Summer 1993

A Market Profile of EPC Foundries in North America

Jennifer D. Ballacchino
University of Northern Iowa

A Market Profile of EPC Foundries in North America

Abstract

The expendable pattern casting (EPC) process was patented on April 15, 1958 by H. F. Shroyer. Shroyer's casting process required cutting a foam pattern out of a block pf expanded polystyrene and placing the foam pattern in bonded sand before metal pouring. This process became known as the full mold process. Later, in 1962, M.C. Flemmings is credited with using unbonded sand with the foam patterns (Monroe 1992). The use of unbonded sand is the process that we now refer to as expendable pattern casting. The process is a metal casting procedure that uses a polystyrene pattern instead of a traditional sand mold in order to produce castings. In the process, a foam pattern in the exact shape of the desired casting is coated with a ceramic coating to protect the surface finish and he structural integrity of the pattern. Next, the pattern is placed into a flask and unbonded sand is compacted around it. The molten metal is then poured into the flask and the metal displaces the foam pattern resulting in a casting that is the exact shape of the foam pattern.

A MARKET PROFILE OF EPC FOUNDRIES IN NORTH AMERICA

A Research Paper for Presentation

to the Graduate Faculty

of the

Department of Industrial Technology

University of Northern Iowa

In Partial Fulfillment of the Requirements for

the Non-Theses Master of Arts Degree

by

Jennifer D. Ballacchino

Summer, 1993

Approved by:

Scott Helzer

Dr. Scott Helzer — 8/10/93 — Date

Ali Kashef

Dr. Ali Kashef — 8/2/93 — Date

A MARKET PROFILE OF EPC FOUNDRIES IN NORTH AMERICA

A Research Paper for Presentation

to the Graduate Faculty

of the

Department of Industrial Technology

University of Northern Iowa

In Partial Fulfillment of the Requirements for

the Non-Thesis Master of Arts Degree

by

Jennifer D. Ballacchino

Summer, 1993

TABLE OF CONTENTS

CHAPTER 1

Statement of the Problem

The expendable pattern casting (EPC) process was patented on April 15, 1958 by H.F. Shroyer. Shroyer's casting process required cutting a foam pattern out of a block of expanded polystyrene and placing the foam pattern in bonded sand before metal pouring. This process became known as the full mold process. Later, in 1962, M.C. Flemmings is credited with using unbonded sand with the foam patterns (Monroe, 1992). The use of uinbonded sand is the process that we now refer to as expendable pattern casting. The process is a metal casting procedure that uses a polystyrene pattern instead of a traditional sand mold in order to produce castings. In the process, a foam pattern in the exact shape of the desired casting is coated with a ceramic coating to protect the surface finish and the structural integrity of the pattern. Next, the pattern is placed into a flask and unbonded sand is compacted around it. The molten metal is then poured into the flask and the metal displaces the foam pattern resulting in a casting that is the exact shape of the foam pattern.

Through the years since its inception, the process has been known by a number of different names. Lost foam and expendable pattern casting are among the two most common names used in reference to this process. The American Foundrymen's Society's Expendable Pattern Division (11) has since designated expendable pattern casting as the official name of the process (Monroe, 1992).

Although the technique has many inherent benefits, there has been a narrow amount of usage of the process. The industry has little information about EPC producers and success stories in EPC. According to Monroe (1992), "Failure to share information and cooperate on general development of EPC hindered its acceptance" (p.9). Without enough convincing evidence, the metal casting industry has been reluctant to exploit this process. Bur

ditt concurs with Monroe when he states "Because there has been little industry-wide discussion at this time . . . more than the usual amount of caution is being shown by those foundries that are seriously considering EPC production" (Burditt, 1988, p.20). Industry -wide discussion, the sharing of information about the EPC process, will help break through the mystique and uncertainty of this process. The problem of acceptance with EPC then tends to be not one of poor performance, but of ignorance on the part of the industry that has been reluctant to embrace it. Monroe also states that "The conservative nature of this industry and the preliminary investments required also delayed development of the EPC technology" (p.9). Although there are foundries that are using this process with much success, the dissemination of information about those successes has been lethargic. The problem of this study is to discover what foundries use the EPC process and what types of castings are most successful when produced with EPC, meaning what characteristics do successful E.P.C. foundries have and what applications have been profitable.

