

**COLLABORATIVE DISTRIBUTED PRODUCT DEVELOPMENT:
THREAT OR OPPORTUNITY FOR SWEDISH SMES?**

Staffan Gullander
Anna Öhrwall Rönnbäck

Abstract

The main objective of this study is to investigate the need of product development for small and medium-sized supplier firms (SMEs) in the engineering industry, in order for them to meet hardening competition and increasing demands from larger buyer firms. A secondary objective is to study the influence of firms' geographical location (especially low-population density areas).

Methodologically, the study combines a quantitative survey of a couple of thousand firms, with a qualitative in-depth interview study of 24 firms, located all over Sweden.

The sample was split into two supplier categories: those who have their own products, and conduct product development, and those who manufacture customer-owned products, which we refer to as "ego" and "lego".

The major conclusion from the study is that several factors have impact on a supplier's strategic business position. The differences between ego and lego suppliers according to the statistical analysis include (a) size, (b) productivity, (c) customer and (d) supplier structure, (e) internationalization, and (f) collaboration. This result indicates that a supplier that wants to conduct its own product development also needs to master a competitive situation characterized by global supply chains, an international market, and international competitors.

Key words: SME, collaborative product development, engineering industry

1 Introduction

1.1 Background

As competition is global to an ever-increasing extent, industry nations such as Sweden experience that large customer firms and their suppliers (eg Ericsson, Flextronics, Volvo, and Autoliv) move production units abroad, choose suppliers in countries with lower labor costs, or outsource to third parties that in turn might source from abroad. Nevertheless, the changes in sourcing could also turn into an interesting opportunity for competent suppliers, since many customer firms have realized that innovative products and production equipment stem from suppliers (as shown already in 1988 by von Hippel [1]). A contributing reason is that higher product complexity and larger technology content in products require specialist knowledge from several technology fields, that one single firm, whether customer or supplier, cannot afford to build up on its own [2]. Customers therefore tend to an ever-increasing extent to conduct product development with suppliers [3], [4].

It is especially interesting to study small supplier firms' possibilities to conduct product development, and implied needs for collaboration with others, horizontally and vertically along the supply chain, in order to meet customers' increasing demands.

1.2 Objectives

The main objective of this study is to investigate the need of product development for small and medium-sized supplier firms (SMEs) in the engineering industry, in order for them to meet the hardening competition and increasing demands from larger buyer firms. A secondary objective is to study the influence of firms' geographical location (especially low-population density areas).

From a research perspective we strive to understand if product development skills can increase competitiveness for SMEs in the engineering industry. From an industrial perspective, the study aims to suggest managerial guidelines for such SME firms.

1.3 Methodology

The study combines quantitative and qualitative research methods. It starts from a survey, conducted by NUTEK¹, where all firms with less than five hundred employees in the Swedish engineering industry² were investigated regarding size and other financial data from their annual reports the last three years (from official statistics³), their offering (eg if the firm regards itself as a supplier, and if it produces and develops its own products), location, client and supplier base, education level, competitive advantages, and their collaboration with others (questions are listed in Appendix 1).

To start with, a quantitative statistical analysis⁴ provided us with a macro picture of the suppliers. However, in order to better understand the reality of a firm [5], we conducted also a qualitative multiple case study at a micro level [6].

¹ NUTEK, the Swedish Business Development Agency, is Sweden's central public authority for industrial policy issues (www.nutek.se). Telephone interviews were conducted by Temo (www.temo.se).

² Selected from so-called SNI codes according to Statistics Sweden, www.scb.se.

³ Annual reports are official information in Sweden.

⁴ Statistical software package SPSS was used, version 11.0, see www.spss.com.

The statistical analysis was then a base both for selection of cases and the choice of question areas. Thus, the results from the quantitative analysis served as early theoretical constructs, and as a guide to which areas that needed to be investigated further in our in-depth interviews. However, we tried not to lean too much on the statistical results when visiting firms and conducting telephone interviews, but instead, we strived to start from “a clean theoretical slate” avoiding thinking too much of relationships between variables and theories at the outset of the study, since expected theoretical perspectives or propositions then may interfere with upcoming results (as suggested by eg Eisenhardt, [7]).

The qualitative study consisted of in-depth, opened-ended, and semi-structured interviews [5] with 24 suppliers (six company visits and eighteen telephone interviews of each between twenty minutes and one hour). We conducted our interviews in parallel, using the same question guide, and compared our results only at the end of the interview series. The advantage of multiple investigators is that complementary insights and different perspectives can contribute to enhance both the richness of data collected and the likelihood of discovering new and interesting results [7].

