

# Towards Global Market-Driven Software Development Processes: An Industrial Case Study

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## ABSTRACT

Market orientation can be shortly defined as gathering, sharing, and using information about “the market” in order to make decisions. Even though existing literature of market orientation stresses the necessity of having all organizational functions participating in establishing market-driven culture, the number of studies taking the perspective of software product development has remained small. This paper presents a study of a software development company that has been motivated to become more attentive towards market information. Due to the lack of established theories of market-driven software development processes, exploratory and inductive research methods were used to explore the phenomenon of market-driven software development. Based on the gathered data, we identified the elements of market orientation in the case company and pointed out two focus areas to concentrate on when implementing the organizational transformation towards market orientation. Finally, the results of this study were reflected to existing market orientation literature and a conclusion was made that Requirement Management processes need to be developed further in order to support the management of market needs. Moreover, it was concluded that increasingly diverse skills will be needed from Software Engineers in transformation towards market-driven software development processes.

## Categories and Subject Descriptors

D.2.1 [Software Engineering]: Requirements/Specification – *elicitation methods, methodologies.*

## General Terms

Management, Economics, Human Factors.

## Keywords

Market orientation, Market-driven software development, Creation of knowledge, Grounded Theory, Case Study

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GSD '06, May 23, 2006, Shanghai, China.

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## 1. INTRODUCTION

Market orientation is commonly seen in the business community as a source of competitive advantage that helps to cope with ever intensifying competition and turbulent market environment. This belief has been confirmed with a number of studies (e.g. [8, 11]) that verify the positive effect of market orientation on the company’s performance dimensions such as profitability, innovativeness, growth of sales and success of a new product. Given the benefits of establishing market-driven culture into the company, why many of them have failed to do so? One reason for this could be that there is still confusion regarding the definition and components of market orientation [9]. As an example, some of the companies may have, in fact, listened customers too closely and have thus had negative experiences on attempts to become a market-driven organization [11]. Another reason for failures to establish market orientation could be that the culture, capabilities and configuration of most organizations can be more a hindrance than help [2]. An overview of market orientation literature and the different perspectives to it has been presented in [7]. When these perspectives are distilled to the essence, it can be said that market orientation simply means: “*gathering, sharing, and using information about “the market” (customers, competitors, collaborators, etc.) in order to make decisions*” [10].

A typical denominator that is brought forward in the market orientation studies is the necessity of having all organizational functions to participate in establishing a market-driven culture. It is therefore expected that there exists different perspectives of market orientation as identified in [7]. However, most of the studies seem to focus on managerial and cultural aspects of market orientation. The number of studies focusing on practical aspects taking the perspective of software product development has remained small.

The purpose of this paper is to gain understanding on the practical aspects of market orientation when developing software products into the global marketplace. The remaining part of the document is organized as follows: Section 2 describes the target of the study and the research methods used, section 3 describes the elements of market orientation and faced challenges that were identified in the case company, section 4 points out focus areas to concentrate on when developing market orientation in software development organizations and finally, section 5 concludes the study and reflects the results with existing literature.

## 2. RESEARCH PROCESS

### 2.1 The Case Company: Structures Inc.

The target of this study is Structures Inc., who offers a product (from now on referred as Structures Modeler) for structural building information modeling. Structures Inc. has in recent times recognized its necessity to become more attentive towards market information. One of the underlying reasons for this is the current product development environment of Structures Modeler, in which forces are pulling the development of Structures Modeler into several different directions. Even though the Structures Modeler can be considered as a single product, it is offered to four different customer segments, which all are, technologically speaking, at their different maturity phases:

*"It is quite a challenge for our resources and processes that we need to serve pragmatic existing customers while searching new businesses and being a forerunner and a visionary."*

-Manager, Structures Inc.

*"The new challenge for us now is that we need to have a single product roadmap. We cannot have a different roadmap for each of our customer segments."*

-Product Manager, Structures Inc.

Furthermore, Structures Modeler has achieved a very strong position in one of the customer segments, while the possibilities for success in the other segments are still emerging. Thus, the challenge for Structures Inc. is to maintain the integrity of a single product and secure a strong position in one of the segments while developing the product further in order to achieve more competitive position in the emerging segments.

The Structures Modeler is currently available in more than 70 countries. The global customer base for Structures Modeler adds yet another dimension to the complex product development environment with different technological maturity levels and diverse needs of geographical market areas.

*"We have a challenge in the future that the ever increasing product offering should be taken into global marketplace. How to set the priorities in such situation? They are convergent to some extent [in different geographical areas] but not completely the same."*

-Manager, Structures Inc.