Statement of the Purpose

The purpose of this study is to discover what successes foundries are having with the EPC process and promote these successes. The EPC casting industry can use this information to encourage adoption of the process and thereby stimulate component conversion and application. Information gathered during this study will be consolidated into promotional materials about the EPC process. The materials will provide information to individuals in the industry, including foundries, suppliers and, most importantly, designers. Through sharing of information about the process, it can be better understood and acceptance may increase.

Statement of Need

The need for information about EPC and its users is readily apparent in the literature on the subject. Robinson (1988) states "The EPC process is in dire need of three things that will allow it to flourish and reach its full potential as a precision casting process. They are: marketing with absolute integrity, integration between foundrymen, suppliers and customers, and incentive for adopting the process" (p.41). A study done by Dow Chemical Company in 1989 on foundry and design engineer awareness of the EPC process illustrates the need for further research. The study concluded that "Foundries perceived barriers to EPC on educational issues such as where are the success stories and on the fact that the benefits of the process aren't defined and documented" (p.10). Through survey techniques, the Dow study discovered perception difficulties with the process resulting from lack of information. One important conclusion drawn

from the Dow research is that "Designers don't design for EPC benefits" (p.51). One of the most important target markets for achieving acceptability of the EPC process is the designers of EPC tooling. Through designers accepting the process, the knowledge can flow from the designer to the supplier to the foundry, as the casting process stems from the design of the part before an ounce of metal is poured. This concept is further expanded by Patz (1988) who states about the EPC process: "It is a process that is very much knowledge driven. EPC depends on transferable technology and experience" (p.40). This statement is further reinforced by Heine (1986) about EPC "While the potential is undeniable, there still exists the need to circumscribe the product range for which the method is suited best" (p.36). The product range that best suits the process can be discovered through research on success stories with EPC, by asking successful EPC foundries what parts and components have the greatest application to EPC.

The relevance of disseminating information about EPC through research has also been recognized by the American Foundrymen's Society. According to Twarog (1993), EPC research that began in 1989 is expected to continue to develop a better perception of the process to be shared with the industry (p.36).

Definitions of Terms

1. Success in the E.P.C. process means what applications/castings have been or will be profitable (or worthwhile-monetarily and otherwise) for foundries when compared to other casting methods. This includes what applications have been more dimensionally

stable and accurate with the EPC process as opposed to other sand casting processes ?

2. Industry applications means what type of castings, for example, crank shafts, intake manifolds, motor housings, ect.

3. Innovations include anything that has been developed for the process that is different and more successful than past methods and equipment.

Statement of Research Questions

The following research questions were addressed in this study:

1. Which foundries in North America are successfully using the EPC process?

2. What type of industry applications have found the most success with EPC, what major markets do EPC castings serve ?

3. Are EPC foundries typically jobbing, captive, or both ?

4. What kind of metals are poured in foundries with this process ?

5. What is the annual tonnage of EPC castings produced in iron, aluminum, copper, and other metals ?

6. What is the approximate annual overall tonnage of EPC castings produced in North America ?

Delimitations

The following delimitations were inherent to this study.

1.This study was delimited to the foundries in the 1991 Casting Source Directory listed as EPC foundries.

2. This study was delimited to information from EPC foundries, excluding designers or suppliers of the EPC process.

Research Design

The following is the procedure that was followed for this study.

1. A census survey instrument was developed with the help of research experts in the metal casting industry, such as Daniel Twarog, Director of Research at the American Foundrymen's Society.

2. The survey draft was presented to Division 11, the EPC technical division, of the American Foundrymen's Society and critiqued to test its effectiveness in November 1992.

3. A population was selected to include all of the EPC foundries in the United States and Canada, N=38.

4. A survey was sent out to the foundries in order to discover successes that foundries have had with the EPC process. The survey had open ended questions in order to

include all possibilities of unique successes and innovations with the process.

