

# Issues in Procurement of Castings

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**Abstract**—The aim of this paper is to present current and future procedures in castings procurement. Differences in procurement are highlighted. The supplier selection criteria used in practice is compared to literature findings. Different trends related to supply chains are presented and it is described how they are reflected in reality to castings procurement. To fulfil the aim, interviews were conducted in nine companies using castings. It was found that largest casting users have the most subcontractor foundries and it is more typical that they have multiple suppliers for the same parts. Currently only two companies out of nine purchase castings outside Europe, but the others are also progressing in the same direction. The main reason is the need to lower purchasing costs. Another trend is that all companies want to buy cast components or sub-assemblies instead of raw castings from foundries. It was found that price is a main supplier selection criterion. All companies use competitive bidding in supplier selection.

**Keywords**—Casting, interview study, procurement, supply trends.

## I. INTRODUCTION

THE aim of this paper is to present current procedures in castings procurement, including the number of suppliers, geographical location of subcontractors and purchased volumes. Differences in procurement are highlighted (according to company size, types of castings purchased, relative importance of castings). The supplier selection criteria used in practice is compared to literature findings. Different trends related to supply chains are presented and it is described how they are reflected in reality to castings procurement. Future trends of castings procurement are described.

To fulfil our goal, we conducted interviews in nine companies using castings. This study is restricted to Finnish companies using castings. Only cast iron and steel castings cast into sand moulds are covered. In this study, raw casting means non-upgraded casting. Cast component is a casting that has been washed, machined and is ready to be installed. We did not find previous studies regarding solely procurement of castings.

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Typical products cast in Finland are, for instance, parts to motors, off-road vehicles, paper machines, heavy vehicles and power production applications. Currently Finnish foundries are generally fully booked. That has led to long delivery times and delivery problems. Although foundries are currently doing well, there are threats nonetheless. Unsatisfactory delivery performance force customers to look for other supplier possibilities. Market price level in certain castings is affected by imports from low-cost countries, especially because the labour cost level per one average industrial worker in China is around 5 per cent of the Finnish level [1]. Many casting users have relocated part of their production from Finland. General view is that if domestic original equipment manufacturers (OEMs) relocate assemblies outside Finland, it is not feasible to make components locally.

## II. RESEARCH METHODS

We chose a qualitative research interview [2] as our data gathering method. The reason for using this method is that earlier information about the theme was not available. We also rather wanted deep insight into the theme than what can be gained with quantitative methods [3].

Semi-structured, face-to-face interviews were conducted in Finland in nine companies using castings. In the beginning of the study, an analysis of castings utilising companies in Finland was conducted. Based on the analysis, we attempted to select a representative sample, including both “large” and “small” casting users. We decided to include only domestic customers in the study, even if Finnish iron foundries directly import 30 % of their production [1]. Fifteen companies were contacted, and nine out of them agreed to participate in the study (referred to as company A–I). Companies vary in size and industry branch, but they all (except company F) manufacture and sell mechanical engineering products. The companies are located in Finland, and they are global companies (except company F). None of the companies involved in this study have an in-house foundry, but castings are purchased from subcontractors. An additional selection criterion was that all companies use iron and/or steel castings that are cast into sand moulds.

Interviews were conducted mainly during 2006 by at least one of the authors. Interviews took place in the respondents’ premises and lasted around two hours. One interview was completed by telephone the following day because of an emergency situation during the interview. We chose sales managers in charge of castings for the main group to be interviewed. In some companies, also representatives from

product development/designing and/or top level management were interviewed. Interviews were structured around a topic guide developed by the authors. The guide served as a prompt for the interviewers to cover key areas, but the interviewees had the possibility to raise topics they considered relevant. All interviews were recorded, transcribed and analysed.

Validity of the results were tried to be confirmed by confirming unclear issues by telephone calls and by sending a draft version of the paper to the interviewees for comments (interpretive validity). Additionally the authors discussed the results of analysis to verify that they had similar interpretation.

### III. LITERATURE REVIEW

The global business environment is and has been under changes. Global competition has tightened, markets and technology are changing rapidly, product life cycles are shorter and uncertainty has increased. The focus of the world economy transfers from Europe and United States to Brazil, Russia, India and China (so-called BRIC-countries) [4].

