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Casting Users' Perspectives on Foundries as Suppliers

T. Saarelainen, O. Piha, P. Makkonen, and J. Orkas

***Abstract*—**Global competition is tightening and companies have to think how to remain competitive. The main aim of this paper is to discuss how Finnish foundries will remain competitive. To fulfil the aim, we conducted interviews in nine companies using castings and analysed buyer–supplier relationships, current competitive advantages of Finnish foundries and customer perspectives on how Finnish foundries remain competitive. We found that the customer-foundry relationship is still closer to traditional subcontracting than partnering and general image of foundries is negative. Current competitive advantages of Finnish foundries include designing cooperation, proximity and flexibility. Casting users state that Finnish foundries should sell their know-how and services instead of their capacity, concentrate on prototype, single and short series castings and supply ready-to-install cast components directly to customers' assembly lines.

***Keywords*—**Buyer-supplier relationship, casting, competitive advantage, customer prespective.

I. Introduction

GLOBAL competition is tightening, raw material and energy prices are rising, manufacturing of products is relocated around the world, product life cycles are shorter and general uncertainty has increased. Original equipment manufacturers (OEMs) focus on their core competencies and outsource non-core activities. Changing global business environment and customer requirements force also suppliers to think how to remain competitive. Competitive subcontractors are essential for their customers' competitiveness.

Competitive edge of a company is based on three principles. Either a company does something at lower costs than the others, or does it at the same costs but better than the others, or does something that no one else does or can do.

The main aim of this paper is to discuss how Finnish foundries will remain competitive in future. To fulfil our goal, we conducted interviews in nine companies using castings to gain a deeper understanding of customer's perspectives of foundries as suppliers.

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]. Neither production capacity nor system is flexible, and a lack of human resources is present in foundries. Environmental legislation has tightened and environmental protection requires financial resources. Many casting users have relocated part of their production from Finland. General view is that if domestic OEMs relocate assemblies outside Finland, it is not feasible to make components locally. Most Finnish foundries cast several types of castings with differing requirements, due to an extensive customer base. Since foundries are general foundries, it is difficult to optimise the production to specific types of castings.

We did not find previous studies regarding customer–foundry relationships, even if several studies on industrial buyer-supplier relationships have been reported, for example [2]–[7]. Most papers concentrate on automakers and their suppliers, and do not consider other manufacturers. However, typical products cast in Finland are parts to industrial goods, for instance parts to motors, off-road vehicles, paper machines, heavy vehicles and power production applications. These parts differ from automotive parts especially in the series size.

This study is restricted to Finnish companies using castings and their relationships with Finnish foundries. Only cast iron and steel sand castings are covered. Nevertheless, we assume that the results of our study are of interest also for other European suppliers, who compete with imports from low-cost countries.

In this study, raw casting means non-upgraded casting. Cast component is a casting that has been washed and machined and is ready to be installed.

II. Research Methods

We chose a qualitative research interview [see for example 8] as our data gathering method. The reason for using this method is that no earlier information about the theme was available. We also rather wanted deep insight into the theme

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Tanja Saarelainen is with the Helsinki University of Technology, Department of Engineering Design and Production, P.O. Box 4100, 02015 TKK, Finland (phone: 358-9-4515069; e-mail: tanja.saarelainen@tkk.fi).

Olavi Piha works in Helsinki University of Technology, P.O.Box 4100, 02015 TKK, Finland (e-mail: olavi.piha@tkk.fi).

Juhani Orkas and Petri Makkonen are with Helsinki University of Technology, P.O.Box 4100, 02015 TKK, Finland (e-mail: juhani.orkas@tkk.fi, petri.e.makkonen@tkk.fi).

than what can be gained with quantitative methods [for example 9]. Typically, statistical generalisations cannot be made of qualitative data. Since qualitative findings result in unifiable conclusions, we expect our findings to be valuable also for a larger audience.

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 (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 that are made-to-order. The companies are located in Finland and they are global companies (except company F). None of the companies 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.

Semi-structured, face-to-face 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.

Before this study we have interviewed numerous employees from foundries. The results of those interviews are refereed in this study when appropriate.

We formulated a relationship analysis model to assist in analysis based on the work of [10]. Characteristics of a relationship are discussed in chapter 3 'Literature review'. Of the presented characteristics, we selected trust, commitment, communication, information sharing and cooperation as the analysed characteristics. These characteristics are described in Table I. We do not attempt to provide absolute values to these characteristics but merely analyse qualitatively.