Such diversity of a market combined with challenges caused by a global presence has thus been one of the motivating factors for Structures Inc. to transform their activities towards market-driven direction.

### 2.2 Research Method

Because the study area, market-driven software development, lacks established theories that could explain the regularities and irregularities of the phenomenon, we decided to use exploratory and inductive research methods. The study describes an exploratory case study with one revelatory case [19] using grounded theory [3, 5] as the research method. The purpose of the study is to explore the phenomenon of market-driven software development, reveal it in its richness, and point out regularities and essential characteristics for further theory development. The

importance of using qualitative and exploratory approaches in software engineering has been emphasized for example in [16].

The study used theme-based interviews as its main data collection method. For this case, 9 persons were interviewed in December 2005. The interviewees represent different functions of Structures Inc., including product management, marketing management, product development, and general management. All interviews were tape-recorded and transcribed to text. The total amount of recordings adds up to 10 hours 32 minutes.

In addition to the interviews, data was also collected from company and product presentations that were held to us and we also received a good number of additional material from Structures Inc., including process, product, and company descriptions and marketing material.

The data analysis is still in its early phases. The analysis started with open coding [18], where essential sections of the data are conceptualized and identified as categories. The categories represent regularities or irregularities or any phenomenon that is considered important in relation to the research question. Currently we have continued to axial coding [18], where the relationships between the categories are in focus. This paper presents some of the results of this phase. The study will continue to selective coding, where a coherent picture or theory of the core category, market-driven software development, will be formed.

## 3. MARKET-DRIVEN SOFTWARE PRODUCT DEVELOPMENT IN STRUCTURES INC.

What does it mean to be market-driven on a practical level? What efforts are needed on a journey towards becoming a market-driven organization? What kind of challenges is expected on the way? These were the types of questions we wanted to find out by examining a real-life example of Structures Inc. Based on the gathered data we decomposed the processing of the market information into elements of *sensing the market, making sense of the market, and acting upon the knowledge*. These elements are further elaborated in the remaining part of this section.

### 3.1 Sensing the Market

Market-driven organizations use many devices to open their collective "mind" to new information that can help anticipate emerging opportunities and competitive threats and more accurately forecast how market will respond to changes in strategy [2]. This is also the case in Structures Inc., where we identified numerous different sources for gathering the market information.

*"Some of the sources from where we receive market information, in one way or another, are: the existing customers, the ongoing sales cases and all sorts of ideas we get at the exhibitions while looking at what competitors have accomplished. We also follow, to some extent, what is happening in the adjacent customer segments."*

-Product Manager, Structures Inc.

A closer look of Structures Inc.'s market information sources revealed that market information could either be sensed by

*listening the staff on the front line* or by *listening the periphery* (Table 1).

**Table 1. Market sensing activities utilized in Structures Inc.**

Activity	Definition
Listening the staff on the front line	Market sensing activity in which the product development organization harnesses its employees to gather market information while communicating with customers
<i>Listening while selling</i>	Sensing activities performed while communicating with a <i>potential</i> customer
<i>Listening while serving</i>	Sensing activities performed while communicating with <i>existing</i> customers.
Listening the periphery	Market sensing activity in which the “surrounding world” relevant to the selected customer segments is monitored.

When organization is *listening the staff on the front line*, it is harnessing its employees to gather market information while interacting with a customer. The interaction can happen either *while selling* a product to a potential customer or *while serving* the existing customers.

When a sales case is ongoing, Structures Inc has been facing a particular challenge on sensing the needs of a potential customer:

*“We have not yet succeeded in having the sales people systematically involved on eliciting customer needs. We receive, in general, very little information from that side.”*

-Product Manager, Structures Inc.

The underlying reason for this is an organizational one:

*“The role of salespersons in our organization is commercial. Salespersons responsibility is to have the sales done. They are not there to collect information on the customer needs. Salespersons always have presales engineers with them and in our organization they are the ones who are left with a responsibility to gather information about the customer needs.”*

-Manager, Structures Inc.

Even though the needs of a potential customer will get elicited by defining it as a responsibility of a presales engineer, Structures Inc. is still left with challenges on fully understanding the customer needs:

*“Passing the responsibility to elicit the customer needs to the presales engineers partly mitigates the problem of non-contributing sales persons. However, when the customer needs come from a technical person we often are left without the understanding of the business implication behind a customer need.”*

-Product Manager, Structures Inc.