Outsourcing has been and still is a significant trend, because companies concentrate on their core competencies and what is strategically important for managing and developing business. Other components and activities are purchased from subcontractors that are specialised in them. Thus the share of subcontracting of sales is increasing. Outsourcing requires coordinating operations between manufacturers and suppliers [5]. Thus manufacturers reduce their supply bases and develop closer relationships with remaining suppliers [5]. Customers want fewer and fewer subcontractors and system suppliers to supply larger systems [4].

Another significant trend has been that production has been relocated closer to customers and markets [4]. Third trend has been that lately the main suppliers' interest in procurement issues has been in the developing markets [4]. In the long term, main suppliers aim at that subcontracting from different countries would be more equal compared to the value of end production [4]. In addition, subcontracted components and systems should come from as close as possible to production of end products. It is often stated that currently supply chains, instead of single companies, are competing against each other [6].

Predicted trends in supply chains include: collaboration will be the most strategic capability in the extended supply chains, service and support will become as important as the product itself, companies will improve their service capabilities to adapt in turbulent environment and assets and functions not at the core of value delivery will be divested [7]. Supported sourcing trends are: companies reduce their supply bases and remaining suppliers supply complete systems and modules, product development time is decreasing, suppliers account for an increasing share of product development resources and the use of JIT deliveries is increasing [5].

Researchers have developed numerous buyer-supplier

relationship portfolios based on Kraljic's pioneering work [8]. In the portfolios, suppliers and/or purchased goods are classified according to specific criteria to help companies to manage their purchases and supply bases by providing different procurement strategies for specific conditions. Purchasing decisions become more important as firms become more dependant on suppliers. Reference [9] has made a review of methods supporting supplier selection. They found that most decision models were related to final choice. The used decision models include linear weighting models, total cost of ownership (TCO) models, mathematical programming models, statistical models and models based on artificial intelligence (AI).

Reference [10] reviewed 74 articles related to supplier selection criteria and methods. Mostly mentioned criteria were net price, delivery, quality, production facilities and capacity, geographic location and technical capability. The degree of trust in a source and the quality of the relationship with the supplier are factors that determine a company's sourcing strategy [11]. The factors for a company to select a more expensive offer instead of lower one include quality, delivery, service and past experience [11]. While environmental regulation tightens, companies have to consider environmental issues in supplier selection. A framework for integrating environmental factors into the supplier selection has been presented [12]. Reference [13] found that even if managers rated quality as the most important supplier attribute, they assign more weight to cost and on time delivery attributes than quality in practice.

Buyers have different strategies. Arguments for one supplier include that properly priced life-of-product agreements encourage suppliers to invest [14]. Additionally in times of shortage, priority is given to the needs of special customers [14]. Other reasons for single supply are: better pricing results from a higher volume, the buyer obtains more influence with the supplier, control and coordination required with just-in-time manufacturing require a single source, lower freight costs, special tooling is required and the use of more than one supplier is impractical or excessively costly [14], [11]. The benefits of single source for the buyer include low total costs, a dependable source of supply and a partner familiar with his needs [14]. Arguments for multiple suppliers include maintaining competition, providing back-up source, avoiding lethargy or complacency on the part of a single-source supplier, greater flexibility for the buyer and buyer becomes knowledgeable about competitive technical innovations [14], [11].

Advantages of local purchasing include closer cooperation, possibility for JIT deliveries, more certain delivery dates, shorter lead times, disputes more easily solved and inventories can be reduced or eliminated [14]. International sourcing requires additional efforts when compared with domestic sourcing, but it can yield large rewards. According to [14], common reasons for a company to source globally include quality, timeliness, cost, product and process technologies, broadening the supply base and counter-trade. Risks related to

global sourcing include communication problems, logistics problems, long lead times, additional inventories, different practices and regulations as well as currency rates [14].

When potential suppliers have been identified, a decision has to be made whether to use competitive bidding, negotiation or a combination of them. Competitive bidding should be used if the value of the purchase is large enough to justify the expense, the item or service to be purchased is clearly specified, there are enough sellers on the market, the sellers actively want the contract and price competitively to have it [14].

#### IV. RESULTS

Procurement of castings in the interviewed companies is presented in table 1. All companies buy both raw castings and cast components from foundries. For company G, the foundry only pre-machines some parts. Companies A, B and H order specific prototypes of castings when developing new parts. Companies C, D and E do not use specific prototypes. All companies (except company F) make-to-order.

