

Iowa Industries
of the Future

Metal Casting
Vision and Roadmap



October 2001

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Metal Casting Vision & Roadmap

Iowa Industries of the Future

October 2001

Prepared by

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Section 1

Executive Summary

Four workshops were held in March through May of 2001 to gather input for the creation of a vision and a roadmap for Iowa metal casters. Although this Iowa Metal Casting Vision and Roadmap parallel the national documents in structure, they also identify unique needs of Iowa metal casters that must be addressed to insure the industry's viability. Following are the six areas identified in the vision and roadmap, and the top three priorities for Iowa metal casters.

Products and Markets

Goal: Increase casting sales by 10%

Vision: Iowa metal casters will be preferred suppliers because of compressed lead times, high-quality, value-enhancing solutions, competitive pricing, and ease of doing business.

Top priorities in the roadmap:

1. Train/educate engineers on foundry process and casting applications
2. Develop ways to demonstrate quality and value of cast metal products
3. Train/educate purchasers on casting applications

Materials Technology

Vision: Iowa metal casters will make effective use of scrap and virgin materials to economically produce higher value components that weigh less, provide better quality, and consume fewer units of energy to produce. Materials cast will be environmentally friendly. Metal casters will be able to quickly, effectively, and economically assess the chemistry of scrap and molten metals. Nondestructive techniques will provide fast accurate, cost effective means for determining cast product chemistries and properties.

Top priorities in the roadmap:

1. Develop environmentally benign, dimensionally stable molding and core make materials
2. Establish a correlation between casting properties and test bars
3. Develop longer life coatings for furnaces and molds

Manufacturing Technology

Goals: Increase overall productivity 15%; Reduce average lead times by 50%; Reduce energy consumption per unit value of shipments by 5%

Vision: Continuous improvement in casting processes, process control mechanisms, material for dies, patterns, cores and refractory material, heat treating, cleaning and post-processing, and energy efficiency will enhance the profitability and competitiveness of Iowa metal casters. Productivity will increase dramatically, consistent quality will be the norm, and production lead times will be slashed.

Top priorities in the roadmap:

1. Develop new technologies in cutting gates, vents and risers to reduce grinding
2. Develop modeling technology for all casting processes to include optimization of energy use
3. Provide energy audits

Environmental Technology

Goals: Reduce waste streams 25% in the short term; Totally eliminate all waste streams in the long term

Vision: The metal casters in Iowa and the governmental regulatory agencies will work cooperatively to continuously reduce environmental impact, eliminate waste streams, and continuously increase reuse and recycling. This will be done in a way that enhances the viability and competitiveness of metal casting in Iowa, and promotes the adoption of new technologies.

Top priorities in the roadmap:

1. Receive tax credits for implementation of technology needed for regulatory compliance (agencies works with, instead of against, industry)
2. Develop a system that has less paperwork for permits
3. Develop a state database to assist understanding of new regulations

Human Resources

Vision: The metal casters in Iowa will offer well-paying, challenging careers. They will retain the best people they currently employ by offering opportunities for professional enrichment. They will attract qualified personnel by supporting students who show interest in metal casting careers and by becoming more active with high school vocational arts and school-to-work programs. Metal casters will provide attractive opportunities for non-traditional workers such as women and non-English speaking minorities.

Top priorities in the roadmap:

1. Develop new training methods for in-house, self-directed education programs for all employees; courses—day or evening; need availability, flexibility, testing, privacy
2. Increase partnering with local, state, and national professional organizations, educational institutions, government agencies, etc.
3. Resolve ergonomic issues: develop new ways to do hard jobs without risk to personnel health

Profitability and Industry Health

Vision: Metal casters in Iowa will actively adopt best practices and adapt research developments to enhance the performance of their industry. Seeing the benefits in the form of higher profits, they will invest a higher portion of their increased profits into more R&D, thus creating an upward spiral that enhances the worldwide competitiveness of Iowa metal casters.

Top priorities in the roadmap:

1. Generate recognition by everyone, from the CEO on down, of the importance of customer service & customer satisfaction
2. Receive tax credits for R&D, environmental compliance, and technology upgrades
3. Gain access to capital for additional spending on new plants and equipment

Follow-through

The Metal Casting Center (MCC) at the University of Northern Iowa will lead the state's metal casting industry along this roadmap, in pursuit of the Iowa Vision in the coming years. To address the Iowa priorities, the MCC will form "Action Teams" that will assess the current situation and the available resources. Each team will then form an action plan for achieving the objective. The MCC will continue to work with the IOF Metal Casting Steering Committee to assure activities are properly focused.

Section 2

Iowa Vision & Roadmap Process Overview

Two vision workshops were held in March and April 2001. Representatives of eleven different Iowa metal casting companies attended them. During these sessions, the national document, “Beyond 2000: A vision for the American Metal Casting Industry” was introduced and discussed in detail. The objective was to then customize this document for the metal casting industry in Iowa.

Following these, two metal casting roadmap workshops were held in May. These sessions, building on the earlier vision sessions, had the goal of identifying what is needed by Iowa metal casters in order to reach their vision. Although this Iowa Metal Casting Vision and Roadmap parallel the national documents in structure, they also identify unique needs of Iowa metal casters that must be addressed to insure the industry’s viability.

Following these four public workshops, the director of the MCC personally visited or talked with approximately 20 more companies to get their input. After compiling the information from these various sources, the steering committee mailed the roadmap issues to all metal casting companies in Iowa, asking them to rank their priorities for each item. The items were divided into the same six areas as the national roadmap. They are:

1. Products and Markets
2. Materials Technology
3. Manufacturing Technology
4. Environmental technology
5. Human Resources
6. Profitability and Industry Health

Responses were received from half of the metal casters in the state, and the results of the rankings are the basis for this document.