2 Previous Research

2.1 A Background to Collaborative Product Development

In fact, buyer-supplier cooperation in highly complex product development has a long tradition, for instance in the aerospace, automotive and medical industries. A change in recent years though is towards a more differentiated attitude to suppliers depending on the long-term strategic importance of their involvement [8]. When large manufacturing firms seek to reduce their supplier base in order to be able to manage closer relationships with a few, strategic suppliers, they become *systems integrators* instead of ordinary manufacturers, with responsibility for the overall quality and functionality of a product consisting of subsystems delivered from major systems suppliers with whom they work closely, as illustrated in figure 1.

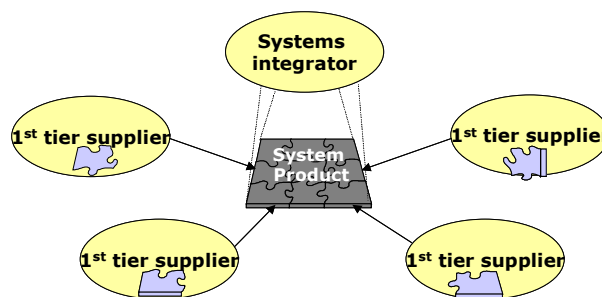


Figure 1 Development of a system product often means to integrate system parts, which major suppliers develop and produce.

Closer vertical cooperation between a buyer firm and its major suppliers can be regarded as a threat for smaller firms, which risk being pushed backwards in the supply chain. Since SME firms are too small to be able to organize cross-functional teams required for larger assignments on their own, collaborative integrated product development (typically involving marketers, design engineers, and manufacturing

engineers) can be obtained if they join their forces [9]. Thus, by joining their forces in supplier networks, several component suppliers can offer complete system products either to buyer firms or to the first and second tiers in the supply chain [10], [11].

In any case, if a supplier develops major subsystems of a system product it cannot easily be replaced. The relationship shall often last as long as the product is in service, which for some products may be ten years or longer, while a development project may last during a tenth of the product life-cycle period. Therefore, innovations carried out together with customers, major suppliers and subtiers implies increasingly complex supply chain cooperation [12], [13].

2.2 Organization of Collaborative Product Development

Product development is recognized as one of the most complex activities of the firm, due to the high degree of uncertainties; the difficulty to estimate future demand often on fast changing markets, working with new, quite unknown technology fields, difficulties to estimate cost and time required, but most perhaps, since innovative activities are depending on a well-functioning communication between individuals from various background [14]. Since collaborative product development always includes a business relationship between the parties it is different from in-house product development. Concerning business relationships in general, Gummesson [15] speaks of the many-headed customer and the many-headed supplier. There is no longer one-to-one communication between cooperating companies. Instead, individual contacts have shifted towards multiple team contacts at several levels simultaneously.

Fine [16] suggests three-dimensional engineering to organize for efficient supply chain product development, and recommends that firms by selecting which projects to participate in, build up their knowledge base and supply chain network relationships, which may be useful for its coming opportunities. Transitory supply chains, where firms risk losing a partner to a competing supply chain are also common threats to an open attitude to knowledge and information sharing between firms [17]. Nevertheless, von Hippel [1] showed in a large quantitative study the importance of external organizations for innovations, and Quinn [12] maintains outsourcing of innovation as a method for survival for most firms since the demands on innovation becomes more and more complex and resource consuming in almost all industries.

Compared to in-house development, collaborative product development also sets higher requirements for communication management, where the balance between necessary openness concerning information sharing and precautions to control proprietary information is delicate [18], [19]. Information sharing in collaborative product development is often highlighted as one of the most important, but also most difficult managerial issues. Many authors report shortcomings, and needs for improvements to achieve more successful collaborative product development [18], [4], [3], [19]. Conclusions on the need for improved information management between collaborating partners is found in several previous research studies in this area (eg [4], [3], [20], [17], [12]).

3 Result and Analysis from Quantitative Data

3.1 The Survey

The study is based on a survey of Swedish companies with between 5-499 employees in the engineering industry (especially those in the automotive, machine, defence and telecommunication sectors), which primarily describes the size of this industry, the economic situation and competitive advantage [22]. Data was collected through 4 430 telephone interviews carried out during 2001-2002, of which 3 170 firms participated (response rate 72 %). Of these firms, 2 033 regarded themselves as suppliers, and were asked further questions, as specified in Appendix 1. Moreover, financial data from annual reports of the firms was gathered for the last three years, and geographical information about the firms was coded. Altogether the firms are described with data from about 200 variables.

3.2 Statistical Analysis 1: Identifying Endpoint Business Types

The basic question for this research concerned the importance of product development competence, and the resulting potential threat to suppliers being asked to provide this competence to their customer. An obvious starting point in an analysis is thus to see what development competence exists with suppliers. Equally close is figuring out companies not possessing this attribute. Question 9 in the questionnaire (Appendix 1) allowed us to construct a one-dimensional scale for this resource, based on whether the firm (1) has its own products and product development or (2) offers production of customer-owned products, ie manufacturing of parts against customers' blueprints, expressed as percentage of total sales.

