Energy

**C
O
N
S
E
R
V
A
T
I
O
N**

DOE/ID/13164--1-Vol.4
(DE95016314)

NATIONAL METAL CASTING RESEARCH INSTITUTE

Final Report

Volume 4: Plan for Technology Transfer

**By
W. B. Griffe
S. Davis**

August 1995

Work Performed Under Contract No. DE-FC07-92ID13164

**For
U.S. Department of Energy
Office of Industrial Technologies
Washington, D.C.**

**By
University of Northern Iowa
Cedar Falls, Iowa**

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401.

Available to the public from the U.S. Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161, (703) 487-4650.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

**NATIONAL METAL CASTING RESEARCH INSTITUTE
FINAL REPORT**

VOLUME 4: PLAN FOR TECHNOLOGY TRANSFER

W. B. Griffe and S. Davis

August 1995

Work Performed Under Contract No. DE-FC07-92ID13164

**Prepared for the
U.S. Department of Energy
Sponsored by the Office of the Assistant Secretary
for Energy Efficiency and Renewable Energy
Office of Industrial Technologies
Washington, D.C.**

**Prepared by
Metal Casting Center
Department of Industrial Technology
University of Northern Iowa
Cedar Falls, IA**

This material was prepared with the support of the U.S. Department of Energy (DOE Cooperative Agreement NO. DE-FC07-92ID13164). However any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the view of DOE.

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	BACKGROUND	1
III.	OBJECTIVES	2
IV.	FINDINGS ON QUESTIONS TO METAL CASTERS	3
	A. Organization of Summary and Discussion Section	3
	B. Summary and Discussion of Questions Asked to Metal Casters	3
	1. Question One	3
	2. Question Two	4
	3. Question Three	9
	4. Question Four	10
	5. Question Five	12
	6. Question Six	13
V.	RECOMMENDATIONS	14
	A. Preface	14
	B. Conclusions and Rationale	14
	C. Recommendations for Improving Current Technology Transfer	16
	D. Recommendations for Experimental Programs	17
	1. Experienced Foundrymen Service Corps	17
	2. Video Information and Training Tapes	17
	3. Electronic Bulletin Board	17
	4. Governmental Regulations Informational Resource Program	18
	E. Recommendation for Regional Technology Transfer Plan	18
	1. Objectives of Plan	18
	2. Basis of Recommended Plan	18
	3. Expansion of Plan	18
	4. Funding	19
VI.	METHODOLOGY	19
	A. Investigators	19
	B. Approach	20
	C. Procedure	21
VII.	APPENDICES	
	Appendix A: List of Questions Asked	22
	Appendix B: Format for Letter of Introduction	23
	Appendix C: List of Interviewed Metal Casting Firms	24

I. INTRODUCTION

Public Law 101-425, "The Department of Energy Metal Casting Competitiveness Research Act of 1990", was enacted by Congress on October 15, 1990. The purpose of the act is stated in section 4 as, "performing and promoting the performance of research and development on issues related to the technology competitiveness and energy efficiency of the United States metal casting industry". The Act establishes an Industrial Advisory Board, (IAB) to identify specific priority areas for research.

One area the board identified was the role of technology transfer in disseminating the results of research and in contributing to industry competitiveness. This concern was stated in Sect. 5 (b) (2) (B) (5) and 5 (d) (5). In order to gather data on technology transfer, it was included as one of six criteria in awarding solicitation proposals. The Board sought a "research proposal [that] identifies a viable mechanism to facilitate the transfer of the technology to the metal casting industry at the earliest practicable time."

In response to this emphasis on technology transfer, the University of Northern Iowa Metal Casting Center designated that one of the four thrust areas in its proposal would focus on gathering data concerning the technology transfer activities, and the source of those activities, that were currently taking place in the metal casting industry. The project sought the opinion of two groups in the metal casting industry, (a) the operating user (foundries and other metal casting producers), and (b) purveyors, (persons involved in transferring information or research data). Both groups were asked what was working, what was not, and what were some promising and innovative programs that are taking place or should be tried. This information was deemed to be beneficial to the industry by providing guidance and insight for evaluation of current and future programs.

II. BACKGROUND

The metal casting industry is quite diverse. It is comprised of metal casters ranging in size from large corporations with thousands of workers to the small proprietor owned shop of four or five employees. They work with a wide range of metals and utilize a plethora of manufacturing processes and techniques to produce their product.

According to the American Foundrymen's Society, 80% of metal casting companies have 100 or less employees. The larger companies seem to acquire the technology they need in a more expeditious way and have more resources at their disposal than do small companies. However, since there are so many more small companies, technology transfer is a particular problem that has national significance for the future of the metal casting industry.

There are four meaningful ways to classify metal casters: (a) tons/capacity produced, (b) types of metal cast, (c) number of employees, and (d) geographical location. The selection of interviewees was based on the type of metal, number of employees, and geographic distribution. The most important selection factor of the study was the number of employees. The rationale was that larger companies had more resources and personnel to access the

technology they needed and desired. Typically, smaller companies are more at risk, due to their lack of personnel and resources. While national trade associations and professional societies serve the industry through conferences, workshops, and publications, small metal casters may not participate in nor be aware of these activities and, therefore, will not benefit from the vital information and new technological advances which these national trade and professional societies provide. If many small metal casters do not participate in the activities or use the resources of the professional societies / trade organizations, then the question is where and how do they acquire appropriate or new technology? This is the main question this study addresses.