The next step of the initiative is to identify resources to address these needs and to facilitate partnerships between industry and funding organizations to find solutions that will help Iowa metal caster’s competitiveness. A meeting was held in September 2001 with researchers and other resources that could assist Iowa’s metal casters in reaching their vision. This began a process that will be continued throughout the coming year by the Action Teams described in more detail in Section 10: Follow Through.

A web site has been established at ISU to update interested parties of the progress of the Iowa IOF. The address is:

- www.ciras.iastate.edu/iof/

Section 3

A Vision for the Metal Casting Industry

Iowa metal casters believe that the foundation of the state vision is working together. Metal casters will move into and out of business-sensible partnerships with each other, state educational institutions, governmental laboratories and professional societies in order to enhance their services to customers, and/or the well being of their employees, communities, owner/shareholders, and suppliers.

The industry in Iowa prides itself on its diversity and economic agility that derives from it. Future challenges to this industry will come less from competition among metal casters than from competing metal forming techniques, competing materials, and competing countries. These challenges can be met successfully only if the industry sets common goals and defines a means by which they can be achieved.

Since the majority of industry participants are small businesses, the industry is very vulnerable to expensive, and sometimes unnecessary, environmental and occupational regulations. Coupled with changing market conditions and increased global competition, this has resulted in attrition in the metal casting population.

The following series of statements collectively express the vision for the metal casting industry in the state of Iowa. These statements are inspired by the national document “A Vision for the American Metal Casting Industry.” After discussing the national vision, representatives of the leading metal casters in Iowa worked together to create this Iowa-aligned vision.

1. Products and Markets

Goal: Increase casting sales by 10%

Iowa metal casters will be preferred suppliers because of compressed lead times, high-quality, value-enhancing solutions, competitive pricing, and ease of doing business. Effective communication will flow freely throughout the supply chain. Engineers that design components will understand the capabilities of metal casting and specify cast parts where appropriate. Where casting technology lags, these engineers will communicate their needs to the metal casters.

Important areas that will contribute to this effort include:

- Develop casting conversion software
- Develop E-manufacturing
- Develop E-business systems from supplier through end-customer
- Train sales/marketing staff
- Train engineers on casting applications and advantages
- Develop dynamic business partnerships

2. Materials Technology

Iowa metal casters will make effective use of scrap and virgin materials to economically produce higher value components that weigh less, provide better quality, and consume fewer units of energy to produce. Materials cast will be environmentally friendly. Metal casters will be able to quickly, effectively, and economically assess the chemistry of scrap and molten metals. Nondestructive

techniques will provide fast accurate, cost effective means for determining cast product chemistries and properties.

Progress in the following areas will provide the industry major benefits:

- Develop new casting alloys
- Develop cast metal matrix composites
- Improve dimensional control of castings
- Eliminate casting defects such as porosity and inclusions
- Develop castings with thinner walls
- Identify and standardize cast metal properties
- Achieve flexibility to melt-pour different grades (alloys)
- Identify impurities in purchased scrap

3. Manufacturing Technology

Goals: Increase overall productivity 15%

Reduce average lead times by 50%

Reduce energy consumption per unit value of shipments by 5%

Continuous improvement in casting processes, process control mechanisms, material for dies, patterns, cores and refractory material, heat treating, cleaning and post-processing, and energy efficiency will enhance the profitability and competitiveness of Iowa metal casters. Productivity will increase dramatically, consistent quality will be the norm, and production lead times will be slashed. Expert systems will combine functional requirements, pattern design, and process technology (including solidification models) to provide superior performance characteristics.

Metal casters will exploit this potential and strengthen their competitiveness through research in the following areas:

- Improve control and interaction of process variables
- Improve surface finish of sand castings
- Compress lead times
- Automate finishing equipment to add value
- Extend life for diecasting dies, patterns, and core boxes
- Produce first-run castings that meet quality requirements
- Recover and re-use waste heat
- Develop advanced sensors and process controls
- Optimize melting and holding-furnace
- Develop energy (PLC) controllers
- Improve burner technology

4. Environmental technology

Goals: Reduce waste streams 25% in the short term

Totally eliminate all waste streams in the long term

The metal casters in Iowa and the governmental regulatory agencies will work cooperatively to continuously reduce environmental impact, eliminate waste streams, and continuously increase reuse and recycling. This will be done in a way that enhances the viability and competitiveness of metal casting in Iowa, and promotes the adoption of new technologies.

Successful research in the following areas will help Iowa metal casters reach these goals:

- Develop environmentally friendly cast metals

- Develop environmentally friendly sand binders and additives
- Complete characterization of waste streams for process modification
- Advance waste treatment technologies
- Develop alternative processes or materials to reduce waste generation
- Partner with regulating agencies
- Develop environmental information network

5. Human Resources

The metal casters in Iowa will offer well-paying, challenging careers. They will retain the best people they currently employ by offering opportunities for professional enrichment. They will attract qualified personnel by supporting students who show interest in metal casting careers and by becoming more active with high school vocational arts and school-to-work programs. Metal casters will provide attractive opportunities for non-traditional workers such as women and non-English speaking minorities.

The following will be improved or added to the industry's initiatives:

- Increase in-house education and training
- Attract more college students to metal casting curricula
- Sponsor high school vocational/apprenticeship programs-train for foundry skills
- Develop skilled trades training/apprenticeship programs
- Provide English/Spanish as second language
- Address ergonomic issues
- Retain the best laborers

6. Profitability and Industry Health

Metal casters in Iowa will actively adopt best practices and adapt research developments to enhance the performance of their industry. Seeing the benefits in the form of higher profits, they will invest a higher portion of their increased profits into more R&D, thus creating an upward spiral that enhances the worldwide competitiveness of Iowa metal casters.