We denote the first group of suppliers "ego", selected from the database as those who answered that they produced 100 % own products and conducted their own product development, and the second group of suppliers "lego", selected as suppliers which answered that their production is 100 % customer-owned products. The sum should equal 100 %, and firms that had answered more or less than 100 % on these two alternatives together were excluded from the study, which left us with 1 804 firms.

Table 1 shows that 61 % of all suppliers are at the endpoints:

- 8 % of the firms are pure ego suppliers, ie produce own products and carry out product development to 100 % of their production.
- 53 % of the firms are pure lego suppliers, ie 100 % of the production is customer owned products. These firms do not carry out product development of their own.

Table 1. Percentage of ego (100 % own products and product development), lego (100 % production of customer-owned products) and mixed suppliers (between 0-99 % ego and lego).

Supplier category	Amount	Percentage
Ego (100 %)	151	8 %
Lego (100 %)	949	53 %
Mixed (1-99 %)	704	39 %
Total (N)	1 804	100 %

COLLABORATIVE DISTRIBUTED PRODUCT DEVELOPMENT

Furthermore, an analysis of the frequency distribution for this variable shows strong peaks at the precise endpoints, with a large majority of lego suppliers, and fairly even spread in between, see figure 2 (the sample viewed in 5 % intervals).

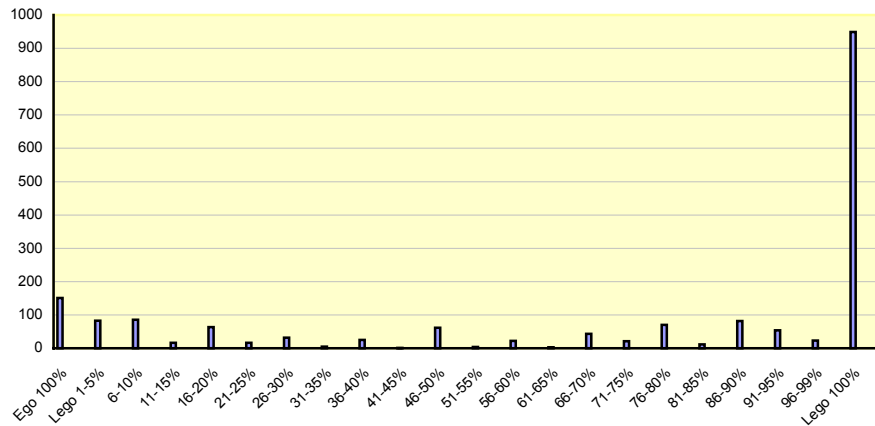


Figure 2 Frequency report for variable 9: from 100 % ego suppliers (151) to 100 % lego suppliers (949), intervals of 5 %. (N=1 804)

Next thing was to compute a correlation matrix on the sample. Analyzing the variables “100 % ego” and “100 % lego” we found that nine out of the 200 variables were significant for describing the two groups, see table 2 below. The same result was obtained also in a discriminant analysis. These nine variables could be condensed into six characteristics preserving the diametrically opposed picture, namely (a) size and (b) productivity, (c) customer and (d) supplier structure, (e) internationalization, and (f) collaboration, as also presented in the right-hand column of table 2.

Table 2. Variables that explain ego and lego suppliers, grouped into six characteristics (a)-(f). (Result of correlation matrix including all variables. Quality: Pearson correlation significant at 0.01 level, 2-tailed.)

Variable	Ego suppliers	Lego suppliers	Contribute to characteristic
Net sales (year 2000)	+	-	<i>(a)</i>
Turnover per employee (2000)	+	-	<i>(b)</i>
International sales	+	-	<i>(c, e)</i>
Production for machine industry	-	+	<i>(c)</i>
Production for “other” industry	+	-	<i>(c)</i>
Purchasing proximity (<50 km)	-	+	<i>(d)</i>
Purchasing internationally	+	-	<i>(d, e)</i>
International competitors	+	-	<i>(e)</i>
Collaboration distance	+	-	<i>(f)</i>

Thus, we have found two groups of suppliers that are different in six different respects (a-f) and in possessing their own resources for product development. An interpretation of the statistical analysis is that the ego business appears to be more externally focused, maybe due to closer contact with the final customer, also using this external strength to provide for foreign suppliers. To operate with such geographical scope requires larger size and higher productivity. The lego business has a close proximity focus, both as to resource input and output, and also as expressed in the collaboration pattern.

The finding of these distinctive groups motivated a deepened analysis as to a more general understanding of ego versus lego business. This difference between the two groups is thus not a difference in one of the resource inputs (product development competence, which was the assumption in the outset of the study), but a real business character difference. This implies that we cannot just transform a firm from lego business into ego business by adding product development competence. Much more is needed – generally a complete change of attitude from close proximity to global focus.