As can be seen in table 1, the largest casting users have the most subcontractor foundries. Currently only companies B and H currently purchase castings outside Europe. Both of them belong to largest casting users. They also have largest series. In addition to a part of high volume casting production, company B buys prototypes and very demanding and/or small volume castings with short delivery time from Finland.

The companies that purchase only from Europe indicated that they have not found a practical way to manage purchases outside Europe. The mentioned obstacles include a need for three storages while JIT-principle is emphasized, a need to modify production strategy, small delivery batch sizes, long transportation time and doubts as to the Chinese quality level. Additionally, respondents pointed out that, if purchasing from China, they have to be present in China. Many companies do not have such resources. Presently agents who handle foreign purchasing are also available, but it was found that casting users prefer to manage casting purchasing themselves. Even if a foundry sells raw castings, it usually has a direct contact to the casting user.

Companies A, B, D, H and I have two supply chains for all or some of the castings. The reason behind the two chains in companies B and H is their main volume imports from China, which requires a local back-up foundry. Company D does not trust one supplier and wants to have another option. Half of the companies have only one supply chain for all castings. They all can be called small casting users.

In the interviews, five somewhat different supply chains of castings were identified (see Fig. 1). Post-cast processes include for instance machining, coating, painting, heat treating and assembly. In Fig. 1, only machining is included for the sake of simplicity. Currently, casting users often have to control the entire supply chain of castings themselves

(alternative 5 in Fig. 1). They have to locate the right suppliers, for example foundry, machinist and paint shop. After locating these suppliers the companies have to negotiate the terms and sign the contracts with them. Then these suppliers are chained. If the castings are late, the casting user has to reschedule the whole chain. Sometimes problems relating to the liability of indirect costs occur.

Most interviewed casting users are actively looking for new supply possibilities. The main driver to switch supplier is money. Casting users look for long-term suppliers when selecting foundries to amortize initial costs. Additionally, building a relationship with a new foundry is expensive and it takes at least one year. By centralising castings purchases, casting users consider that they gain a more beneficial position due to increased volumes. Casting users feel that foundries serve their old customers better.

Price is a main supplier selection criterion especially with new supplier as well as references (other customers) that a foundry can present. Environmental or quality certificates are not determining in supplier selection. Quality and delivery reliability are not considered as potential competitive advantages, but they are merely order qualifiers. Many casting users said they know they can obtain castings at a lower price from abroad, but they prefer to buy then from Finland. The reasons include designing cooperation, easiness of contact and flexibility. According to the interviews, supplier selection is merely based on buyer's experience. Some companies have a more formal supplier evaluation and selection practices.

The quotation for a prototype manufacturing is usually requested from one foundry. With series production, invitation for bids is always sent to several foundries. With series castings, casting users monitor regularly that the price is on market level by calling for bids from various foundries. Generally contracts are signed for one year. Usually there are yearly price negotiations between the foundry and the customer.

A few issues on future of casting procurement need to be mentioned. Customers expect the total price level to be globally competitive and to obtain lower prices every year to balance the rise of other raw materials. Other properties desired from foundries include high delivery reliability, flexibility and ability to deliver at a short notice.

TABLE I  
PROCUREMENT OF CASTINGS IN THE INTERVIEWED COMPANIES

Company	Consumption of castings (kt/a)			Series (per year)	Distribution of castings' purchase*			Number of foundry suppliers		
	< 1	1- 10	>10		Finland	Europe (ex. Finland)	Outside Europe	< 5	6- 10	> 10
A			•	Thousands	80 %	20 %			•	
B			•	Thousands to tens of thousands	30 – 40 %	•	•			•
C	•			Single castings, less than ten	•	•		•		
D		•		A few hundred to a thousand	40 %	60 %		•		
E	•			Single castings, very small series	•**	•			•	
F	•			Series, mainly a few hundred	•	•***		•		
G	•			From a few to less than hundred	25 %	75 %			•	
H			•	From single castings to few thousands	•	•	•			•
I			•	Main products several/ tens of thousands	30 %	70 %				•

