of steps for solving the problem. In general, they achieved better in less time than fresh engineers.

After all, learning how to use a computer – moving the mouse, selecting the menu and pressing the buttons – is only a skill. This can be taught in a few hours and mastered by practice. But learning how to produce a perfect casting requires experimentation, observation, insight and creativity. These can not be taught in a classroom no matter how many hours are spent.

The moral of the story – fresh engineers may be too young for casting, but senior engineers are definitely never too old for computers!

Cooperative CAD/CAM Centers

American visitors are usually struck by the proliferation of small shops in our country. They are accustomed to shopping malls for even daily requirements (toothpaste, milk and vegetables). These malls contain several department stores. Some stores (like Wal-Mart) have hundred or more sections. There are common parking lots (which can accommodate hundreds of vehicles), eateries and cinema halls. Specially trained staff members handle the administration, maintenance and security of the entire mall. Indeed, just two or three malls cater to the needs of the entire local population in many small towns in the USA.

Store owners in a mall benefit from an umbrella organization catering to their common needs, while retaining the attraction and advantages of individual enterprise.

A similar business model, which has been very successful in our country, is cooperatives. Many cooperative ventures have been quite successful and have set an example for others to follow. Some of these have developed or acquired advanced techniques and technologies for improving the quality of their services while retaining competitive advantage. They have also promoted ‘family feeling’ and overall goodwill among the members.

The Karad-Sangli-Kolhapur belt in Maharashtra, well known for foundries, is equally known for its cooperative grape farms, milk societies, sugar mills and banks.

So why not cooperative CAD/CAM centers to handle casting development and pattern-making needs of small and medium foundries? These activities take the longest time and have the greatest influence on the quality and cost of the cast product. By using appropriate software tools, it is possible to reduce the casting development time by 50% or more, provide a high level of quality assurance and explore creative ways to reduce costs in collaboration with customers. But acquiring CAD/CAM systems is usually too expensive for small foundries. By setting up a cooperative center, the member companies will not only have access to advanced technology, but also benefit from a common platform for exchanging ideas and experiences.

A cooperative CAD/CAM center may be started with just two to dozen or more member companies. The main decisions involved in setting up the center include facilities, location, personnel, financing and mode of operation.

The facilities will depend on the requirements of the members. Basic facilities may include solid modeling, casting simulation and NC machining. Competing software vendors may be contacted to obtain information about comparative features, hardware requirements, performance, technical skills required, appropriate case studies, local technical support and licensing options. An on-site project may be carried out to get a clear picture of all these issues.

The facility may be located in any commercial space, which may be acquired or leased. It may be also be located in a space owned by one of the members, as long as the rights of use are clearly understood by all members and included in a written agreement.

At least two engineers should be identified to manage the center. They should be fully trained in operating the systems. They should be able to train other engineers from the member companies as well as assist in carrying out the projects. The salary and incentives (perhaps even share options) must be suitably designed to retain them for longer periods.

Seed finance may be available from the state government, banks (technology upgrading schemes) and venture capital agencies (if the center is operated as a commercial venture by charging fees to non-members).

The mode of operation should be well thought out. One way is to reserve days of the week or hourly slots for each member organization. The engineers of the member companies will use the system for the allotted hours, transfer the results to their company (through floppy/CD or e-mail) and hand-over the facility to the engineers from the company reserving the next slot.

Another way would be to charge suitable fees to all users based on the type of system used (which will depend on its initial cost and overheads), number of hours of using a system, time of usage (nights or weekends cheaper than normal daytime), urgency (compensation to a 'booked' user) and the type of membership (frequent user, occasional user, non-member). More ideas for the charging pattern can be borrowed from international airlines companies.

It is best to involve a neutral facilitator – preferably a local technical institute or professional organization – in the above exercise. These may even turn out to be the most suitable location for the center, besides ensuring ready availability of technical manpower. They may also be able to obtain research grants from government agencies (such as the Department of Science & Technology and the Ministry of HRD) for partially funding such a center.

For implementation, the reverse order must be followed: identify the facilitator, decide the mode of operation, obtain the finance, recruit the personnel, finalize the location and then install the hardware and software. The center personnel as well as engineers from the member organizations must get trained in using the systems.

Foundries and toolmakers as well as engineering OEMs can become members of such cooperative CAD/CAM centers. Casting design consultants can use the facilities to double-check their recommendations. Even competing organizations can become members of such a center while protecting their business interests. Rigorous security systems can be set up to shield the project data of one member from others.

Does this all sound like a far-fetched concept?

The Government of Andhra Pradesh has already taken the lead in initiating and seed financing a computer-aided casting design center in Hyderabad. The Software Technology Parks of India (STPI) and the Institute of Indian Foundrymen (IIF) played the role of facilitators. Several small and medium foundries in Andhra Pradesh have become members of the center. Jyoti Limited set up a similar center in Vadodara, primarily for catering to the CAD/Simulation needs of their casting suppliers.

We cannot fight today's battles with yesterday's weapons and survive tomorrow. Will IT become the Brahmastra of the Indian foundry industry for succeeding in the global competitive battle? Only time can tell us.