In this time of rapid technical and product market changes and increased global competition, it is imperative that metal casters receive new technologies to bring them to the forefront of product manufacturing. This is especially true for small metal casting manufacturers, whose main business is jobbing. The job shop, by its very nature, is labor intensive. This presents a challenge to U.S. metal casters when it comes to competing with foreign companies, who, in many cases, have labor and environmental costs considerably lower than those found in the U.S. One strategy for U.S. metal casters to be competitive is to avail themselves of new technologies that will provide cost saving benefits through improved and more efficient manufacturing processes. U.S. metal casters are threatened by the loss of business resulting from downstream importation of castings used in products such as automobiles. Unless U.S. metal casters can, in a timely manner, avail themselves of this new and appropriate technology, their future prosperity and ability to be competitive in the world and domestic market may be in jeopardy.

III. OBJECTIVES

This research project had five objectives:

1. To identify what current technology transfer mechanisms are being used in the metal casting industry and ascertain their effectiveness.
2. To identify and categorize what information is needed by small metal casters.
3. To identify current and potentially promising technology transfer mechanisms.
4. To design a plan for technology transfer that could be field tested on a regional scale.
5. To establish the potential cost and energy savings that would ensue from a technology transfer plan. (This objective was not met by the project, as the wide range in variables precluded reliable estimates.)

IV. FINDINGS ON QUESTIONS TO METAL CASTERS

A. Organization of summary and discussion section

As previously stated, the two separate groups interviewed were the metal casting owners, who operate plants, and the purveyors of information. In the summary and discussion of findings, the results of these interviews are presented separately. The analytical procedure was to (a) state the question, (b) summarize the answers, (c) follow-up discussion of the responses indicating what was considered significant, and finally (d) to state the conclusions drawn from the responses. In the following discussion, the numbers in parentheses indicate the frequency with which a particular response item was referenced. Each interviewee could respond to as many items as they choose. A total of thirty-eight metal casters were interviewed, thirty by phone and eight by on-site visits.

B. Summary and Discussion of Findings of the Questions Asked Metal Casters.

1. Question one: What do you think of when you hear technology transfer?

a. Summary of answers (not ranked).

- + Better way of doing whatever you're doing.
- + Transfer of useful information from institution to business.
- + Taking information and putting it to a practical use.
- + Technology transfer is part of a total philosophy of how you conduct your business.
- + Methods or processes, a way of doing something. (Better was implied)
- + High Tech equipment.
- + Any technical system that can be adapted for use in the foundry.
- + Ideas conveyed elsewhere and put on the market.
- + Innovative new processes.
- + Modernization in factory to produce items quicker for less.
- + New ways of doing things and sharing it.
- + Staying with the state of the art.
- + Information flowing from research people to people who will use it.

b. Discussion.

This question was asked to prompt the interviewee to focus on the issue of technology transfer and to get the conversation flowing freely. It was not a question that could be answered with a simple yes or no, but had to be thought out and put into their own words. The interviewee's answer also helped in understanding whether the person characterized it as information, a process, or equipment.

c. Conclusions.

A central theme that emerged in the answers to this question was that technology transfer is viewed from a practical point of view. It is seen as a problem solving tool for practical problems and not as a transfer of abstract theoretical information. If the respondent referred to technology as equipment, then it was referred to as technical equipment that would benefit the company -- usually some specific item was referenced. In either case, it was related specifically to the individual's production problems. Several respondents stated that technology transfer was whatever it took to enable the company to do something better to meet their customers needs. Only one person spoke of technology transfer in an abstract way.

2. Question two : What particular modes of technology transfer has your company found most successful? Along with this question the follow-up question was asked. What made it successful? Where did you get it?

a. Summary of answers. Each respondent could indicate as many sources as they wished.

- + Vendors, Suppliers, or Salesmen. (26) - used interchangeably
- + Trade Journals. (25)
- + Create it Ourselves. (18)
- + Seminars and Schools. (18) - includes AFS chapter meetings)
- + Conventions and Shows. (15) - AFS and others
- + Outside Consultants. (14)
- + Universities or Technical Colleges. (10) - Of this number one company received help from a University in Scotland where their supplier was located
- + Technical Books and Papers. (7) - includes society literature
- + Talking to Other Metal Casters Still Active in Business. (7)
- + Retired Persons, Former Employees. (5)
- + Societies in General. (4) - AFS, NADCA, SFS, NFFS
- + Equipment Shows. (3)
- + AFS Library, Technical Search. (2)
- + Chamber of Commerce. (1)
- + One interviewee listed all of the following: Federal Labs, Private Labs, Department of Energy Workshops and Federal Agencies. However, it should be noted this was a foundry that was a subsidiary of a much larger company and had 100 employees in the foundry.
- + OSHA. (1)
- + Technical Papers. (1)

b. Discussion

The one point that virtually every one stressed as the most important factor was a "one-on-one" relationship. They emphasized the point that it was in the talking and sharing of ideas between individuals where they really could ask

questions and come to understand what they needed. This appeared to be the main facilitating factor according to the people interviewed.

The following section is a point by point examination of where they obtained the technology they needed.

+ Vendors or Suppliers, or Salesman. (26) - used interchangeably

This was the most frequently cited source for technology. One impression received regarding V/S was that the talent of the V/S representative was an important factor in whether the interviewee found them valuable. From what was said, it appeared that the representative who was knowledgeable and helped his client solve problems was used by the operators. Several interviewees who felt that the V/S was their number one source of technology could name the specific problems that the V/S had helped them solve. Two interviewees who said they did not receive any help from this area commented that most V/S representatives had little practical knowledge of metal casting or of their own product. They said they were order takers, rather than resources to help you solve your problems. This thought was expressed by all the persons who didn't view V/S as a source of technology.