3.3 Statistical Analysis 2: Investigating the Intermediate Business

The correlation analysis indicates the existence of two forms of business conduct, ego and lego, displayed in the six different characteristics identified that together form a coherent, internally consistent web of relationship. This raises new research questions. How do managers of these firms view the situation – do they make any distinction between these two kinds of business? How do such business function, how has it evolved? Do these two extreme positions represent a stable, equilibrated situation, or do the firms try to leave them for some other state – maybe the mixed in-between state? These are issues that we wanted to investigate further in the qualitative part of the study (see section 4).

However, from the database of macro-data, we could find out more about the intermediate position (defined as between 1 and 99 % ego and lego), which represents 39 % (704 firms) of all suppliers, according to table 1. We then selected a subgroup of these intermediate suppliers, characterized by between 40 and 60 % of ego and lego business, as a control group to the pure ego and pure lego suppliers. These firms represent 6 % of the sample (113 firms). In the following analysis we denote this group “mixed”, belonging of course to the total mixed group of 704 firms.

A discriminant analysis run on the sample showed that the most important discriminating variables (ie that explain the difference between ego, lego and mixed) were rate of international sales out of total sales and international competitors, a result that verifies our interpretation of the correlation matrix.

We also performed a one by one analysis of the differences and similarities between the mixed suppliers and the ego suppliers, showing that mixed firms were smaller than ego firms, had lower productivity, less international customer orientation, and more close-by cooperation. The mixed sample shows a weaker display of distinguishing traits than the ego and lego suppliers. This can be interpreted to indicate that the mixed supplier actually is composed by two pure businesses, and an amalgamation of the two, and presented as one aggregate reading for the different variables, which by necessity results in a blurred picture. This finding in turn generated an interest to find out from the interview part of the project, how the managers of the firms looked upon the situation. Did they consider their business as composed by two separate? Are they financially separated? What kind of interaction exists between ego and lego business at a mixed supplier firm? How could the externally orientated ego business affect the more proximity-oriented lego business? Are the suppliers and customers of the ego business non-domestic, ie the opposite pattern for the pure lego business? These are questions to proceed with in the interview part, section 4.

3.4 Statistical Analysis 3: Investigating the Location of the Firms

As stated in the problem definition, we expect a relationship to exist between product development competence and geographical location. Firms located in low-population

COLLABORATIVE DISTRIBUTED PRODUCT DEVELOPMENT

density areas can be expected to have larger difficulties in finding an acceptable solution to get access to this competence resource. Accordingly we split the sample into two categories “economic center” as opposed to a “small region”, depending on their location⁵. These two categorizations are shown in Table 3.

Table 3. Classification of suppliers according to their activity (100 % ego, 100 % lego or 40-60 % mixed ego and lego), and their geographical location. (Result of cross tabulation.)

Supplier category	Economic center	Small region	Not classified	Total (N)
Ego (100 %)	131	18	2	151
Lego (100 %)	802	114	33	949
Mixed (40-60 %)	92	16	5	113
Other	493	76	22	591
Total	1 518	224	62	1 804

An analysis of variance (ANOVA) and a chi-square test did not demonstrate any influence of the geographical variable on the presence of the different firms. This opens up questions for small regions on how managers of ego business handle their product development competence, and how lego firms would respond to requests from customers for this competence. This will be investigated by the interviews.

4 Result and Analysis from Qualitative Data

4.1 Selection of Firms

The interviewed firms were selected from the database used in the quantitative study, where results indicated that our selection of cases for in depth qualitative studies should be based on (1) the firm’s strategic business focus (ego, lego or mixed 40-60 %), and (2) location (economic center or small region). Moreover, due to the strong influence of the external orientation, proximity versus global, we also in the selection process took this dimension into account through the proxy-variable (3) amount of export sales. Since our main interest is in smaller SMEs, we limited our selection to firms with less than 50 employees. With this design we expected to maximize the variability in the characteristics of the interviewed firms. The firms are listed in Table 4 (cf Appendix 2).

Table 4. Firms selected for in-depth interviews concerning product development.

Supplier category	Economic center	Small region	Total
Ego (100 %)	5	3	8
Lego (100 %)	6	4	10
40-60 % ego and lego	4	2	6
Total	15	9	24

⁵ Definition according to NUTEK (1 – large city, 2 – university region, 3 – regional center, 4 – secondary center, 5 – small region with people employed mainly in private-owned firms, 6 – small region with people employed mainly in state-owned organizations). We recoded region families 1-4 into “economic center” and region families 5-6 into “small region”.

The interviews were concentrated to a few regions, where we tried as far as possible to interview firms with different amount of export sales, eg one firm with no export at all and another with between 20 and 100 % export sales.

4.2 Interview Questions

Interviewees at the studied firms were the president, the development and/or the production manager. The interviews started with a presentation by the interviewee of the firm's product and business in general. With few exceptions, the interviewer had looked at the firm's publicly available web site, and also some of the data from the database. The interview questions concerned the firm's current position (as ego, lego or mixed, although these terms were not used by the interviewer), history (past position) and future (desired position). It also concerned whether an increased demand for product development competence was perceived, and if there were any special hindrance to meet future demand due to the firm's location.