\* Some companies did not want to give detailed information

\*\* Mainly

\*\*\* Finished products, most volumes

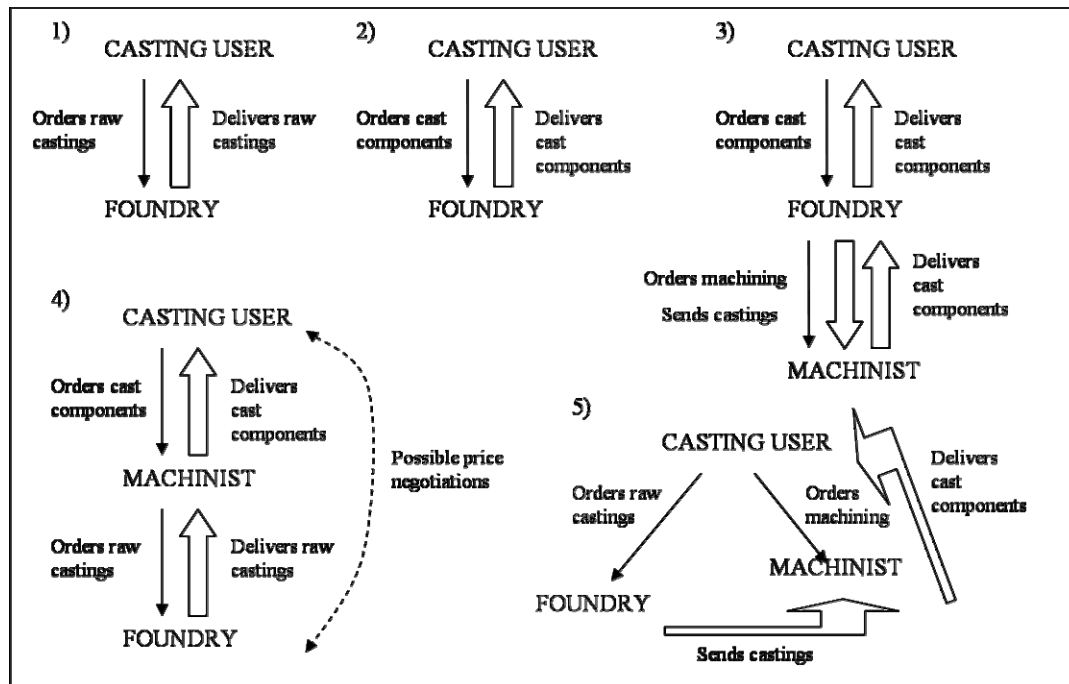


Fig. 1 Casting purchasing procedures

All the interviewed casting users said that they would be interested, if a foundry could offer machining in addition to casting. Companies A, B, D and H would be interested in outsourcing also some finishing painting and assembling to foundries. Casting users C, G and H intend to develop deeper collaborative partnerships with some foundries. Company G would be interested in having a partner foundry that could design castings for them. They would also be willing to pay for it. From the foundries' perspective, company G is not an attractive customer because of demanding and small series castings. Company H pointed out that they would be interested in signing long-term partner contracts with foundries, but foundries are not eager to such a commitment.

#### V. CONCLUSION

The number of foundry suppliers used by a company follows the consumption of castings and typical series sizes. Largest users have most suppliers. Largest users also have two supply chains for some or all of the castings. This is partly because of their castings are series castings. Small casting users have only one supply chain for all castings.

According to the conducted interviews, price is one of the most determining supplier selection criterion. Many casting users prefer to purchase from Finland regardless of higher price level because of designing cooperation, easiness of contact and flexibility. In addition to those, the authors assume that casting users consider domestic purchasing to be easier and less risky compared to purchasing, for instance, from China. The importance of designing cooperation was pointed out, but in practice casting users are not ready to commit to a foundry in the early phases of product

development. All interviewed companies use competitive bidding in supplier selection. Delivery reliability and quality are essential when companies select those foundries to which the invitation for bids is sent.

None of the casting users have an in-house foundry. Currently, in addition to purchasing castings, the interviewees want to purchase upgrading of castings from foundries. Thus increase of outsourcing and wish for larges systems are supported trends. Currently two out of nine companies source castings outside Europe, but the others are also progressing in the same direction. The main driver is the need to lower purchasing costs. Three out of nine companies stated that they intend to develop closer collaborative partnerships with some foundries. Reducing supply bases was partly confirmed by our study. Even if all casting users look for new foundry suppliers, they prefer to buy also post-cast processes from foundries and not from separate companies as they currently have to do.

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