+ Trade Journals. (25)

Journals from various disciplines, as well as specific metal casting journals were read. The most frequently mentioned journals were, Modern Casting, and Foundry Management and Technology. The journals they read varied, depending on the particular product that the metal caster produced and the materials and equipment they used. All interviewees regretted the fact that they didn't have time to keep up on their reading. When asked about papers presented at conferences or technical society meetings, their responses were that they seldom used them because they were written in such an academic style that they weren't very helpful and usually were not related to their specific interest or area of concern.

+ Create it Ourselves. (18)

When asked to elaborate on this response, the discussion showed that small operators are usually aware of the existence of needed technology, but in many cases either don't know where to get it or don't have the money to buy it, so they often develop their own. In most cases this is an eclectic and innovative process. Several of the places visited had developed their own software and trained their shop people to use it. In several cases the owners or sons were trained engineers. In several other cases, a person who had bought out the company was a trained engineer or the son of the owner had gone to college and had the expertise to develop needed technology. In some cases they hired a person who had knowledge in the needed field, who became their research person charged with developing technology for the company.

+ Seminars and Schools. (18) - including AFS chapter meetings

About half of the metal casters interviewed attended some sort of meeting conducted specifically for metal casters, such as Cast Metals Institute seminars, AFS chapter meetings or special workshops conducted by vendors. A majority of the persons interviewed said they would attend meetings if they were of specific interest to their production or manufacturing processes. Many of the interviewees commented that most of the seminars were not geared for the small operator who was a jobber, but were more for shops that had larger runs and had more sophisticated equipment.

+ Conventions and Shows. (15)

Fifteen interviewees responded that they acquired technology at shows. Those who did not attend were asked why. The two main reasons given were: (a) not having the time to get away, and (b) the cost of attendance. The 1993 AFS Cast Expo experimented with holding the show over a weekend. This was a positive move in addressing the issue of foundry-people not being able to take time to attend shows. According to AFS records the attendance of workers below the executive officers (for those looking at equipment substantially increased). The attendance at technical sessions did not change. This appears to be one answer to the lack of time problem.

+ Outside Consultants. (14)

Fourteen interviewees said that they used consultants to help solve specific problems. Those who never used consultants offered two reasons why they were not used: one was that they had no perceived need for them, and the second was a perception of not being able to afford them. In cases where outside consultants were used, it was for such items as special equipment installation, or in solving problems dealing with governmental agencies, such as EPA regulations. They would probably be used more if the operators saw a specific need for them, and if they felt there would be a quick payback. Another factor that is operating here is the personal relationship between the foundrymen and the consultant. The respondents indicated that consultants would be used more if the foundrymen knew them personally and respected their expertise. For example, the use of retired foundrymen is, in effect, the same thing as using consultants. The use of consultants appears to be a problem of perceived value on the part of the operators. They seem to be more prone to use consultants in areas where they have little or no expertise (i.e. governmental regulations).

+ Universities or Technical Colleges. (10)

The following is a list of schools and the assistance they offered to metal casters:

San Diego University	-----
University of Iowa	CAD/CAM assistance
University of Northern Iowa	environmental regulations and metal problems
University of Missouri/Rolla/Columbia	metal analysis
Michigan State	varied
Purdue	testing
University of Dundee/Scotland	processes
Penn State	varied
University of Tennessee	gas in metals
University of Arizona	energy analysis
Colorado State University	process control / OSHA
Unspecified (used college professors as consultants)	

The response in this area is significant in that the only time a contact was made, it was related to a particular need of the metal caster, and the contact was usually initiated by the metal caster rather than the university.

+ Technical Books. (7)

Most of the use in this area was related to the technical societies, the books were society publications.

+ Talking to Other Metal Casters Still Active in Business. (7)

Other foundrymen were mentioned by seven of the interviewees as both a main source, and a main way they derived the technology they needed. They were identified as one of the most valuable ways of getting new technology and needed information. The remark that technology transfer had to be "one-on-one" was used by the majority of persons interviewed. Even when they talked about seminars or trade shows, they said that the way they picked up what they needed was through talking and visiting with individuals. Often the conversation took place in an informal setting. This source of information supports the argument for belonging to a professional society.

+ Retired Persons, Former Employees. (5)

Five of the interviewees said they consulted with retired metal casters on certain specific problems. They responded that they would like to see a listing of other retired experienced foundrymen they could use when specific problems arose.

+ Societies in General. (4) - (AFS, NADCA, SFS)

With respect to the technical societies, most responses did not name the technical societies specifically, but referred to the specific area of help they received from the societies. This may indicate that many users of services provided by the societies do not always make the connection between the service and the society. This is a perception problem that may need attention by the societies -- possibly to blow their own horn more effectively. In analyzing the responses of the interviewees, 24 of them had used resources from one or more of their professional societies.

The interviewees were asked to evaluate the role of societies in technology transfer, in terms of what they do well, what they don't do well and how they could improve. The respondents that had used the seminars stated that generally, they were good when they got the participants involved. Just straight lecturing and handing out information was not seen as very effective. Discussions that involved the participant or made an attempt to relate the subject to the problems of the individual operating foundry were seen as very useful. One of the problems touched on by all the interviewees who used the societies' resources, was the difficulty of sending people long distances to attend classes or seminars. This created a problem for small businesses in two ways. First, they could not spare key personnel for the time they were away, (in small shops the loss of a key person for several days often delayed getting orders out the door, this is especially true with on-demand inventory). The second problem was the out-of-pocket expenses for room, board, travel, and tuition fees.

There was a general feeling expressed by all the participants that the societies' technical help was more often geared to larger operators, and was more relevant to large scale operations than to small operators. Several stated that the new technologies and research the societies were looking into were only tangentially relevant to their operations.

+ Equipment Shows Other Than Metal Casting Technical Societies. (3)

Some respondents indicated they attended shows of their vendors, or shows of their customers, and found these useful.