5. One month after the survey was mailed, follow up telephone calls were made to non responsive foundries.

6. After follow up telephone calls, a third follow up was conducted by faxing the survey to any nonrespondents.

An example of the survey sent out follows:

EPC FOUNDRY DIRECTORY SURVEY

1. Company name _____

2. Address _____

_____

3. Phone _____

4. Fax _____

5. Contact person(s) (title) _____

_____

6. Metal type poured (circle all that apply)

Aluminum Steel Copper Iron Other_____

7. Smallest casting produced in EPC (size) _____

8. Largest casting produced in EPC (size) _____

9. Most typical size casting produced in EPC _____

10. Are the castings you produce in EPC for captive purposes, commercial sale, or both

? (what %?) _____

11. What major markets do your EPC castings serve ? (circle all that apply)

Railroad Metalworking Plumbing Other _____

12. What, if any, special EPC capabilities and/or innovations do you offer ?

_____

_____

_____

13. What is your flask size and shape ? _____

14. What is your annual capacity of EPC castings (in tons/lbs) ? _____

15. What other information would you like to include in this survey ?

_____

CHAPTER 2

Review of Related Literature

The Dow Chemical Company (1989) conducted a study to discover people's perceptions and knowledge level about the EPC process. The study concluded that there is a need for further research on this process in order to promote it and raise awareness levels of the process. This study also specifically stated the need for further investigation into successes that individuals in the metal casting industry have had with EPC.

Twarog (1992) of the American Foundrymen's Society discussed the past efforts of AFS in the EPC area. Twarog stated that successes and innovations have arisen with research into the process. The EPC process has become a priority in research at AFS, its potential is still untapped, which may be due to limited technology transfer as well as informational transfer about the process.

Monroe's (1992) book about the EPC process, entitled Expendable Pattern Casting, details every aspect of the EPC process. It includes how the process is performed from beginning to end. It includes advantages as well as disadvantages. The advantages and disadvantages are of a technical as well as a marketing nature. Monroe lists the lack of information concerning the process as a disadvantage inherent to EPC.

Kanicki (1988) reported on two foundries, Robinson and Bodine, that decided to pursue a joint venture and produce EPC castings. Bodine made the decision to produce EPC castings after it decided to merge with the existing EPC foundry, Robinson. Bodine was hesitant about getting into EPC on their own because they were unsure about the

value of the investment and wanted more information about the process before adopting it for production purposes.

Kanicki and Thomas (1991) discuss the reasons behind Willard Industries decision to use the EPC process. The article states that Willard thought it was taking a risk in using the innovative process, but the company is now enjoying many successes with the process. The article gives specific examples of benefits as opposed to traditional sand casting techniques. This type of information about inherent EPC benefits can be beneficial in advancing the process.

Panigrahi (1974) describe different innovations in the foundry industry as of 1974. These innovations include innovations in pattern making, molding, core making, and melting and casting. Foam patterns are discussed in reference to new methods of pattern making. Panigrahi extols the benefits of foam patterns as their elimination of the use of cores. This allows for a coreless casting and easier manufacturing.

CHAPTER 3

Results and Discussion

Through the survey conducted, 38 EPC foundries were discovered. These 38 foundries are located across the United States and in Canada. In the United States, EPC foundries can be found in 17 states nation wide. These states include Pennsylvania, Michigan, Wisconsin, Ohio, New Jersey, Alabama, New York, Oregon, Rhode Island, Georgia, Indiana, Iowa, Washington, Tennessee, Louisiana, Texas, and Missouri. The largest concentration by region of EPC foundries is found in the midwest region of the country, followed by the northeast (see figure 1).