TABLE I
RELATIONSHIP ANALYSIS MODEL

Characteristic	Description
Commitment	How many alternative suppliers for same parts
	How long contracts
	How foundry's contribution to part development influences supplier selection
	Suppliers are competed based on what
Communication	Who communicate (one person vs. whole organisations)
	When the first contact occurs
Information sharing	What kind of information is transmitted (about coming projects, geometry of the part, about the use of environment, assembly drawings, conditions of use)
Cooperation	What kind of cooperation: development, management, technical
	When the supplier participates to product development
	Does the buyer retain control over the design
Trust	Related to all other characteristics

III. LITERATURE REVIEW

The buyer–supplier relationship type affects the prices and quality of components, which determine the price and quality of the final product [11]. Subcontracting can reach up to 70 per cent share of sales. Thus suppliers can be a source of a competitive edge for a company [12]. Consequently, supplier management [2] and supplier selection [3] is vital for a company's success. Buyers should evaluate suppliers across several dimensions, such as product quality and performance as well as delivery reliability [3]. Suppliers should be analysed strategically to see how the supplier's product contributes to the buying company's core competence and competitive edge [2]. Reference [13] 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.

Researchers have developed numerous portfolio models to help companies to manage their supply bases, purchases and buyer–supplier relationships. Some portfolio models are presented in Table II.

The buyer–supplier relationship analysis is based on several dimensions. Based on the dimensions presented in table 2 and [10],[16], characteristics of a relationship are: trust, cooperation, commitment, communication, information sharing, opportunistic behaviour, risk/reward sharing, relative supplier attractiveness, buyer/supplier power and the importance of the purchase. Some of these characteristics are discussed.

TABLE II
SUMMARY OF PORTFOLIO MODELS

Portfolio model	Classification dimensions	Categories
Kraljic [14]: Classification of purchased materials	Complexity of supply markets Importance of purchasing	Non-critical items Leverage items Bottleneck items Strategic items
Kamath and Liker [15]: Supplier roles	Design responsibility Product complexity Specifications provided Supplier's influence on specifications Stage of supplier's involvement Component-testing responsibility Supplier's technological capabilities	Partner Mature Child Contractual
Olsen and Ellram [4]: Analysis of purchases	Strategic importance of the purchase Difficulty of managing the purchase situation	Non-critical Bottleneck Leverage Strategic
Bensaou [5]: buyer-supplier relationships	Supplier's specific investments Buyer's specific investments	Market exchange Captive buyer Captive supplier Strategic partnership
Oberoi and Khamba [3]: Supplier segmentation	Sourcing strategy	Component suppliers Capacity suppliers Technology suppliers System suppliers

It is important to implement all types of trust in buyer–supplier relationships. The buyer can show trust by reducing the number of suppliers and increasing the average contract length with remaining suppliers [11]. Companies lacking trust with their suppliers have multiple suppliers for a component to ensure that the supplier is not overcharging and to have a readily available alternative in case of problems [11]. Transferring information and technology between buyers and suppliers helps to establish mutual trust [11]. If suppliers are changed frequently, common information accumulation is limited [17] while knowledge accumulation improves organizations' competitive performance [11]. By developing relation-specific routines, buyers and suppliers can share hard-to-transfer knowledge more efficiently [18].

Cooperation between the buyer and the supplier can be divided into cooperation in development, technical cooperation and integration of management [4]. Factors that have a favourable influence on supplier involvement in development include technical uncertainty and technical complexity of the component as well as supplier's in-house technical capabilities [17], [19].

Traditional subcontracting is characterised by short-term contracts, low levels of trust and information sharing, frequent re-bidding, multiple sourcing, lack of customer perspective, fear of know-how leakage, and price-based supplier competition [2], [20], [11]. Traditional subcontractors manufacture according to customer's drawings, technical specifications and other instructions [3].

Successful partnerships are characterised by long-term relationships, mutual trust, cooperation, supplier involvement in product design, relation-specific investments, shared know-how and wide-scope relationships between the buyer and the supplier [5], [6], [11]. Buyers have a greater impetus to assist partner suppliers, because their own success is tied to the success of these suppliers [2]. A supplier is required to have resources and ability to handle design, analysis, prototyping and testing services, if they wish to move up to partnership status [15], [17]. On the other hand, these relationships are costly to develop and maintain [2], [5]. Due to specialized investments, they are risky [5] and may reduce a customer's ability to switch inefficient suppliers [2].

Renewal of subcontractors is needed [21]. The reasons include relocation of production and subcontracting closer to markets, new roles of suppliers, increasing value of procurement and alteration of technology in production networks. Small suppliers have low risks carrying capacity. Small-and-medium-sized suppliers have to grow into middle-and-large-sized companies that are able to internationalise, participate to product development and provide larger systems as well as be responsible for the quality of products [21].