+ AFS Library, Technical Searches. (2)

Only two of the persons interviewed indicated they used the AFS Library, and both of them were active AFS members and former officers. It may be that the Library is used directly in relation to how many persons are aware of it. This is speculation, but it could be ascertained fairly easily.

+ Chamber of Commerce. (1)

One respondent cited the local chamber of commerce as a source for technology. Their definition of technology was information with respect to governmental regulations. The local chamber offered assistance with waste disposal regulations.

+ OSHA. (1)

One respondent in a very small state said that the OSHA people were very helpful to him, and worked with him to develop his plant and solve various problems. This seemed to be the exception rather than the rule.

3. Question Three: What technology is needed by operators of small metal casting plants? (What help do you need?)

a. Summary of Answers

- + Governmental Regulations. (11)
- + New Equipment. (7)
- + Waste Recovery. (6) - getting scrap and waste down
- + Sand Practices. (5)
- + Melting Techniques. (4)
- + Energy Recovery. (4)
- + Metallurgy. (4)
- + Not High Tech., Just Off the Shelf. (4)
- + Molding Processes and Procedures. (3)
- + Quality Control. (3)
- + Dust Collection. (3)
- + How to Use Computer. (2) - CAD/CAM
- + Increase Permanent Mold and Die Life. (2)
- + Ceramic Cores. (1)
- + Dust Collection. (1)
- + Defect Analysis. (1)
- + State-of-the-Art Melting. (1)
- + What it Takes to Meet Our Customer's Requirements. (1)
- + Ductile Processes. (1)
- + Extrusion of Ceramic Cores. (1)
- + Help on ISO 9000. (1)
- + Gas in Metals. (1)
- + Stereo-Lithography. (1)
- + Recycling Water. (1)
- + Help in Core-Making. (1)
- + Don't Need Cutting-Edge Technology, Just What is Dependable and Proven. (1)
- + Trained People in Metal Casting. (1)
- + Metal Shrinkage. (1)
- + Extruding Ceramic Cores. (1)
- + Tensile Strength Research. (1)
- + Heating and Cooling Stress Factors. (1)
- + Quicker Way of Finding Information. (1)

b. Discussion

This list shows the wide diversity of information and help that operators need. It also reveals that most small operators do not perceive a need for what they conceive of as "High Tech", of course the definition of what is high tech changes from individual to individual. What they seem to indicate is that for them technology development is problem driven. The kind of technology they want is what helps them. They see the world from their own position. This is probably true of all companies. The important fact is that while the small operator is aware that research is being done by universities, government labs and government funded research programs, he feels most of it is not relevant to his needs, and what is relevant he has difficulty finding.

It is somewhat surprising to find the item of governmental regulations at the top of this list. This would not usually be considered technology. The interviewees defined technology as information, and they stated they needed information that would help them deal with this problem area.

The second item on the list was waste recovery. This item shows that metal casters are conscious of efficiency and would like to find ways to economize and be environmentally aware. It is worth mentioning here that the Iowa Waste Reduction Center, at the University of Northern Iowa has successfully worked with small foundries on governmental regulations. The Sand Reclamation Project at the Metal Casting Center, has also attracted a great deal of interest by small foundries.

4. Question Four : What limits (or restrains) you from acquiring new technology or the technology you need?

a. Summary of answers (ranked)

- + Lack of Capital or Money. (25)
- + Government Regulations and Red Tape. (17)
- + Lack of Time to Pursue it. (11)
- + Lack of Personnel to Pursue it. (8)
- + Foreign Competition. (3) - Market Unsure, Wouldn't Payback
- + Unsure of Future Laws and Regulations. (2)
- + If I Don't See a Fairly Immediate Payback I'm Not Interested. (2)
- + Not Knowing Where to Find Information. (1)
- + Lack of Production Orders to Justify Investment. (1)
- + No Space to Test in Plant. (1)
- + Don't Know Where to Get it. (1)
- + Geographical Isolation. (1) - plant in North Dakota
- + Insurance Liability. (1)

b. Discussion

There is a relationship between the three items of lack of time, lack of capital, and lack of personnel. It is very difficult for small shops to take time away from production problems to explore new technologies and to study the many ramifications of what that technology could have for them. Many of the CEOs of the small companies have the ability to find or develop needed technology, but they do not have the time. An associated area is the shortage of money – this limits small operators when they are not able to hire additional personnel to help them develop or find the technology the company needs. A lack of capital also limits small companies from purchasing needed equipment. With a limited amount of resources, some of the helpful equipment would not be justified by their small production runs. This is particularly true for the job shop that produces only three or four pieces at a time. Small metal casters that have short jobbing runs have difficulty providing rational and financial figures for justifying new equipment purchases to financial lending institutions. It is tenuous, at best, to project payback on large capital investment based on small orders from other companies, with no guarantee of their long range business. One area that needs examination is how governmental tax policies, (both state and federal), could be changed to address this problem.

The number two answer the respondents gave was government regulations and red tape. A good illustration was given by one respondent when he talked about wanting to install some new capital equipment which needed a permit. The old equipment was already approved, the new equipment needed a new permit. The problem was a new permit would not be issued to the company until the new equipment was installed and run through a series of tests. If the new equipment, which was already on the market and installed in other out of state locations, did not perform satisfactorily for the regulating agencies computer modeling and stack tests, the company, (who was billed \$5,000 for the tests), would be denied the use of it even though it was already installed. Needless to say the company has not invested in the new technology. This was not an isolated story, similar problems and examples were cited by many of the interviewees. The U.S. can develop all the technology it needs, but if bureaucratic roadblocks are not minimized, small metal casters will not make use of new technology. The present system rewards the status quo and does not encourage innovation and change. Associated with this same problem is the uncertainty metal casters have over how new laws will impact on their businesses. In numerous cases, the persons interviewed said they were afraid to change their present procedure of operation and their equipment, without knowing if new equipment and procedures would pass future standards.