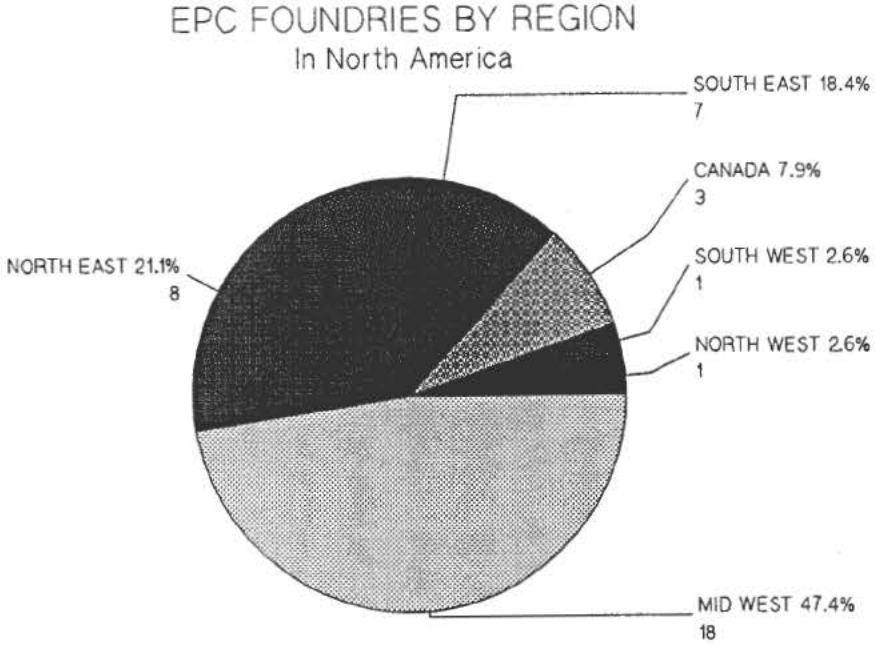

Figure 1 EPC Foundries by Region

The U.S. state with the most EPC foundries are Wisconsin and Ohio , followed by Alabama, the rest are scattered across various states (see table 1).

Table 1 Number of EPC Foundries by State

PA	4	TN	1
WI	5	LA	1
MI	3	TX	1
OH	5	NY	2
AL	4	NJ	1
IN	3	RI	1
WA	1	GA	1
IA	1	MD	1
		ONT	3
			38

Source: EPC Foundry Survey

EPC castings serve a large variety of markets. The majority of the 38 foundries surveyed produced EPC castings for the automotive and truck industry, 29%. The next

highest amount of EPC castings to an industry were to the marine industry, with 15% of the EPC castings in this market. Next, the machine tools (12%), followed by pumps and metalworking markets, each with 8% of the castings. Finally, 28% of the markets served fell into the category marked "other", which included markets such as electrical, plumbing, art, railroad, and aerospace.

Of the 38 respondents, the majority were jobbing foundries, followed by captive foundries. A foundry that indicated that they were from 50-100% jobbing foundry were classified as such, this applies also to the captive classification (see figure 2).

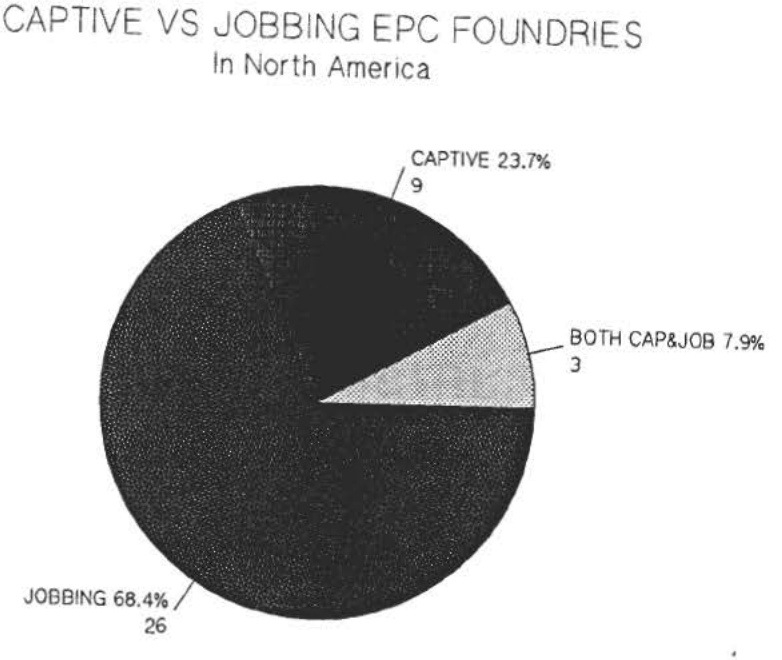

Figure 2 Captive vs Jobbing EPC Foundries

The metal used most often in EPC castings of the foundries surveyed is iron, followed by aluminum, copper, steel, and other metals including bronze (see figure 3).