The following areas will provide the industry major benefits:

- Increase R&D spending
- Increase collaborative partnerships
- Increase educational investments
- Transfer information and technology rapidly from research
- Increase spending for new plants and equipment

Conclusion

The vision outlined here cannot be achieved without collaboration between the metal casters of Iowa and the Iowa Energy Center, the Iowa Department of Natural Resources, US Department of Energy, the Iowa Metal Casting Center, CIRAS and Iowa State University Extension, and others. Working together to successfully achieve all aspects of this vision will indeed transform metal casting in Iowa to an Industry of the Future!

Section 4

Roadmap for Products and Markets

The goal in Products and Markets is to increase sales by 10%. In order to accomplish this, metal casters in Iowa identified several factors. The eight highest priority items are listed in order in Table 1 below.

Table 1. Priority Ranking for Products and Markets

1. Train/educate engineers on foundry process and casting applications
2. Develop ways to demonstrate quality and value of cast metal products
3. Train/educate purchasers on casting applications
4. Develop standards that effectively communicate the capability of castings
5. Determine how castings can be marketed effectively
6. Develop tools and techniques to reduce prototype development and production lead times
7. Find/create more users of, and applications for, castings
8. Develop tools to enable concurrent engineering

Figure 1 displays these eight items graphically so that those that must precede others can be easily identified.

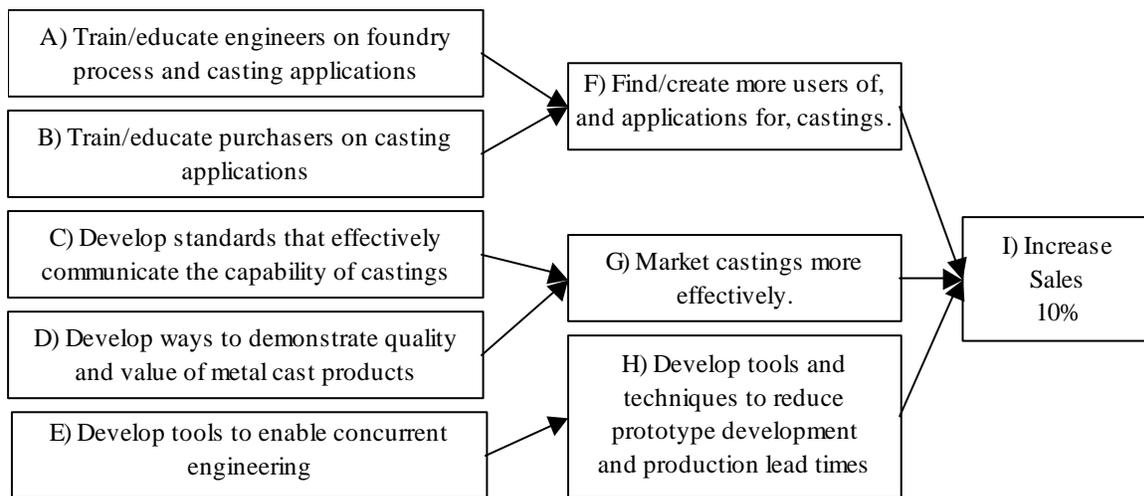


Figure 1. Roadmap for Products and Markets

Beginning at the right, the goal in products and markets is to, I) increase sales by 10%. In order to accomplish this, the following three prerequisites came out of the discussions with Iowa metal casters.

- F) Find or create more users of and applications for, castings
- G) Market castings more effectively to existing customers, and
- H) Develop tools and techniques to reduce prototype development and production lead times.

Each of these three, in turn, has prerequisites.

In order to, F) Find or create more users of and applications for, castings it will be necessary at least to:

- A) Train/educate engineers on foundry process and casting applications, and to
- B) Train/educate purchasers on casting applications.

In order to, G) Market castings more effectively, it will be necessary at the least to:

- C) Develop standards that effectively communicate the capability of castings, and to
- D) Develop ways to demonstrate quality and value of metal cast products.

In order to, H) Develop tools and techniques to reduce prototype development and production lead times, it will be necessary at the least to:

- E) Develop tools to enable concurrent engineering.

Figure 1 will be useful to the Action Team as they consider where to begin the effort in Iowa to reach the goal of increasing sales of castings by 10%. Note that Figure 1 does not claim that achieving all eight objectives will be sufficient to reach the goal. There are other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 1 sequences the eight highest priorities among Iowa metal casters, in support of their belief that they cannot increase sales of castings by 10% unless these, at least, are accomplished.

Section 5

Roadmap for Materials Technology

The goal in Materials Technology is to produce higher quality castings. In order to accomplish this, metal casters in Iowa identified several factors. The seven highest priority items are listed in order in Table 2 below.

Table 2. Priorities for Materials Technology

1. Develop environmentally benign, dimensionally stable molding and core make materials
2. Establish a correlation between casting properties and test bars
3. Develop longer life coatings for furnaces and molds
4. Correlate cast property results for various size test specimens
5. Assess techniques for melt quality and its affect on part quality
6. Improve techniques to measure the acceptability of liquid metal prior to casting
7. Develop material that adheres to dies and does not have to be replaced for each cycle

Figure 2, displays these seven items graphically so that those that must precede others can be easily identified.