4.3 Awareness of the Ego and Lego Concepts and other Supplier Archetypes

We were astonished by the immediate adoption of the ego, lego, and mixed concepts at the interviewed firms. The lego concept is already well anchored among suppliers, and was thus the natural starting point in a discussion. Then, the ego concept was no big mind-stretcher! This concept appears fruitful also in practice, and not only an academic construct limited for research purposes. In addition, the interviews showed that the managers in the mixed firms separated the two businesses strategically. Still they exploited synergies between the businesses where available, thereby obtaining a better use of investment and employee resources. For example, if sales in ego products drops due to normal cyclical factors, compensation could be obtained by more efforts in getting lego business, and vice versa, if sales in lego production dropped, the firm could produce its own products against stock that could be sold from during periods of higher lego demand. Another example is where an ego firm possesses a number of specialty machines, that require skilled operators and need full utilization to be profitable, and where lego work could be an effective solution.

There could also exist an historic and supply-chain related coupling between ego and lego. An ego customer could ask a supplier to take over the whole responsibility for a whole product due to restructuring, falling sales volume or the like.

We discovered the existence of some different archetypes of lego firms. The particular archetype so often described in research from the automotive sector, is a supplier strongly integrated with very few customers, typically Volvo, Saab and Scania, manufacturing an important part or subsystem, with product development performed to some extent by the supplier. One such representative (out of 24) was discovered in our sampled interview firms. Another lego archetype was the firm in the telecom business focused on one very well delimited section in the total production chain in the manufacturing of a component.

Also ego archetypes were discovered that had created a strong foothold in a proximity market. Many interviewed ego firms did not feel any threat from large global firms, because the business in itself did not allow for long transportation, or islands of local business could not be exploited through economies of scale on a strategic level in product development or by franchising. Another ego characteristic discovered was that some firms, when the product was developed and industrialized, started up a new firm for the new product, in order to split the new from its traditional business, and obtain

better risk-management. Moreover, ego suppliers expressed that they depended on close collaboration with network partners (mainly other SMEs both at far and close distance) in order to carry out product development activities. This issue will be discussed in 4.5.

It turned out that the majority of the firms had a stable history concerning the ego-lego variable, and often resulting from a fission of some sort (spin-off, bankruptcy, restructuring) of a larger firm. Few had developed from a start-up, and grown organically. The firms appeared, with one exception, to consider their present strategic situation generally acceptable – none had any strong desire to move from the existing ego, lego, or mixed position. It is of course possible that this reflected a general propensity of difficulty to change.

4.4 Request from Customer for Taking on Product Development

One of the principle issues in the investigation concerns suppliers' growing needs to possess competence in product development. Among the interviewed firms, the ego firms had of course no problem with this issue, since they already had that responsibility. The mixed firms were in a related situation, since their ego part provided the potentially lego-originated requested competence. Thus, already 47 % of the suppliers are able to meet the request without too much of concern.

The pure lego firms (53 %) were potentially in a more difficult situation. However, the interviews provided a lot of interesting insights into this issue. First, there was in a large number of cases no request from the buyer of taking product development responsibility. If and when such requests were made, they could be met in different ways. One was to subcontract a product developer, if possible a small, maybe one-man firm, even on distance, who on a part-time basis could support the lego firm in this respect. Another was to start an independent firm that could attract employees with product development competence by means of partnership, or located in an economic center in the case of a small region supplier.

The often-debated issue on the possibilities to communicate in product development across distance was also looked into in the interviews. There was a need for language skills for ego or mixed suppliers with international customer and suppliers. There was also a high degree of person-dependence coupled to product development orders, for example with customer contacts. Our question about location revealed interestingly that long-distances was not a big problem. Firms located in small regions seemed to be used to this situation, and had found means to cope with large distances. They traveled when needed and used IT communication (mainly e-mail).

In the common debate on the negative effects in pursuing business in low-population density areas, it is claimed that recruitment of skilled personnel is difficult. What came up spontaneously in the interviews was that actually the small regions might have an advantage in recruitment and keeping of such personnel. This does not refer to highly educated personnel like engineers in product development, but highly skilled manufacturing capabilities are also competences to consider.

Thus, requests from the customer for product development competence was not considered as a threat to the lego supplier. Another threat of larger significance was organizational changes with the customer, which are not possible for the supplier to influence. In a few cases, the multinational customer had initiated a transfer of the organizational responsibility for the whole product, to which the lego firm supplied an important part or subsystem to another country. At least when this product was due for

a model change, the supplier foresaw a large risk that it would not be able to keep its supplier status. This break in business was thus not the result of poor cost, quality or delivery performance on the part of the supplier, or any other self-afflicted issues.