IV. RESULTS

According to the conducted interviews, general image of foundries is negative. Foundries are considered conservative, old-fashioned and not willing to carry indirect costs. Casting users feel that foundries have accepted the attitude "we are always late because the foundry process is more complex than other manufacturing processes." In addition, service does not correspond to customer needs. Delivery times are long and foundries are not active towards customers. Foundries wait for customer's invitation for bids and do not inform customers if castings are supplied late. Negative aspects related to Finnish foundries, which were mentioned in the majority of the interviews, include unsatisfactory delivery performance, high price level and foundries are not interested in small volumes and prototype castings. However, several interviewed casting users said they know they can obtain castings at a lower price from abroad, but they prefer to buy them from Finland. The reasons include designing cooperation, easiness of contact and flexibility. Current competitive advantages of Finnish foundries with subsequent benefits are collected in table 3 According to the interviewees, quality and delivery reliability are not considered as potential competitive advantages. They are merely order qualifiers.

TABLE III
CURRENT COMPETITIVE ADVANTAGES OF FINNISH FOUNDRIES

Competitive edge	Subsequent benefits
Designing cooperation	Design for manufacturability → less defective castings, lower production costs
	Added value → e.g. lighter part
Proximity	Short delivery time → fast lead-time (it takes one month to import from China to Finland)
	Daily deliveries → storages can be minimized → less capital is tied-up
	Face-to-face discussions easily and quickly arranged → problem solving easier
	Faster feedback from customer → corrective actions can be started faster
	Easier and cheaper communication, no time differences
	Lower transportation costs
	Flexibility
Flexibility	Customer does not have to know long in advance the need for specific castings; can use make-to-order principle
	Large variety of parts with different batch sizes can be ordered from one foundry
	Can back-up foreign deliveries
Same language**	Beneficial in product development
	Communication easier
Technical competence	Demanding castings possible
	Parts can be integrated into a single casting
	Management of design modifications
Upgraded castings* (in this context machining, finished painting)	Easier life for customer → can order all from one place
	More work for a foundry
	Immediate quality feedback

*Some foundries manage currently, but not all. Company B pointed out that Finnish foundries are not currently able to offer machining at a competitive price and quality level.

** Some interviewees mentioned that language is a competitive advantage to a Finnish foundry. On the other hand, younger purchasers said that being Finnish does not provide a competitive edge in their point of view.

Most interviewed casting users are actively looking for new supply possibilities because of long delivery times, delivery reliability problems, capacity shortage and the need for lower priced and upgraded castings. The main driver to switch supplier is money. Quality and delivery problems are reasons for "quick" supplier switches. Typically new suppliers are given new parts, but existing parts are changed to new foundries only when the savings potential is remarkable. According to one respondent, the price has to be at least ten to twenty percent lower.

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. 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, especially if a foundry has contributed to the part development. When the part is ready for the 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. Especially customers with large volume production use this tactics whereas smaller customers are merely informed of rising prices.

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.

The level of collaboration, information sharing and communication between a foundry and a casting user varies greatly, but is generally rather low. Company A discusses regularly with their suppliers their future projects while company B develops problematic parts with foundries. Company C draws the kind of parts they need and asks offers for that kind of parts. Company H designs castings together with a foundry when the casting is demanding and/or "completely" new. Company I cooperates with a foundry when designing new parts or when an existing part is modified.

In offer making phase, communication usually occurs between and via sales and purchasing departments. If the foundry and the casting user know each other, the designers of both organisations might discuss directly about the development of the part. When the series production has begun, the communication is mainly related to quality and delivery problems, changes in predictions etc. Sometimes parts are further developed together. Most of the communication between different parties happens by phone or by email. Sometimes meetings are organized. Plenty of communication is undertaken through CAD-files or other documents.

Relating to new parts, the invitation for bids is usually the first contact between a casting user and a foundry. At this point, the part geometry is almost fixed. No real designing cooperation happens in these cases. The foundry may give

comments like "this hole will be machined, not cast; a feeding filling is needed here" to the customer. Casting users send the geometry of the part and the material standard to a foundry, but typically no information about conditions of use or joining parts. In addition to lack of communication at the early product development phase, the missing parts of information prevent foundries from truly contributing to the castability of the part. Some casting users, such as A and B, might send the 3D-model of the new part before the formal invitation for bids to obtain comments on castability. Thus the foundry can comment on the geometry to improve castability.

Designing cooperation between a foundry and a casting user is currently mostly related to designing single castings more castable. Few examples of true concurrent engineering were mentioned in the interviews. Casting users do not expect deeper designing cooperation, but value the contribution provided by foundries, even if they do not have enough casting-specific knowledge within their companies. Foundries are not paid for the consultancy, because casting users consider that designing cooperation is beneficial also for foundries due to more castable parts. In their opinion, a foundry can be competitive by providing designing help. If a foundry would charge for the designing help, it could out-price itself in the beginning.

Even if a foundry has contributed to the development of a casting, the buyer is always liable for the design. Interviewees considered that, when comparing Finnish and international foundries, cooperation is more efficient with the Finnish ones due to a shared native language, short distances and "easiness" of contact. Thus Finnish casting users develop their castings mainly with Finnish foundries and solve problems with foreign 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.