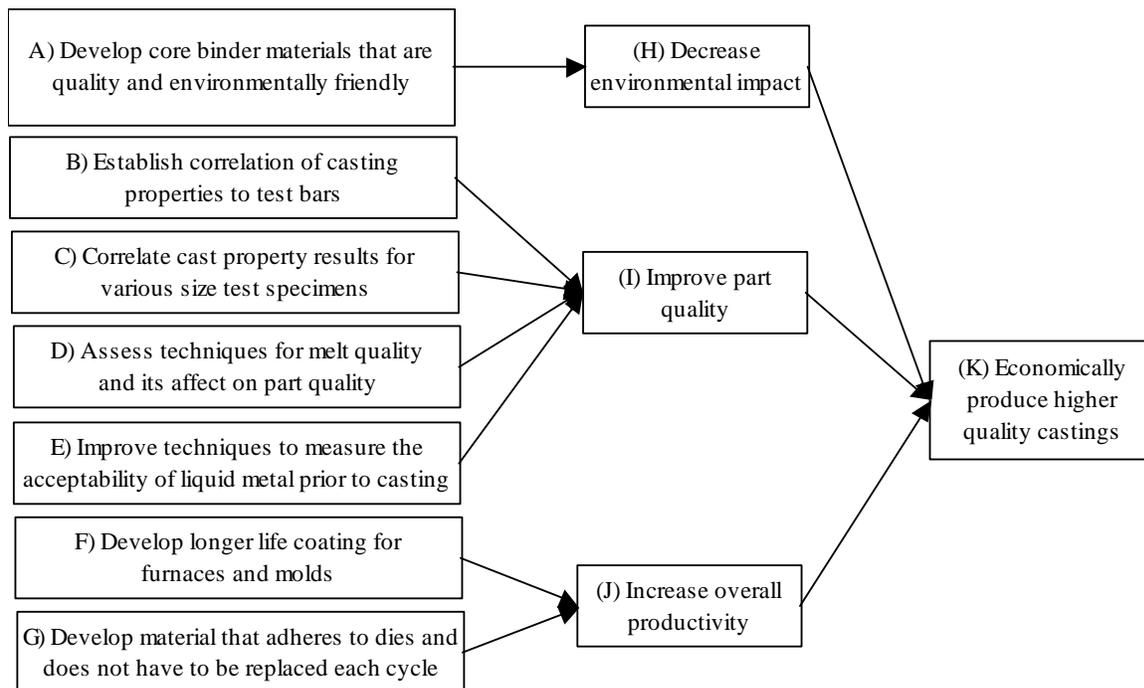


Figure 2. Roadmap for Materials Technology

Beginning at the right, the goal in materials technology is to, K) Economically produce higher quality castings. In order to accomplish this, the following three prerequisites came out of the discussions with Iowa metal casters.

- H) Decrease environmental impact,

- I) Improve part quality, and
- J) Increase overall productivity.

Each of these three, in turn, has prerequisites.

Environmental issues receive greater coverage in the Environmental Technology section. However, in regard to reaching the goal of the Materials Technology section, one of the priority actions will decrease environmental impact. It is:

- A) Develop core binder materials that are quality and environmentally friendly.

In order to, I) Improve part quality, it will be necessary at the least to:

- B) Establish correlation of casting properties to test bars,
- C) Correlate cast property results for various size test specimens,
- D) Assess techniques for melt quality and its affect on part quality, and
- E) Improve techniques to measure the acceptability of liquid metal prior to casting.

Productivity is addressed more fully in the Manufacturing Technology section. However, in regard to reaching the goal of the Materials Technology section, there were actions that will increase overall productivity. These are:

- F) Develop longer life coatings for furnaces and molds
- G) Develop material that adheres to dies and does not have to be replaced for each cycle

Figure 2 will be useful to the Action Team when considering where to begin the effort in Iowa to reach the goal of economically producing higher quality castings. Note, however, that Figure 2 does not claim that achieving all seven objectives will be sufficient to cause the goal to be reached. There are many other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 2 sequences the seven highest priorities among Iowa metal casters, in support of their belief that they cannot economically produce higher quality castings unless these, at least, are accomplished.

Section 6

Roadmap for Manufacturing Technology

The goal in Manufacturing Technology is to be a strong global competitor. In order to accomplish this, metal casters in Iowa identified several factors. The eight highest priority items are listed in order in Table 3 below.

Table 3. Priorities in Manufacturing Technology

1. Develop new technologies in cutting gates, vents and risers to reduce grinding
2. Develop modeling technology for all casting processes to include optimization of energy use
3. Provide energy audits
4. Develop methods for suppliers to provide more knowledge and engineering help
5. Develop robust sensors and controls suitable for hostile environment
6. Develop melting and pouring technologies that don't introduce gases to the process
7. Develop finite element analysis technology from design engineer through solidification modeling to assure casting quality with minimum waste
8. Develop ways to save energy for gas-fired ladles

Figure 3 displays these eight items graphically so that those that must precede others can be easily identified.