Another issue that turned out from interviews was the felt threat from low-wage countries in the Close (Baltic, Russia etc) and Far East parts of the world. The suppliers felt that lower cost suppliers in these areas might substitute them. The response to this from lego firms consisted of slight refinement of their strategy, focusing on proximity and close relations in combination with prototype and short-series development, and in some cases taking the role as intermediary between the customer and the supplier concerning quality control, specifications, or modifications.

A further finding was that the suppliers often delivered to Swedish customers that in turn had a very strong international outlook. These suppliers felt very international in the sense of participating on the global scene indirectly, and the affiliation with the buyer made them open to competition from abroad anyway, and where the buyer often was very useful in costing improvements. Thus the often-heard recommendation in the public debate that all firms should "go international" falls flat on its face in its simplicity. It only lures SMEs into situations requiring skills in language, culture, logistics and he like, which may not be necessary at all.

We also find, at the stage of insight from the project now reached, that the basic issue initiating the project – what are the consequences of increasing requests on supplier of product development competence, cannot be answered in isolation. It has to be considered within the context of the supplier strategy, and it thus turns out that the development capacity concerns a strategic resource that is strongly interlinked with the firms geographical attitude and environmental outlook. The issue somehow also misses more central issues on threats to suppliers that cannot directly be affected by them, such as organizational restructuring and low-cost country competition.

5 Concluding Discussion

5.1 Recommendations to SMEs

Since the fundamental question for this project originated from a concern to support SMEs, we would like to include a short recommendation on strategic behaviour for the identified type of firms.

To start with, all firms, whether it is ego, lego, or mixed, need to understand its competitive environment, since the firm is influenced by it, and sudden changes might appear like in restructuring etc. Thus a SWOT (strengths-weaknesses-opportunities-threats) analysis could be a starting point.

Then, for the *lego firm* we propose the following actions:

- Identify your position in the supply chain, both upwards and downwards.
- Evaluate the ways and means to acquire product development competence.
- Cooperate with other firms where suitable.
- Improve the competence level in the direction shown in the SWOT analysis (eg through quality certification, lean thinking etc).

For the *ego firm* we suggest:

- Structure the supply chain in the most advantageous way for your firm
- Improve the competence level in the direction shown in the SWOT analysis (eg through quality certification, lean thinking etc), both in your own firm and at the suppliers.

The *mixed ego and lego firm* should:

- Perform the SWOT analysis for the ego and lego part separately according to the above.
- Identify and exploit the synergies between the firm's ego and lego business.
- Identify the desired balance between the two businesses, and try to achieve this partition.

5.2 Conclusion and Suggestion for Further Research

We can conclude that several factors have impact on a supplier's strategic business position. The large differences between ego suppliers and lego suppliers concerning several important features indicate some precaution if a lego firm wants to move in the direction towards ego. Our study shows that a supplier that wants to conduct its own product development also needs to handle a competitive situation characterized by global supply chains, an international market, and international competitors. However, the firm's geographical location (especially low-population density areas) did not appear to be a hindrance, instead the studied firms seemed to cope with and take advantage of the characteristics of their location.

For a small lego supplier the journey from lego to ego can be too demanding to pursue on its own, and we therefore suggest collaboration between suppliers as a means to reach new strategic positions. This collaborative product development requires additional skills in cooperation both vertically with the customer, and horizontally with other suppliers, pointing to the need to manage eg e-business platforms required by larger customers as well as IT tools and methods for distributed engineering teams. The increasing demands from customer firms should be looked into in more detail, as well as requirements on collaboration.

We also found in this study that supplier firms in the engineering industry are a large, heterogeneous group. For example, there are firm that successfully combine own products with lego production. To map supplier archetypes in order to increase understanding of these firms is another area that we suggest for further research.

Acknowledgments

We acknowledge the important contribution from Sten Axelsson and Lennart Sandberg at NUTEK concerning access to and interpretation of the database. We also thank Roland Sjöström at Linköping Institute of Technology for valuable support in the statistical analysis.