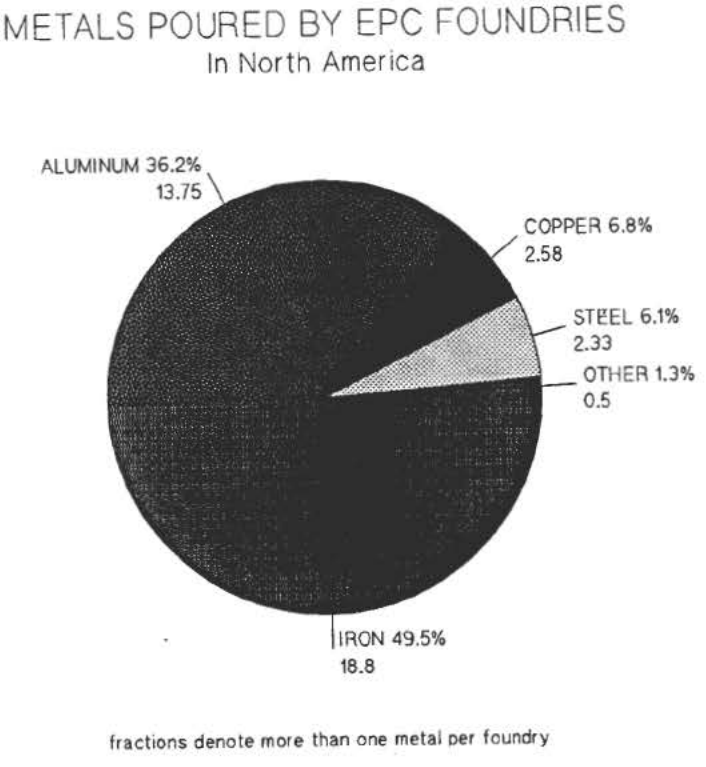

Figure 3 Metal Types Poured by EPC Foundries

As far as amounts of each metal poured are concerned, 79,974 tons of iron are poured to make EPC castings, while 135.4 million pounds of aluminum are poured. For comparison purposes, 6,770 tons of aluminum is poured. Copper is poured in the amount of 78,000 pounds per year, and steel accounts 767 tons per year. Other metals comprised approximately 150,000 pounds. For classification purposes, nonferrous metals were classified according to pounds, while ferrous metals were classified according to

tons.

An overall count of EPC castings by metal type poured is 135,628,000 lbs. of nonferrous metals and 80,741 tons of ferrous metals.

CHAPTER 4

Summary, Conclusions, and Recommendations

The purpose of this research was to determine where successful EPC foundries are located in North America and what applications and industries use EPC castings. In short, the purpose of this research was to establish a profile of the EPC foundry market in the United States and Canada.

From the data collected, it can be concluded that the majority of the EPC foundries are located in the midwest, pour iron, and are jobbing, or commercial foundries. Aluminum is also another popular metal used with the EPC process. Of the approximately 3,100 foundries in the United States, 38 or 1% of the foundries use the EPC process. Another purpose of this research was to gather information about EPC foundries so that it could be used to help promote and disseminate information concerning the process. As only 1% foundries are EPC foundries in the U.S., it is apparent that the process needs to be marketed successfully before it may become a widely practiced and accepted process.