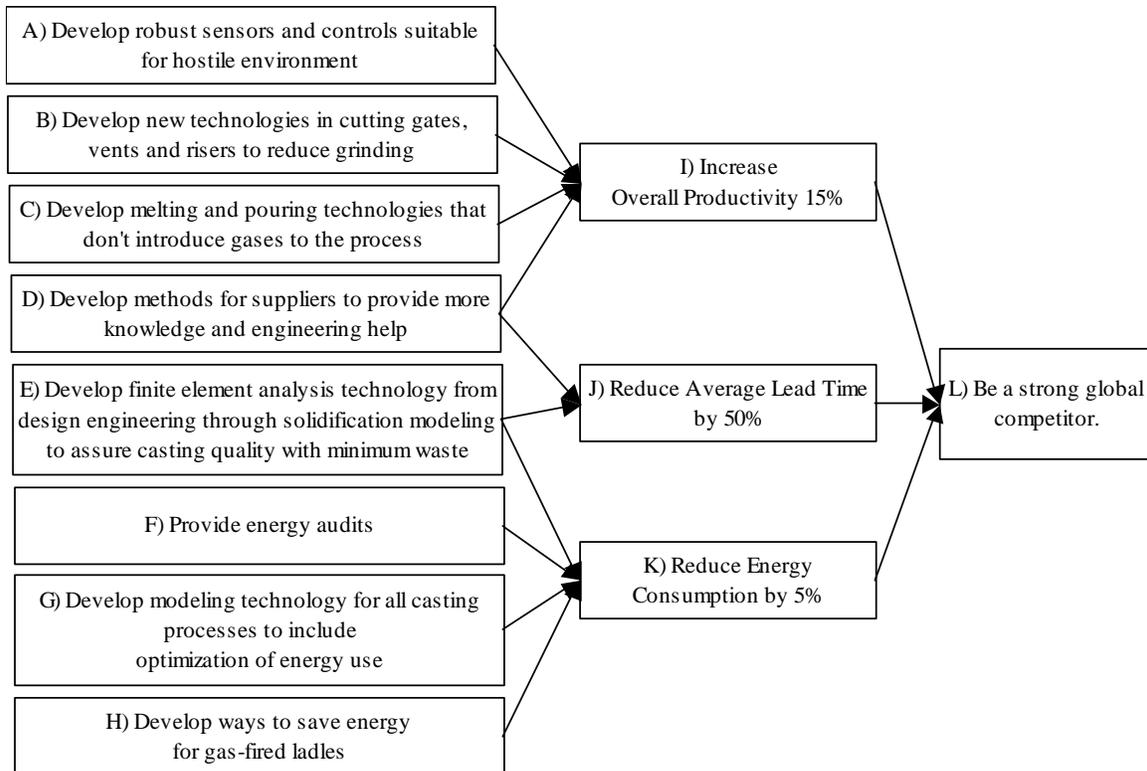


Figure 3. Roadmap for Manufacturing Technology

Beginning at the right, the goal in manufacturing technology is to, L) Be a strong global competitor. In order to accomplish this, the following three prerequisites came out of the discussions with Iowa metal casters.

- I) Increase overall productivity 15%,
- J) Reduce average lead-time by 50%, and
- K) Reduce energy consumption by 5%.

Each of these three, in turn, has prerequisites.

In order to I) Increase overall productivity 15%, it will be necessary at the least to:

- A) Develop robust sensors and controls suitable for a hostile environment,
- B) Develop new technologies in cutting gates, vents, and risers to reduce grinding,
- C) Develop melting and pouring technologies that don't introduce gases to the process, and
- D) Develop a method for suppliers to provide more knowledge and engineering help.

In order to, J) Reduce average lead-time by 50%, it will be necessary at the least to:

- D) Develop a method for suppliers to provide more knowledge and engineering help, and
- E) Develop finite element analysis technology from design engineering through solidification modeling to assure casting quality with minimum waste.

In order to K) Reduce energy consumption by 5%, it will be necessary at the least to:

- E) Develop finite element analysis technology from design engineering through solidification modeling to assure casting quality with minimum waste,
- F) Provide energy audits,
- G) Develop modeling technology for all casting processes to include optimization of energy use, and
- H) Develop ways to save energy for gas-fired ladles.

Figure 3 will be useful to the Action Team when considering where to begin the effort in Iowa to reach the goal of being a strong global competitor. Note, however, that Figure 3 does not claim that achieving all eight objectives will be sufficient to cause the goal to be reached. There are many other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 3 sequences the eight highest priorities among Iowa metal casters, in support of their belief that they cannot be strong global competitors unless these, at least, are accomplished.

Section 7

Roadmap for Environmental Technology

The long-term goal in Environmental Technology is to eliminate all negative environmental impact. This is not immediately achievable, so the short-term goal has been set to reduce negative environmental impact by 25%. In order to accomplish this, metal casters in Iowa identified several factors. The six highest priority items are listed in order in Table 4 below.

Table 4. Priorities for Environmental Technology

1. Receive tax credits for implementation of technology needed for regulatory compliance (work with, not against industry)
2. Develop a system that has less paperwork for permits
3. Develop a state database to assist understanding of new regulations
4. Decrease the delay in getting permits
5. Provide ventilation studies for foundries
6. Learn the free silica & NIOSH standards

Figure 4 displays these six items graphically so that those that must precede others can be easily identified.

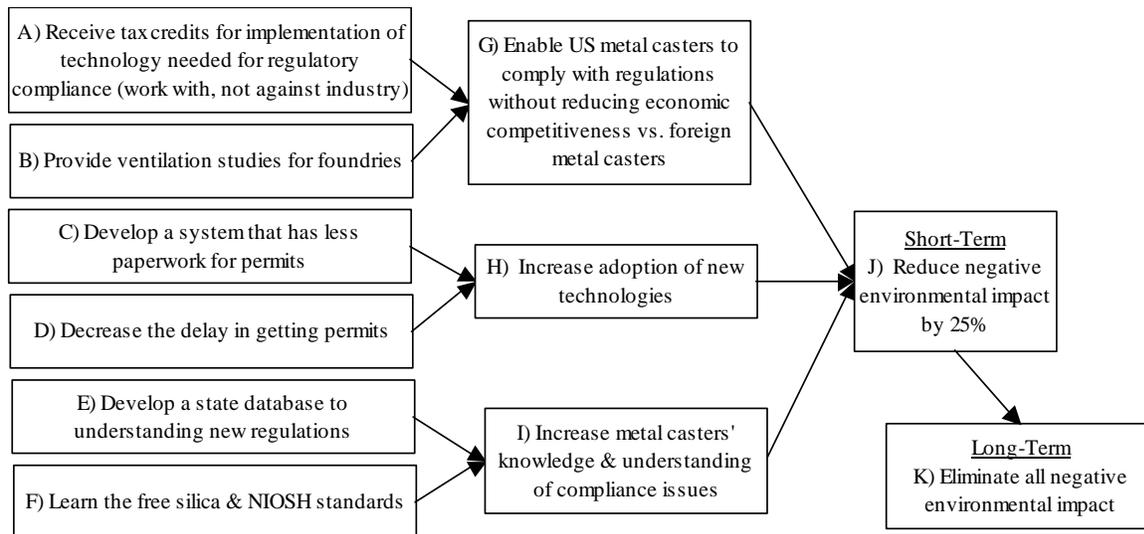


Figure 4. Roadmap for Environmental Technology

Shown at the right are the long-term and short-term goals. In order to, J) Reduce negative environmental impact by 25%, the following three prerequisites came out of the discussions with Iowa metal casters.