In conclusion, it is apparent that small metal casters lack important resources to find and adapt technology. There is a need for small companies to grow, so they can have more resources to avail themselves of technology. In the interim, some subsidized support for technology transfer programs would help small metal casters avail themselves of new and appropriate technologies.

5. Question Five: Do you ever receive any help in terms of technology transfer from universities? If yes, then what; and if no, why not?

a. Summary of answers

- + No Help. (31)
- + Yes. (9)
- + Doesn't Seem to Fit. (1)
- + Hard to Get A Hold of. (2)
- + Too Theoretical, Not Related to Our Needs. (5)
- + Slow to Respond. (2)

b. Discussion

About 25% of the interviewees have received some help from universities. The universities and the help they offered was listed on Page 7 of this report. The second question was asked to ascertain why there was such little relationship between the metal caster and the university. The main answer given was that, from the point of view of the metal casters, universities are too theoretical and do not address the needs of the metal casters. The validity of this judgement depends upon the individual university. Some universities provided pertinent technology for some of the respondents. Overall, it would appear that only a select, few universities provide meaningful help for small metal casters; and this is not a major source of new technology for metal casters.

Several of the respondents indicated their desire that universities would provide educational opportunities for persons interested in going into metal casting. They added the comment that the education should be both hands-on, as well as theoretical. The interviewee who indicated they had received help from the university in Scotland felt that European universities were better at providing practical education than were the universities in the United States.

6. Question Six: What would you like to see happen, that you think would benefit the small businessman, such as yourself, in acquiring technology?

a. Summary of Answers (no order of ranking)

- + Set up a Way of Contacting Retired Foundrymen as a Resource.
- + Coop Program or Summer Intern with FEF.
- + Expand CMI Local Courses (In-Shop if Possible).
- + Some Subsidy for CMI Courses for Small Operators.
- + Use of Video Tapes for Training and Spreading New Ideas.
- + Government More of a Partner, Less of an Adversary.
- + Instead of Grants to Universities, Give Them to Small Foundries.
- + Make Something Small Foundries can Afford to Buy.
- + Have Training Classes in Plant.
- + Would Like Some Place to go to Understand Government Regulations.
- + Would Like to See More Round Tables on Practical Topics.
- + Tax Incentives for Small Foundries.
- + More Interaction Between Metal Casters.
- + Place Where Equipment Could be Demonstrated to Small Metal Casters.
- + Help With Equipment Capital Funding for Small Metal Casters.
- + Computerized Database Available for Information on Sources of Suppliers and Resource People.
- + Government to Treat Small Firms Different Than Larger Ones on Reports and Equipment Depreciation Rates.
- + Less Government Regulations and Paperwork.
- + Videos of Seminars to Take Back to Plant.
- + Information on Metal Casting From Federal Labs Made Available on Database.

b. Discussion

In the section on recommendations many of these items will be discussed and recommendations made regarding them.

V. RECOMMENDATIONS

A. Preface

This project was developed because of a growing concern over the decline of the metal casting industry in the United States. This decline has been extensively documented. Some of the main points were cited in a December 14, 1991 article in the journal *Glesserei*, "American Foundry Industry Suffers From Severe Overcapacity". While not everyone might agree with the assumption that this is due to overcapacity, the facts that document the decline are valid.

- # From 1980 to 1991 the number of U.S. foundries has declined from 4,360 to 3,260, a 27% decline. The greatest in any western country.
- # The decline in small foundries with under 100 employees was from 1754 foundries to 1191, a decline of 32%.
- # There was a 28.1% decline in total number of tons poured during the same period.

These figures do not indicate the many foundries that have not closed, but have greatly reduced their workforce or have reduced their workdays, so that many employees are working only part time.

It was because of this trend and the importance of the metal casting industry to the national security and economic well being of the United States that the "Department of Energy Metal Casting Competitiveness Research Act of 1990" was enacted. This research project was an outcome of that act. Even as research is encouraged to modernize and strengthen the metal casting industry; for that research to have a positive impact it must reach the plant floor of the nation's metal casters.

This section of the report fulfills the third and fourth objectives of the project. These were:

- Objective Three: To identify current and potentially promising technology transfer mechanisms.
- Objective Four: To design a plan for technology transfer that could be field tested on a regional scale.

B. Conclusions and Rationale

The following items comprise the conclusions that were drawn from the responses given by the interviewees -- they form the underlying assumptions that guided the development of the recommendations.

1. The private sector of the metal casting industry should be mainly responsible for technology transfer. This means, primarily, the technical societies and the individual metal caster. The role of governmental units, universities, or private research

institutes is to cooperate with the industry -- the small metal casting operators, and to support them in mutually agreed upon ways.