In an industry that began so long ago, as the foundry did, it is often difficult to introduce new processes into the industry. One problem concerning the EPC process acceptance is its relative newness, with its inception in the 1960s. One way to overcome this fear of the unknown is through information sharing in the industry. This sharing of knowledge must not only originate with technical societies, but also must emerge through

foundry to foundry knowledge sharing and foundry to designer sharing. In an effort to be competitive in the global market, U.S. foundries must be willing to help their fellow foundry colleagues and stand together in a united front.

Another hinderance to the acceptability and knowledge of the EPC process is the fact that the process has been known by different names. As Monroe points out, "This casting technique has been referred to by a variety of generic names, . . . lost foam, evaporative pattern casting cavityless casting, full mold, ect." (1992, p.1) As surveying was conducted for this research, many foundries that were contacted by follow up telephone calls were not aware, or did not acknowledge, the fact that the American Foundrymen's Society has designated the name for this technique as expendable pattern casting, EPC. Some of the foundries that were using the process were not aware that what they were calling "lost foam" is also known as EPC. This confusion with the name brings up a fundamental marketing issue when trying to promote the process. One of the most important issues in marketing a new product (or process) is name recognition. It is difficult to promote and market a process that has so many names that the target market is clearly confused when it comes to the official name of the process. The official AFS name should be adopted by all in the industry to make matters simpler for those who know little about the process and for those who are trying to promote the process.

A final conclusion drawn from this research is that the individual EPC foundries were somewhat reluctant to participate in EPC market research. After the initial mailing

of the survey, only 12% of the surveys were completed. It is understood that survey response is usually not near 100%, however, a return rate of 12% was considered unacceptable. After three follow ups, information was obtained from 39 of the 41 identified EPC foundries. If EPC foundries wish to promote the fledgling process that they use, they need to become more active participants in the technology transfer concerning EPC to each other and to suppliers and designers.

Recommendations for further research include survey research to discover EPC "horror" stories. In order to find the limitations of EPC, research could be conducted to determine the areas that have caused the most problems for foundries. Often, these mistakes will become powerful learning tools in an effort to make the process a more exact science. There appears to be so many variables in the EPC equation, that by identifying common mistakes or trouble spots, future endeavors with the EPC process can help eliminate some of these variables.

Another aspect of EPC research that needs to be explored is the designer perceptions of the EPC process. This research was limited by time, and hence the only point of view that was explored was that of the foundry. Designers should be asked about their success stories with EPC. In order to discover why designers have shied away from EPC, research should be done to discover the problems and overall perceptions they have about the process. In this manner, information can be disseminated to designers and hopefully, greater understanding and acceptance will follow.

In conclusion, the future of the EPC market depends largely on the commitment of the current users of the process. Once more information is shared about how to correctly use the process, it will be able to be used more for specific applications. Markets that are having successes with EPC now can continue to be exploited by EPC if foundries are wiling to be patient as more research is conducted. Lastly, existing EPC foundries should be willing to help the EPC process promotion, they are the future of the industry, and they will determine the future of the EPC process.

References

Dow Chemical Co. (1989). Evaporative pattern casting process awareness study. Unpublished raw data.

Heine, H. (1986, October). EPC developments. Foundry Management and Technology, 114(10), pp. 36-41.

Kanicki, D. (1988, August). Bodine-Robinson Co: a business relationship built on EPC. Modern Casting, 78(8), pp.26-27.

Kanicki, D. & Thomas, S. (1991, August). Willard industries pioneers new EPC applications. Modern Casting, 100(10), pp. 24-27.

Monroe, R. (1992). Expendable pattern casting. Des Plaines:American Foundrymen's Society.

Patz, M. (1988, September). Net shapes, new shapes, expanding casting markets through EPC. Modern Casting, 79(7), pp. 40-43.

Panigrahi, S.C. (1974, January). New ideas in foundry. Indian Foundry Journal, pp. 8-16.

Robinson, R. (1988, September). Integrity, integration, incentive: planning needed for EPC to succeed. Modern Casting, 79(7), pp. 41-43.

Twarog, D. (1992, December). AFS reveals new research plan. Modern Casting, 82(12), p.36.

Twarog, D. (1993, February). EPC research reinforces benefits. Modern Casting, 83(2), p. 36.