- G) Enable US metal casters to comply with regulations without reducing their economic competitiveness versus foreign metal casters,
- H) Increase adoption of new technologies, and
- I) Increase metal casters' knowledge and understanding of compliance issues.

Each of these three, in turn, has prerequisites.

In order to G) Enable US metal casters to comply with regulations without reducing their economic competitiveness versus foreign metal casters, it will be necessary, at the least, to:

- A) Receive tax credits for implementation of technology needed for regulatory compliance (work with, not against industry), and
- B) Provide ventilation studies for foundries.

In order to H) Increase adoption of new technology, it will be necessary, at the least, to:

- C) Develop a system that has less paperwork for permits, and
- D) Decrease the delay in getting permits.

In order to I) Increase metal casters' knowledge and understanding of compliance issues, it will be necessary, at the least, to:

- E) Develop a state database to understanding new regulations, and
- F) Learn the free silica & NIOSH standards.

Figure 4 will be useful to the Action Team when considering where to begin the effort in Iowa to reach the short-term goal of reducing negative environmental impact by 25%. Note, however, that Figure 4 does not claim that achieving all six objectives will be sufficient to cause the goal to be reached. There are many other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 4 sequences the six highest priorities among Iowa metal casters, in support of their belief that they cannot be strong global competitors unless these, at least, are accomplished.

Section 8

Roadmap for Human Resources

The goals in Human Resources are to attract talented people and to retain the best employees. In order to accomplish these, metal casters in Iowa identified several factors. The five highest priority items are listed in order in Table 5 below.

Table 5. Priorities for Human Resources

1. Develop new training methods for in-house, self-directed education programs for all employees; courses—day or evening; need availability, flexibility, testing, privacy
2. Increase partnering with local, state, and national professional organizations, educational institutions, government agencies, etc.
3. Resolve ergonomic issues: develop new ways to do hard jobs without risk to personnel health
4. Work closer with universities: they need more hands-on rather than all textbooks; increase support for cooperative educational programs
5. Work with high schools and community colleges: inform them of the industry's basic requirements, such as a 2-yr. degree for foundry management and technical staff

Figure 5 displays these five items graphically so that those that must precede others can be easily identified.

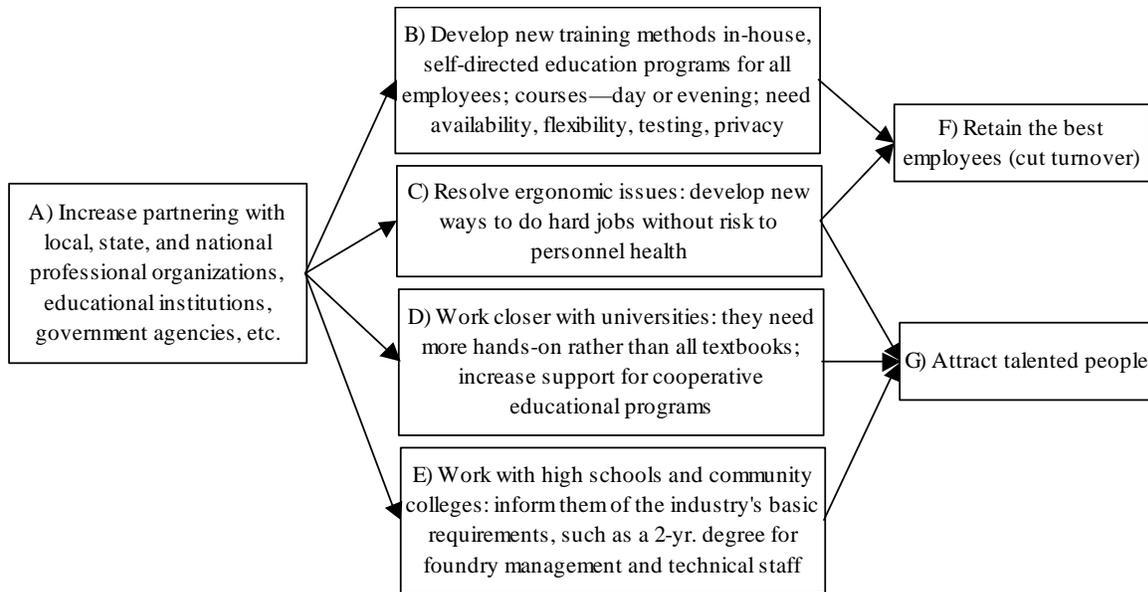


Figure 5. Roadmap for Human Resources

Shown at the right are the two goals. Starting at the top, in order to, F) Retain the best employees, i.e. cut turnover, the following two prerequisites came out of the discussions with Iowa metal casters.

- B) Develop new training methods for in-house, self-directed, education programs for all employees; courses should be offered day or evening; need availability, flexibility, built in testing, and privacy, and
- C) Resolve ergonomic issues: develop new way to do hard jobs without risk to personnel health.

On the right, again, is the second goal, G) Attract talented people. In order to do this, the following three prerequisites came out of the discussions with Iowa metal casters:

- C) Resolve ergonomic issues: develop new ways to do hard jobs without risk to personnel health,
- D) Work closer with universities: they need more hands-on rather than all textbooks; increase support for cooperative educational programs, and
- E) Work with high schools and community colleges: inform them of the industry's basic requirements, such as a 2-yr. degree for foundry management and technical staff.

On the left is shown the single item that was identified as a prerequisite to all 5 of the other actions. It is:

- A) Increase partnering with local, state, and national professional organizations, educational institutions, government agencies, etc.