The relationship between the customer and the software product provider does not typically end when a sale has been finalized and a delivery has been made. In most cases, the customers will take part on a yearly maintenance program through which they will

continue the interaction with a provider of the product. This interaction can happen in forms such as reporting defects, requesting new features and exchanging ideas at the training sessions. This type of *listening while serving* has been recognized as valuable source of information in Structures Inc.. However, the information received while serving the customer has its limitations:

*“The customers typically give ...especially if they are end-users as well... information only about the current situation (such as: this is not working, that is not working). It is very difficult to get visionary views related to the product from the customer. On the other hand, customers typically don’t even have the technical competence to see what would be possible with existing technology.”*

-Manager, Structures Inc.

As the limitations of market information received from the customer is understood, it is evident that more market information is needed to be able to make better-judged decisions. Many of the potential information sources can be categorized as being part of the *periphery*. This type of information is typically general in nature describing things such as what is happening in customer segment, what the competitors are doing and how the enabling technology is changing. Structures Inc. has organized such kind of “periphery sensors” around specific customer segment organizations:

*“The customer segment organizations are the ones, who are responsible on collecting information all the time regarding to what is happening on the market, what are the needs of the customer, what is the maturity level of customers, what is their attitude to adapt emerging technologies and then what is the competition in the market, what competitors are doing...all in all this kind of market related information...each of our customer segments are responsible on gathering their own market information.”*

-Manager, Structures Inc.

### 3.2 Making Sense of the Market – Distilling Information into Knowledge

Before organizations can use the information they have collected, they must *make sense* of it by classifying, sorting and simplifying it into coherent patterns. What knowledge should the organization focus on developing? Simply packing the shared knowledge base with undigested information is about as useful as reading an encyclopedia cover to cover. Information only becomes knowledge when it is converted into a solid basis for action [2].

Such sense-making has been organized in Structures Inc. in the form of prioritization sessions of market needs. It was found out that in order to accomplish the purpose these sessions tacit knowledge is required.

*“There does not exist any equation that can determine the priorities of market needs correctly. It takes certain touch, hunch and experience to understand the priorities. This knowledge has just been built into the organization. [...] The more we*

*have made business, the more we have gained this tacit knowledge.”*

-Manager, Structures Inc.

Due to the need of tacit knowledge in a prioritization session, it is vital that diverse expertise is present at the sense-making situation. This has been recognized also in Structures Inc., where we identified the following roles of sense-making team members:

- *Segment Sensor*, who brings general knowledge of the customer segment
- *Finder of Latent Needs*, who looks solutions beyond the imagination of customers
- *Technician*, who brings technical knowledge on what is technologically possible with the product
- *Visionary*, who has a long term view on where the product should be going
- *Geographical Experts*, who brings the domestic knowledge of the market areas where the product is available
- *Guardian*, who protects the integrity of the product
- *Business Manager*, who sets commercial targets for the new product

In order to increase possibilities of making better-informed decisions, Structures Inc. has recognized the necessity of attaching business implications together with customer needs:

*“We receive large amounts of market information, but the typical problem we are facing with it is that the business implication behind the customer need is often missing. In such case, we have difficulties on prioritization. We might not be able to see that focusing on other request would actually benefit us much more. We have a horn of plenty on receiving market information, but understanding the priority of information often gets lost in the abundance of technical details.”*

-Manager, Structures Inc.

In such case where the business implication behind a customer need is missing, the customer requirement can be considered as a *blind* one. The typical cause for blind requirements is, as indicated earlier, the low contribution from the business-oriented employees at the market-sensing phase. Thus, the level of market sensing capabilities is one of the deciding factors for the success of sense making.

### **3.3 Acting upon Knowledge – Relying on the Messenger**

The final phase on processing the market information is to *act upon the knowledge*. Now it is time to move towards details and to concentrate on building the product according to the decisions made in the sense-making phase.

A typical approach to manage the development of a product is to assign the product management responsibilities to a single organizational unit within a company. This has been the case also in Structures Inc.. However, this approach comes with a risk. Assigning the product ownership into a single organizational unit may cause information bottlenecks between the organizational

units. In such a situation the success of product development is dependent on verbal skills of product management team members. The product management team thus has been assigned the role of a messenger and from an organizational point of view, relying on a messenger can leave the others as ignorant:

*“We have had difficulties on informing the customers about the practical meaning of new product features. We have listed what features the new product version has, but the true practical meaning has not been understood.”*

-Product Manager, Structures Inc.

*“Our marketing department has not been able to write anything related to the new product until the product has been implemented.”*

-Product Manager, Structures Inc.

or misinformed:

*“The R&D department has only been able to see a planning window of one third of a year. Because of this, they do not know what features are to be implemented on the next version.”*

-Product Manager, Structures Inc.