2. Both research and technology transfer are essential ingredients in strengthening the metal casting industry. Both activities should be supported and coordinated, with resources dedicated to both activities.
3. Most individuals familiar with the metal casting industry (at least those that were interviewed in this project), agreed that there is a need for more efficient and effective modes of technology transfer. A number of those interviewed believe that a new paradigm for technology transfer is needed, particularly for small metal casting operations.
4. A special effort needs to be made to assist the small metal casting operators in the area of technology transfer. If technology transfer is a priority of the government then it is essential and appropriate that some federal funding be dedicated to this task.
5. The technology that is needed by larger companies is not necessarily the same as that needed by smaller companies. The needed technology is most appropriately determined by the primary user, i.e. the local operator.
6. Technology transfer for the small individual metal caster, in most cases, should be driven by a problem solving model rather than by an information transfer model.
7. For the small operator the importance of one-on-one contact in the transfer of technology cannot be overemphasized. It is a vital ingredient of the process. It is very important, however, that personnel involved in this process be experienced and respected by the small operator.
8. Technology that is needed by the individual metal caster means any information, process, or equipment, or combination thereof, which enables the small metal caster to solve his problem.
9. The most desired way of effecting information technology transfer for the small metal caster, is to do it in the plant or as close to the recipient as possible.
10. The individual metal casters' problems were varied. There is no single source which will provide all the answers. Therefore, a degree of cooperation and communication between the various sources will be beneficial to all.
11. To benefit the small metal caster in technology transfer, two major activities should be carried on simultaneously: (a) current activities of the professional societies, universities, governmental entities, and private research institutes should be reexamined and evaluated in the light of the needs of small operations, and they should be encouraged and supported in making effective changes. (b) New ideas and models for technology transfer should be formulated and tested; and when possible, all interested parties (societies, individual metal casters, universities, private research groups, governmental agencies) should form coalitions to cooperate in this endeavor.

12. Due to the multitude of laws and regulations propagated by governmental agencies, the status quo is rewarded more than innovation. The laws, as currently administered, are viewed by the small metal casting operator as impediments to change, and place burdensome roadblocks in the way of small operators.
13. The majority of appropriate technology that small metal casting operators need is currently in existence.
14. The main problems the small metal casters have are: (a) lack of financial resources to acquire the technology needed, (b) the lack of personnel and time to evaluate and adapt appropriate technology, and (c) the problem of finding the appropriate and needed technology.
15. The lack of capital for new equipment and updating of old is a major impediment to acquiring new technology.
16. Metal casters from small sized firms are liable to get more out of meetings with other metal casters from similar sized operations with similar problems.

C. Recommendations for Improving Technology Transfer for the Small Metal Casting Operator.

1. The technical societies should consider the different types of problems faced by different sized companies when they plan their seminars and conventions. Sessions should be formulated for discussion on topics that are relevant to the size of plant or operation. Emphasis should be on practical, off-the-shelf technology, answering a current need.
2. Updating and training should be carried on as close to the plant floor as feasible.
3. There should be an in depth examination of possible ways in which either tax incentives, governmental grants or programs, and depreciation schedules could assist the small metal caster in acquiring needed technological equipment.
4. Governmental regulatory agencies should examine the tack they take with small metal casters, and consider an advisory posture (prior to an adversarial position) to explore whether there are options for working out problems in the workplace. There is precedent for this in the one OSHA office that was cited as an actual help to a company, rather than an adversary.
5. Governmental labs should initiate a program of dialogue with small metal casters, to see if there is any technology they have which is not so esoteric and specialized that it might be of some use to the small operations.

D. Recommendations for Experimental Programs That Should be Considered.

1. Experienced Foundrymen Service Corps.

A service corps of retired foundrymen would make available a wealth of information to the industry. With the experience these people have, they represent a broad and in-depth resource pool that could be utilized, and they would also be accepted by the industry. Several of the companies interviewed used retirees as a resource for technology. The Metal Casting Center at the University of Northern Iowa has called on these people for consultation and help, and they have proven to be of great benefit. This Corps could be modeled after the International Executive Service Corps, (IESC). The IESC is a group of some 10,000 volunteers from the ranks of retired business executives who assist third world countries in solving specific problems in which the volunteer has experience. These volunteers are assigned to a specific project, which might last from two weeks to three months. Transportation and living expenses are provided for the volunteer and his wife, but no compensation is offered. Funding comes from the U.S. Government, private industry, and the client company -- depending on ability to pay:

If this were extended to the metal casting industry, persons with experience could be found to offer help and advice in all metal casting operation areas, from core making to molding, etc. A sliding fee scale, perhaps tied to size or sales volume, could be established. There would need to be a data bank established, which would give all the particulars on individuals. This could be done with an 800 number, and run by any number of existing institutions, or professional societies. Cooperation would be needed with local and state chapters of technical societies, and governmental information agencies. Federal funds in the form of a grant or demonstration project should be considered for this.

2. Video Informational and Training Tapes.

One idea that was mentioned by those interviewed, was the use of video tapes for the spread of "hands-on" applications of certain foundry processes. Small companies could use them for review or training of new employees. There could be a quarterly series that covered new developments and new techniques in the different areas of metal casting. Several people who recommended this cautioned that these would best be used as adjuncts to learning situations, for example as a part of a training course where the participants could then apply what they just saw.

3. Electronic Bulletin Board.

With the advent of PCs, there are new possibilities for the use of electronic communications. The Metal Casting Center at the University of Northern Iowa is initiating a Metal Casters Bulletin Board. With this program the metal casters in Iowa will have access to a central bulletin board. Items that will be on the board will include resources of individuals who have special expertise in specific areas of metal casting technology, notice of meetings and cluster group programs, special problems that local operators want help with. This program is being developed in cooperation

with the Steel Founders' Society of America and the American Foundrymen's Society.

4. **Government Regulations Informational Resource Program.**

If there is one area where metal casters want help it is in understanding and dealing with governmental regulations at both the state and national levels. The main concern seems to be in the area of environmental and waste disposal laws. A resource center should be established on a regional scale for the metal casting industry. This center should be familiar with federal and state laws within its region, which apply to foundries and metal casters. This is an area where cooperation between professional societies, state and federal governmental agencies and universities could provide a vital and badly needed service for the metal casting industry.

E. Recommendations for Regional Technology Transfer Plan.

1. **Objectives of Plan**

- First Objective:** To assist small metal casting operators in accessing appropriate and new technology for use in meeting their needs.
- Second Objective:** To bring together, in a coalition, those parties who are involved in the metal casting industry i.e. small metal casting operators, professional societies, universities, community and technical colleges, independent research institutes, governmental agencies both state and federal, in a united effort to provide a structure for the enhancement and support of technology transfer activities on a regional basis.