Figure 5 will be useful to the Action Team when considering where to begin the effort in Iowa to reach the goals of retaining the best employees, and attracting talented people. Note, however, that Figure 5 does not claim that achieving all five objectives will be sufficient to cause the goal to be reached. There are many other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 5 sequences the five highest priorities among Iowa metal casters, in support of their belief that they cannot attract and retain the best people unless these, at least, are accomplished.

Section 9

Roadmap for Profitability and Industry Health

The goal in Profitability and Industry Health is to be a profitable, healthy industry that re-invests more money in research and development. In order to accomplish this, metal casters in Iowa identified several factors. The six highest priority items are listed in order in Table 6 below.

Table 6. Priorities for Profitability and Industry Health

1. Generate recognition by everyone, from the CEO on down, of the importance of customer service & customer satisfaction
2. Receive tax credits for R&D, environmental compliance, and technology upgrades
3. Gain access to capital for additional spending on new plants and equipment
4. Improve communication with casting customers, which can increase a metal caster's chances for repeat business
5. Offer customers more value-added services, such as casting design, machining services, chemical impregnation, etc.
6. Increase collaborative partnerships: private & public; business & business; business & customer; etc.

Figure 6 displays these six items graphically so that those that must precede others can be easily identified.

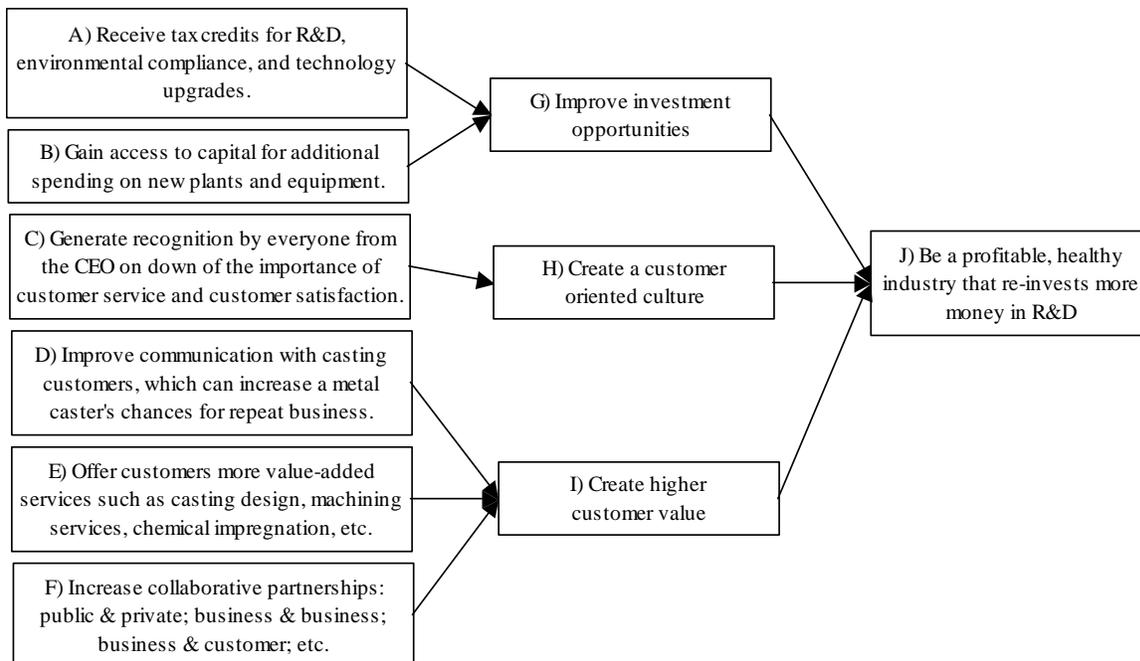


Figure 6. Roadmap for Profitability and Industry Health

Beginning at the right, the goal in profitability and industry health is to, J) Be a profitable, healthy industry that re-invests more money in research and development. In order to accomplish this, the following three prerequisites came out of the discussions with Iowa metal casters.

- G) Improve investment opportunities,
- H) Create a customer oriented culture, and
- I) Create higher customer value.

Each of these three, in turn, has prerequisites.

In order to G) Improve investment opportunities, it will be necessary at the least to:

- A) Receive tax credits for R&D, environmental compliance, and technology upgrades,
- B) Gain access to capital for additional spending on new plants and equipment, and

In order to H) Create a customer oriented culture, it will be necessary at the least to:

- C) Generate recognition by everyone from the CEO on down of the importance of customer service & customer satisfaction.

In order to, I) Create higher customer value, it will be necessary at the least to:

- D) Improve communication with casting customers, which can increase a metal caster's chances for repeat business,
- E) Offer customers more value-added services, such as casting design, machining services, chemical impregnation, etc., and
- F) Increase collaborative partnerships: private & public; business & business; business & customer; etc.

Figure 6 will be useful to the Action Team when considering where to begin the effort in Iowa to reach the goal of being a profitable, healthy industry that re-invests more money in research and development. Note, however, that Figure 6 does not claim that achieving all six objectives will be sufficient to cause the goal to be reached. There are many other objectives identified in the national roadmap and/or in the Iowa workshops whose achievement may also be necessary. Rather, Figure 6 sequences the six highest priorities among Iowa metal casters, in support of their belief that they cannot be a profitable, healthy industry that re-invests more money in research and development unless these, at least, are accomplished.

Section 10

Follow-Through

Leadership

The Metal Casting Center (MCC) at the University of Northern Iowa will lead the metal casting industry along this roadmap, in pursuit of the Iowa Vision in the coming year. Other organizations including the Recycling and Reuse Technology Transfer Center (RRTTC) also at the University of Northern Iowa, and the Center for Industrial Research and Service (CIRAS) of Iowa State University will assist the MCC in this effort.