References

- [1] von Hippel E., The Sources of Innovation, Oxford University Press, 1988.
- [2] Hamel G., Doz Y., and Prahalad C. K., “Collaborate with Your Competitors – and Win”, Harvard Business Review, Jan-Feb, 1989, pp. 133-139.
- [3] Ragatz G. L., Handfield R. B., and Scannel T. V., “Success Factors for Integrating Suppliers into New Product Development”, Journal of Product Innovation Management, Vol. 14, 1997, pp 190-202.
- [4] Bruce M., Leverick F., Littler D., and Wilson D., “Success Factors for Collaborative Product Development: a Study of Suppliers of Information and Communication Technology”, R&D Management, Vol. 25, No. 1, 1995, pp. 33-44.
- [5] Merriam S. B., Fallstudien som forskningsmetod, Lund: Studentlitteratur, 1994. Translated from English version Case Study Research in Education, 1988.
- [6] Yin, R. K., Case Study Research, Design and Methods, Newbury Park: Sage Publications Inc, 1989.
- [7] Eisenhardt K. M., “Building Theories from Case Study Research”, Academy of Management Review, Vol. 14, No. 4, 1989, pp. 532-550.
- [8] Kraljic, P., Purchasing Must Become Supply Management, Harvard Business Review, vol. 61, Issue 5, 1983.
- [9] Öhrwall Rönnbäck A., Interorganizational IT Support for Collaborative Product Development, Linköping studies in Management and Economics, Dissertation no. 54, Linköpings universitet, Sweden, 2002.
- [10] Womack J. P., Jones D. T., and Roos D., The Machine that Changed the World: Based on the MIT 5-million-dollar 5-year Study on the Future of the Automobile, New York: Rawson Associates, 1990.
- [11] Miles R. E. and Snow C. C., Fit, Failure & the Hall of Fame: How Companies Succeed or Fail, New York: The Free Press, 1994.
- [12] Quinn, J. B., “Outsourcing Innovation: The New Engine of Growth”, Sloan Management Review, summer, p 13-28, 2000.
- [13] Lambert D. M. and Cooper M. C., “Issues in Supply Chain Management”, Industrial Marketing Management, Vol. 29, 2000, pp. 65-83.
- [14] Griffin, A. and Hauser, J. R., “Integrating R&D and Marketing: A Review and Analysis of the Literature”, Journal of Product Innovation Management, Vol 13, 1996, pp. 191-215.
- [15] Gummesson, E., Relationsmarknadsföring: från 4P till 30R, Malmö: Liber-Hermods AB, 1995.
- [16] Fine, C.H., Clockspeed, Perseus Books, Reading, Mass, 1998.
- [17] Chandrashekar A. and Schary P., “Toward the Virtual Supply Chain: The Convergence of IT and Organization”, The International Journal of Logistics Management, Vol. 10, No. 2, 1999, pp. 27-39.

COLLABORATIVE DISTRIBUTED PRODUCT DEVELOPMENT

- [18] Biemans W. G., “Product Development within Networks: On the Other Side of the Coin”, in Developing Relationships in Business Networks, by Håkansson H. and Snehota I. (eds), London, New York: Routledge, 1995.
- [19] Parker, H., “Interfirm Collaboration and the New Product Development Process”, Industrial Management and Data Systems, Vol. 100, No. 6, 2000, pp. 255-260.
- [20] Wynstra F., Purchasing Involvement in Product Development, PhD dissertation, Eindhoven University of Technology, 1998.
- [21] Eisenhardt K. M. and Tabrizi B. N., “Accelerating Adaptive Processes: Product Innovation in the Global Computer Industry”, Administrative Science Quarterly, Vol. 40, March, 1995, pp. 84-110.
- [22] NUTEK, Sveriges verkstadsleverantörer - kartläggning och analys, No B 2002:03, 2002. (translated to English: Suppliers in the Swedish Engineering Industry – Survey and Analysis)

Appendix 1: Survey questionnaire

Questions asked (by Temo) to 3 170 firms (out of 4 430):

Questions translated from Swedish

1. Did you deliver to the manufacturing industry? (*yes: continue, no: end of interview*)
2. How large amount of the production was supplied to other companies during 2000? (%)
3. To how many firms did you deliver?
4. How large amount was sold to the three largest customers? (% to each)
5. How large amount of the sales was sold locally (50 km), regionally (50-200 km), within the rest of Sweden, internationally? (%)
6. How large amount of the purchased goods were bought locally (50 km), regionally (50-200 km), within the rest of Sweden, internationally? (%)
7. How large amount of the production was sold to automotive, machining, electronics, telecom, defence, other engineering, other manufacturing industry (%)?
8. How many technicians have higher education (under-graduate)?
9. To which amount did you carry out manufacturing to other firm, so called lego manufacturing (%), and to which amount did you produce and develop your own products (%)?
10. How large amount of the production was produced to another supplier (%), and how large was produced to a customer that has own products (%)?
11. Where are your most important customers situated? Locally (50 km), regionally (50-200 km), within the rest of Sweden, internationally? (%)
12. To what amount can your competitive situation be explained as due to (scale 1=not at all, 2=to some extent, 3=important, 4= very important):
 - a. Lower prices
 - b. Higher quality
 - c. Larger series
 - d. More flexible to the customers' demands
 - e. More stable and long-term relationships with our customers
 - f. Other: _____
13. How long is the average contractual period with you r customer (alternatives from less than 6 months to longer than 48 months)
14. Collaboration: Have your firm cooperated with other firms within the following areas (1= not at all, 2=to some extent, 3=much, 4= very much)
 - a. Production
 - b. Purchasing
 - c. Sales
 - d. Marketing
 - e. Research and development
15. Collaboration: Which are the main reasons form collaboration with other firms? (1=not important, 2=minor importance, 3=important, 4= very important):
 - a. Cost reduction
 - b. Access to new markets
 - c. Increased flexibility
 - d. Increased access to knowledge
 - e. Increased information about new business opportunities
16. Where does your collaboration take place? Locally (50 km), regionally (50-200 km), within the rest of Sweden, internationally? (%)

Appendix 2: Interviewed firms

Details concerning location, export sales (percentage of total sales), turnover, and number of employees for the firms selected for in-depth interviews.