According to the conducted interviews, Finnish foundries can survive in the global competition by

- Focusing on supplying flexibly single and small series castings made-to-order with short delivery times. The reasons include that often customers know only some weeks or months in advance their needs, delivery time is often customer's own competitive advantage and for those casting users who do not have standard castings, it is difficult to book capacity.
- Supplying ready-to-install cast components or sub assemblies directly to customers' assembly line.
- Providing designing cooperation. The reasons include that designing cooperation enables foundries to provide value added to customers and in product development, domesticity and proximity are competitive advantages. Additionally, there will always be foundries that are ready to sell at a lower price.
- Adjusting to the role of prototype and back-up foundry. Western back-up foundry is always needed if the volume castings are imported for example from China.
- Specialising and building customer-specific lines in order to enable high efficiency, quality and subsequently lower costs.

V. Discussion

Even though the general image of foundries is negative, casting users see foundries as essential parts of the supply chain possessing knowledge that they do not have themselves. For example casting users do not have enough casting-specific knowledge within their companies, but a foundry is needed to optimise castability of parts in order to reduce manufacturing costs and problems. Thus it is not surprising that designing cooperation was mentioned as one of the competitive advantages of Finnish foundries. Other competitive advantages mentioned in the interviews include proximity, flexibility, same language, technical competence and upgrading of castings. Most of these are interconnected, for example proximity and same language are beneficial in product development and proximity enables flexibility. Many mentioned problems, such as long delivery times, are related to current high demand for castings. However, such problems force casting users to look for other supply possibilities. If they find another competitive supply chain abroad, they do not easily switch back to domestic one. Thus it is imperative that foundries focus on their serviceability and have a long-term perspective on how to remain competitive.

Based on the interviews results, the customer–foundry relationship is closer to a traditional subcontracting than a partnership. The level of collaboration, information sharing and communication between a foundry and a casting user varies greatly, but is generally rather low. Few examples of true concurrent engineering were mentioned in the interviews. Casting users expect foundries to be flexible, provide designing support, upgraded castings and short delivery times. However, the level of information sharing and communication between organisations is generally rather low. Additionally, casting users are not ready to commit to a supplier at the early phase of product development. The series production is subject to competitive bids regardless of foundry's contribution. On the other hand, company H stated that foundries are not willing to sign long-term partner contracts with them. In the interviews it was mentioned that contracts are signed typically for one year. In addition, casting users look for long-term suppliers when selecting foundries. However, most interviewed casting users are actively looking for new supply possibilities, increasingly from low-cost countries due to the need to lower purchasing costs. We also

found that price is a main supplier selection criterion. However, half of the casting users use single supply sources. It can be seen as a sign of trust, but there are also other reasons such as limited purchasing resources in the companies.

We consider that customer-foundry relationship should be deepened because supply chains are affected by decisions made in other, connected supply chains. The relationship affects supplier's allocation of manpower to the company's product development process, availability of products in times of shortage, and/or protection of information confidentiality [22]. According to [11], it is a mistake for a supplier to make major investments in dedicated customer-specific assets if long-term contracts are missing. We consider that deepening the relationship would be beneficial both to the foundry and the customer, because building new relationships requires time and resources. To benefit from a deeper relationship, more efficient information sharing and communication than currently is required. According to [22], continuous information flow helps to create the best product flows. However, few foundries can make the investments in personnel, CAD-systems and research-and-development capabilities that a true partnership with their customers requires.

We consider that in the future, a Finnish foundry should sell know-how and services instead of capacity. Capacity suppliers are more easily switched to other suppliers and they are more vulnerable to imports from low-cost countries. In certain series castings, Finnish foundries can reach, and even undercut, the global price level, but generally it is always possible to find someone willing to offer lower prices. We expect that the future for Finnish foundries will be brighter, if they concentrate on competing based on criteria such as proximity, flexibility and short delivery times instead of price.

We, as well as the interviewed casting users, expect that Finnish foundries should focus on supplying flexibly single and small series castings made-to-order with short delivery times. Such castings are for example prototypes, back-up and spare parts. As mentioned in the interviews, casting users know often only some weeks in advance their needs for specific castings. Also a western back-up foundry is always needed if volumes are imported from China for example. Proximity allows the advantage of JIT-delivery. Currently foundries prefer volume castings and prototypes are considered as a disturbance to a series production. Thus this necessitates an attitude change in foundries.

Even currently many foundries do not offer upgrading of castings. However, casting users clearly stated that foundries should supply cost-efficiently upgraded cast components or sub-assemblies. Most foundries are of small or medium size and have limited resources. It is necessary that these foundries network with other suppliers or grow themselves to being able to provide the service customers require.

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