Action Teams

To address the Iowa priorities, the MCC will facilitate the formation of “Action Teams” to address the top priorities in each area. These teams will:

- Assess the status of the given item
 - Does a solution already exist?
 - Is research under way?
 - Is new research needed?
- Establish a goal
- Make a plan, including a timeline, for attaining the goal
- Report progress to the MCC

These teams will be encouraged to make use of all available resources, including the MCC, Iowa State University, University of Iowa, DOE’s Office of Industrial Technology, the Iowa Department of Natural Resources, etc. The IOF web site will be developed so that an intranet page will be available to each team to keep each other, the MCC, and the IOF leadership informed of progress. The Metal Casting Steering Committee will meet at least twice during the year to review the progress of the teams, and to assess whether the approach of using Action Teams is successful.

Researchers

The metal casting IOF Resource Team is in place. Included on it are representatives from Ames Lab; Iowa State University’s Center for Industrial Research and Services (CIRAS), College of Business, Center for Non Destructive Evaluation, Institute for Physical Research and Technology, and the Department of Industrial and Manufacturing Systems Engineering; the Iowa Energy Center; and the University of Northern Iowa’s Department of Industrial Technology, Metal Casting Center, and Recycling and Reuse Technology Transfer Center (RRTTC).

At the initial meeting members reviewed the top priorities that are listed here. They began to share the work they are doing that should help metal casters reach their vision. The MCC will continue to meet with the Resource Team to communicate the needs of the metal casters to the researchers, and to disseminate research results and best practices to the metal casting industry.

Appendix

Iowa Based Resources for Metal Casters*

This is an initial listing. One of the ongoing outputs of the IOF metal casting effort in Iowa will be to maintain an updated listing of resources on the IOF web site: www.ciras.iastate.edu/iof/

Resource	Area(s) of Assistance
<p>Ames Lab Iowa Company Assistance Program Iowa State University 111 Metals Development Bldg. Ames, IA 50011 (800) 884-8548 (phone) (515) 294-8727 (fax) E-mail: icap@iastate.edu http://www.iprt.iastate.edu/icap.html</p>	<ul style="list-style-type: none"> • Materials technology • Solidification processing • Chemical analysis • Microstructural analysis
<p>Center for Industrial Research and Service Iowa State University 2272 Howe Hall, Suite 2620 Ames, IA 50011-2272 (515) 294-3420 (phone) (515) 294-4925 (fax) http://www.ciras.iastate.edu/</p>	<ul style="list-style-type: none"> • Productivity improvement • Rapid prototyping • Lead time reduction
<p>Center for Nondestructive Evaluation Iowa State University ASC II, Iowa State University 1915 Scholl Road Ames, Iowa 50011-3042 cnde@cnde.iastate.edu 515-294-8152 (phone) 515-294-7771 (fax) http://www.cnde.iastate.edu/cnde.html</p>	<ul style="list-style-type: none"> • Iowa Demonstration Lab • Eddy Current Testing (EC) • Magnetic Testing (MT) • Penetrant Testing (PT) • Radiography (RT) • Ultrasonic Testing (UT) • Nondestructive Evaluation Education
<p>Energy Bureau, Iowa Dept. of Natural Resources Michael Adams Wallace Building, 502 E. 9th St. Des Moines IA 50319 515-281-4262 (phone) http://www.state.ia.us/dnr/energy/index.htm</p>	<ul style="list-style-type: none"> • Energy Education • Energy Efficiency • Energy Emergency Preparedness • Renewable Energy
<p>Industrial & Manufacturing Systems Engineering Iowa State University http://www.imse.iastate.edu/homepage.html Dr. Frank Peters (515) 294-3855 (phone) Email: fpeters@iastate.edu</p>	<ul style="list-style-type: none"> • Control of metal casting processes to reduce dimensional variability and decrease lead time • Developing design rules that incorporate the casting process and subsequent machining • Manufacturing system design for metalcasting • Ergonomics • Barcoding for metalcastings

Appendix (continued)
Iowa Based Resources for Metal Casters

Resource	Area(s) of Assistance
Industrial Assessment Center Iowa State University 2088 Black Engineering Building Ames, IA 50011 (515) 294-3080 (phone) http://www.public.iastate.edu/~cber/	<ul style="list-style-type: none"> • Energy audits for small and med size manufacturers
Industrial Technology University of Northern Iowa http://www.uni.edu/indtech/ Dr. Yury Lerner (319) 273-2590 E-mail: Yury.Lerner@uni.edu	<ul style="list-style-type: none"> • Foundry metallurgy • Ductile iron technology • Precision casting processes • Cast alloys development • Non destructive testing
Iowa Energy Center 2521 Elwood Drive Suite 124 Ames, IA 50010-8229 (515) 294-8819 (phone) E-mail: iec@energy.iastate.edu http://www.energy.iastate.edu/	Applied research and information dissemination in the fields of: <ul style="list-style-type: none"> • Energy efficiency • Renewable energy sources • Industrial energy systems including compressed air, steam, motors, pumps, and lighting • HVAC control systems
Mechanical Engineering University of Iowa http://www.me.engineering.uiowa.edu/Default.asp Christoph Beckermann (319) 335-5681 (phone) E-mail: christoph-beckermann@uiowa.edu	<ul style="list-style-type: none"> • Yield improvement in steel castings • Solidification of metal alloys and composites • Computer simulation of casting • Integrated design of castings for service performance
Metal Casting Center University of Northern Iowa 76 Industrial Technology Cedar Falls, IA 50614-0178 (319) 273-6894 (phone) (319) 273-5959 (fax) http://www.uni.edu/metalcst/web/	<ul style="list-style-type: none"> • Applied research • Technology transfer • Education • Problem solving
Recycling and Reuse Technology Transfer Center University of Northern Iowa 239 WRC Cedar Falls, IA 50714-0241 (319)273-7090 (phone) (319)273-5815 (fax) http://www.rrttc.uni.edu/	<ul style="list-style-type: none"> • Waste stream reduction • Recycling • Reuse • Material testing