2. **Basis of Recommended Plan**

This plan is based on the experience of the professional societies and the model of the UNI Metal Casting Center. The basic concept of the plan is to foster the development of small cell groups that meet on a regular basis. In Iowa there are now 6 cell groups meeting with a membership of 47 Iowa metal casters. The cell groups set their own agenda (need driven) and the Metal Casting Center Field Representative responds to that agenda by searching out resources for what the cell groups want. Resources are sought from many areas; professional societies, specialists, other foundries, universities, etc.

3. **Expansion of Plan**

The Iowa program is already in operation and its program should be expanded to test the four new ideas recommended in this report: the Foundrymen Service Corps, Video informational training tapes, Electronic Bulletin Board (already in process) and the Governmental Regulations Informational Resource Program. This should be a cooperative effort between the UNI Metal Casting Center and the professional societies.

While this is taking place, an effort should be made to assist other interested regions in the development of this type of a program. The two regions suggested are the states adjacent to Iowa, and the west coast. Contact should be made with surrounding states such as Minnesota, Wisconsin, Illinois and South Dakota, and the west coast states to explore their interest and discuss possible forms of cooperation. After holding these discussions with all interested parties, a program for these regions could be developed and steps taken to implement it.

It is premature to attempt to describe the exact relationship between the cooperating parties. It is sufficient to note that there is cooperation in the Iowa program among the universities, the area colleges, the state and the professional societies. Each region will need to define its own relationships and unique way of operating. However, the cell group concept and having the agenda set by the operators must be basic to any operation.

4. Funding

Some funding should be made available by the federal government for this activity. The current Iowa program is funded by the University of Northern Iowa and the state through the Wallace Technology Transfer Corporation. The professional societies (AFS & SFS) have committed resources to helping establish the Electronic Bulletin Board for the coming year.

To carry out the activities herein described, funding in the amount of \$1.25 million should be committed. This would provide support for two years at the rate of \$500,000 for year one and \$750,000 for year two. At the end of two years, an evaluation should be made and future funding concerns addressed.

VII. METHODOLOGY

A. Preface

This project had two phases. The first was an on-site visit of nine foundries and purveyors by either Mr. Davis or Mr. Griffiee, in some cases it was a joint visit. Persons were interviewed in-depth, and asked the survey questions. Phase two of the project was a telephone survey of thirty additional metal casters.

B. Investigators

This project had two investigators. The first was Stubbs Davis, who has over thirty years of experience in the metal casting industry. He has served as a manufacturer, a works manager, a consultant for metal casting companies, and as a member of the Board of Directors of the American Foundrymen's Society. The second investigator was Bill Griffiee, a technical writer and consultant, who has had a wide range of experience in working with both management and labor as a mediator, arbitrator and personnel director. He also teaches writing at Wartburg College in Waverly, IA and is a professional grant writer. The telephone survey was done by Mr. Griffiee.

C. Approach

This project was developed in conjunction with the professional societies. Due to fiscal limitations, it was not possible to contact all of the many professional societies. The main professional societies consulted were: the American Foundrymen's Society, the Cast Metals Institute, Inc., the Steel Founders' Society of America, the Non-Ferrous Founders' Society and North American Die Casting Association.

The investigators met with representatives of the above societies and solicited names of people and companies that they would recommend for interviewing. The approach was to interview people from two different groups, operators and purveyors. The operators were individuals who were currently operating metal casting businesses, and the purveyors were persons familiar with technology transfer in the metal casting industry through their capacity as society personnel, governmental agency personnel, academic or private research companies. This approach enabled the investigators to approach the problem of technology transfer from a broad perspective.

There were three criteria used to pick the operator interviewees: (a) companies had to be small, having around 100 employees or less; (b) there should be a good cross section of different types of metal casters represented (i.e. ductile iron, grey iron, steel, aluminum, brass, etc.); (c) the choices should represent a wide geographical selection. Interviewees were selected who had been active in the respective societies and used their resources, and some who had not. At a meeting with the professional societies, both kinds of interviewees were selected, those who were active in the professional societies and those who made little, if any, use of their technical society resources.

Finally, we added to our list the purveyors. Our criteria for choosing these people were: (a) we wanted different individuals from a wide range of backgrounds (i.e. academia, independent research, governmental agencies, etc.); (b) we wanted people with a variety of ideas, and (c) they must be knowledgeable concerning the metal casting industry.

We do not make the claim that this is a highly scientific, statistically formulated sampling; but we do believe that it represents a good cross section of persons who have had years of experience in the metal casting industry, either as operators or as purveyors. We also wanted people who were currently actively involved in the metal casting industry or in the transfer of metal casting technology.

Our final list of interviewees included nine companies: four from the west coast, three from the midwest, one from the south, and one from the east. One foundry from the west employed 165 workers, which was outside our established size parameters. However, we did interview them to ascertain if their views on technology transfer were dissimilar to those of the smaller metal casting operators. We did find a significant difference in the fact that the larger company had more resources and money at their disposal, so they were not subject to the same limitations in acquiring technology, that applied to the small operators.

D. Procedure

The following procedure was used in carrying out this project. Using the program objectives as the guide, a set of interview questions were designed (see appendix). Since the interviewees were divided into two different groups, (current operators and industry personnel associated with technology transfer or purveyors) the questions had small variations in them -- but overall, were designed to provide information to achieve the objectives of the study. The questions were open-ended, and designed to encourage the interviewee to elaborate on their answer to the fullest extent. This procedure was preferred over a multiple choice approach, as it would not restrict the answers to a preconceived menu of items. Using these questions, the interviews were conducted on a face-to-face basis in Phase One. This required that, with an open format, such as had been designed, it would take a personal interviewer to record the answer. It was also believed that more in-depth information would be received in a face-to-face situation. The third reason interviews were conducted in this manner, was that it presented an opportunity to follow-up and encourage the interviewee to expand on alternative areas of thought; in summary, to probe the persons thinking, encourage them to elaborate on their ideas and to give examples.