Supplier category	Economic center				Small region			
<i>Ego (100 %)</i>	<i>Location</i>	<i>Ex- port</i>	<i>Turn- over</i>	<i>Emp- loyees</i>	<i>Location</i>	<i>Ex- port</i>	<i>Turn- over</i>	<i>Emp- loyees</i>
	Stockholm	100 %	2 M €	10	Mora	0 %	5 M €	27
	Malmö	0 %	5 M €	25	Kiruna	0 %	5 M €	35
	Göteborg	0 %	2 M €	12	Västervik	0 %	0.4 M €	6
	Linköping	98 %	1 M €	9				
	Skellefteå	0 %	4.5 M €	35				
<i>Lego (100 %)</i>								
	Malmö	0-3 %	3 M €	20	Mora	0 %	1.5 M €	15
	Malmö	0 %	7 M €	52	Vimmerby	0 %	1 M €	9
	Stockholm	0 %	1.1 M €	19	Västervik	0 %	2 M €	14
	Stockholm	0%	3.5 M €	28	Västervik	60 %	2 M €	18
	Linköping	0 %	2.5 M €	11				
	Skellefteå	0 %	1.8 M €	18				
<i>40-60 % ego and lego</i>								
	Stockholm	50 %	4 M €	34	Kiruna	5	7 M €	45
	Stockholm	4 %	1.2 M €	15	Vimmerby	0 %	4 M €	38
	Göteborg	0 %	3 M €	40	Västervik	50 %	1.5 M €	17
	Motala	20 %	4 M €	30				

Corresponding author:

Anna Öhrwall Rönnbäck, Associate Professor Industrial Economics and Management
 International Graduate School of Management and Industrial Engineering (IMIE)
 Department of Management and Economics
 Linköping Institute of Technology
 581 83 Linköping
 Sweden
 Phone: + 46 70 311 44 81
 Fax + 46 13 28 18 73
annoh@eki.liu.se
 URL: <http://www.eki.liu.se/indek/aor>

IMIE is supported by the Swedish Foundation for Strategic Research, www.stratresearch.se.

<u>COLLABORATIVE DISTRIBUTED PRODUCT DEVELOPMENT: THREAT OR OPPORTUNITY FOR SWEDISH SMES?</u>	1
<u>1 INTRODUCTION</u>	2
1.1 <u>BACKGROUND</u>	2
1.2 <u>OBJECTIVES</u>	2
1.3 <u>METHODOLOGY</u>	2
<u>2 PREVIOUS RESEARCH</u>	3
2.1 <u>A BACKGROUND TO COLLABORATIVE PRODUCT DEVELOPMENT</u>	3
2.2 <u>ORGANIZATION OF COLLABORATIVE PRODUCT DEVELOPMENT</u>	4
<u>3 RESULT AND ANALYSIS FROM QUANTITATIVE DATA</u>	5
3.1 <u>THE SURVEY</u>	5
3.2 <u>STATISTICAL ANALYSIS 1: IDENTIFYING ENDPOINT BUSINESS TYPES</u>	5
3.3 <u>STATISTICAL ANALYSIS 2: INVESTIGATING THE INTERMEDIATE BUSINESS</u>	7
3.4 <u>STATISTICAL ANALYSIS 3: INVESTIGATING THE LOCATION OF THE FIRMS</u>	7
<u>4 RESULT AND ANALYSIS FROM QUALITATIVE DATA</u>	8
4.1 <u>SELECTION OF FIRMS</u>	8
4.2 <u>INTERVIEW QUESTIONS</u>	9
4.3 <u>RESULTS AND ANALYSIS 1: AWARENESS OF THE EGO AND LEGO CONCEPTS AND OTHER SUPPLIER ARCHETYPES</u>	9
4.4 <u>RESULTS AND ANALYSIS 2: HISTORICAL SITUATION AND PRESENT STATUS</u> ERROR!	
BOOKMARK NOT DEFINED.	
4.5 <u>RESULTS AND ANALYSIS 3: REQUEST FROM CUSTOMER FOR TAKING ON PRODUCT DEVELOPMENT</u>	10
<u>5 CONCLUDING DISCUSSION</u>	11
5.1 <u>RECOMMENDATIONS TO SMES</u>	11
5.2 <u>CONCLUSION AND SUGGESTION FOR FURTHER RESEARCH</u>	12
<u>ACKNOWLEDGMENTS</u>	12
<u>APPENDIX 1: SURVEY QUESTIONNAIRE</u>	15

[APPENDIX 2](#) 16