When we finalized our interview list and completed our questionnaire, we interviewed several clients together. We each wrote up separate accounts of the interview, so as to have two different perspectives of what transpired. After comparison, it was apparent that both recorded accounts had recorded all the main points of the interview, and thus our questions seemed to be valid and eliciting responses which would enable us to address our research objectives.

After our initial interviews, we split the list, and each took responsibility for interviewing persons in our geographical area of the country. Stubbs Davis covered the west coast and Bill Griffie covered the midwest and south. There was one exception: we both met in California half-way through the project, and jointly interviewed a number of California metal casters. Again, we wrote up the interviews separately and compared notes. There was no major divergence on our reporting of these interviews over time.

Another point important to the methodology was how we approached the interviewees to ensure their cooperation. Initial contact was made by phone, often mentioning that they had been referred to us by their technical society. We then explained why we were doing this project, what we wanted to ask them, and how long we thought the interview would take. In cases where Stubbs Davis knew the people, he would make the call. We then asked for an appointment, at their convenience. Not a person we approached refused us an interview, and every one of them spent more time with us than we had originally planned. They were completely open and cooperative. It was an enjoyable experience to interview them.

The phone interviews were conducted by Mr Griffie, using the same format of questions. An introductory letter was also sent to the prospective interviewees, informing them who we were and why we were calling them.

APPENDIX A

List of Questions Asked

The following is a list of the questions asked of the interviewees. Because of the difference between operators and purveyors you will note a difference in the questions asked the two parties.

Question One:	What do you think of when you hear technology transfer?
Question Two:	What particular modes of technology transfer has your company found most successful? What made it successful? Where did you get it?
Question Three:	What technology is needed by operators of small metal casting plants? What do you need?
Question Four:	What limits or restrains you from acquiring new technology, or the technology you need?
Question Five:	Do you ever receive much help in terms of technology transfer from the universities? If yes, then what? If no, then why not?
Question Six:	What would you like to see happen, that you think would benefit small businessman such as yourself in acquiring technology?

APPENDIX B

Format for Letter of Introduction

Date
Address

Dear _____:

Allow me to introduce myself I am Dan Quick, the Director of the Metal Casting Center at the University of Northern Iowa I came here four years ago after spending thirty years in the metal casting business, in a wide variety of responsibilities Our center has a two-fold mission: first to educate students in foundry work by providing both classroom and hands-on experience; and second, to provide services to the regional metal casters

In addition to the above mission, we have been designated by the Department of Energy as one of two national metal casting centers in the United States.

One of our projects for the Department of Energy has been a study of small metal casters, to determine their concerns regarding technology transfer: the kind of technology they need and want; where they get it; and what have they found useful We have interviewed a number of owners of small metal casting firms on a face-to-face basis The DOE has asked us to expand the number of firms we have interviewed Unfortunately, we don't have the resources to contact everyone on this basis; therefore, we will expand our activities through telephone contacts We would appreciate it, if you would allow us to visit with you and include your opinions in our study results We are careful to protect the privacy of the individual by simply listing the firms we have contacted, and then summarizing the final results without identifying who has said what.

This interview will take 30 minutes, or less, and will be conducted at your convenience MrBill Griffie is conducting these interviews for us, and he will be doing the calling He will call you, and set up a time to visit with you that would be convenient for you Basically, he will ask you the four question listed above, and visit with you in more detail regarding them If there is a particular person, other than yourself, that you would want to answer these questions, would you please tell Bill when he calls you.

If we want the government to be responsive to our needs, or even to leave us alone, this is a way to channel that message to them I hope you will afford us a few minutes of your time and visit with us It will be greatly appreciated.

Sincerely,

Daniel B. Quick

APPENDIX C

List of Interviewed Metal Casting Firms

A Brass Foundry Inc. 2052 East Vernon Ave. Los Angeles, CA 90558	7	Copper	Bernie O'Hara Foundry TechMgr.
Roemer Electric Steel P.O.Box 156 Longview, WA 98632	35	Steel	Ken Roemer Foundry V.P.
Metal Dynamics Corp. 1145 Niroquois Tulsa, OK 74106	30	Aluminum	Cooper & Donald Doss President
Superior Aluminum 1211 S Powell Road Independence, MO 64051	12	Aluminum	Dwight Barnhard Owner & Pres.
Keokuk Prototype Foundry Inc. Keokuk, IA 52632	25-40	Alloy Steel	Ken McNew Owner & Pres.
Seneca Foundry, Inc. Box 142 Webster City, IA 50595	35	Gray/Ductile	Kirk McCullough V.P.
Brookman Cast Industries P.O.Box 302 Salem, OR 97303	28-30	High Alloy Stainless	Robert Brookman Owner & Pres.
Dameron Alloy Foundry * 927 South Santa Fe Compton, CA 90224	165	High Alloy Iron Investment	Jack Dameron Chairman of Board
Watson town Foundry 5th & Ash Watson town, PA 17777	20	Iron	Jim Stanley Plant Manager

Note:

- * *This foundry was larger than we realized and it was apparent that many of the problems that the smaller foundries had Dameron did not experience They are large enough to have more people and more capital They stated they didn't have much trouble in developing or finding the technology they needed They did have one thing in common with the smaller foundries: they felt government regulations were a real hassle, but they put people in charge of it, and handled it that way.*