*“In many cases, knowing the plans for the future versions would have an impact on the design decisions. If we would know that a certain requirement is actually laying a foundation to something forthcoming, we would implement the requirement differently.”*

-Software Engineer, Structures Inc.

Therefore, one of the current challenges in Structures Inc. on acting upon market knowledge is clearing the communication blockages within the organization:

*“We have detected challenges on how to share the information between the customer segment teams and the product management team. In addition, we have identified another communication barrier between the product management team and the development team. If we can solve these two Gordian knots then everyone’s work will be easier.”*

-Manager, Structures Inc.

Interestingly, the challenges caused by the communication blockages are experienced differently depending on the abstraction level of the shared information:

*“It is the sharing the high-level information that is difficult. Sharing information about the low-level details is much more under control.”*

-Product Manager, Structures Inc.

It is evident that the efficient communication is the matter of utmost importance in this last phase of processing market information. To be more specific, the challenge is to have the market knowledge communicated loud and clear across the organization. This is vital in order to produce a product that matches better the expectations of a customer.

#### 4. TOWARDS MARKET-DRIVEN SOFTWARE PRODUCT DEVELOPMENT IN STRUCTURES INC.: IDENTIFIED FOCUS AREAS FOR THE PRACTITIONER

As it can be seen from the example of Structures Inc., being market oriented requires diverse combinations of skills. To be truly market-driven, the organization needs to focus comprehensively to all aspects of market orientation. Strong sense-making abilities do not help if the sensing mechanisms are not in place or if the distilled knowledge does not get communicated across the organization and is not being acted upon.

What are the implications for the practitioners within the organization when the shift towards market orientation is under way? What can be learned from the case of Structures Inc.? In the remaining part of this section we will discuss the trends that we detected in Structures Inc. on its journey towards market-driven software development processes.

##### 4.1 From Relying to the Messenger towards Being a Participant

A typical pattern to organize work in a software product company is to build teams around specialized skills. When this is combined with the humans' preference to communicate mainly with their "own kind", the behavior of the company will not be optimized as a whole, but instead, the organization's actions are defined as a collection of sub-optimized processes:

*"In our company and perhaps in many other organizations as well, the software product development starts mainly on the terms of the R&D unit from ideas such as what things we are capable of doing. Then we start to think that to whom we can sell such a product. It can easily happen that many of the requests originating from the market will be left unfinished because the software developers are more interested in meeting the next challenge rather than finishing the previous one."*

-Manager, Structures Inc.

Such kind of compartmentalization has been recognized problematic in Structures Inc. and the shift is now towards blurring the clear-cut hand-off points of job assignments by having more interactive participation. This enables the transfer of tacit knowledge behind the documented items between the specialized teams. The new challenge arising now is who should be present in the context of decision-making. In addition to the obvious concern of using employee's time efficiently, there is also another tradeoff to consider. The more employees can be reached at the same time, the less rich can the nature of the shared information be (Figure 1). It is hard to develop a formula that defines the optimum number of employees that should attend on each decision making context, but what is certain is that the communication and human interaction skills are becoming more and more needed in a software engineer's work. Thus, there is clearly a visible shift from *relying the messenger* archetype towards *active participation* in the world of software product development.

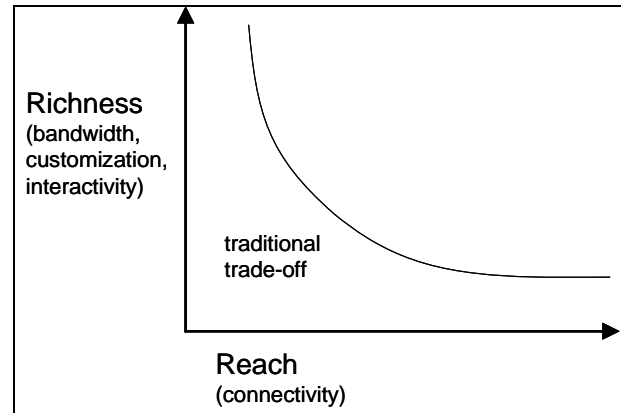


Figure 1. Economics of organizational information [4].

##### 4.2 Seeing the Forest from the Trees – the Rise of the Roadmap

A repeated theme in interviews with Structures Inc. was the importance of understanding the business implication behind the customer need. As discussed earlier, the business implication may have been already lost when eliciting the need of a customer. Such technical requirement can be considered as *blind* for the potential business implication and is then causing challenges to the sense-making phase. Even in the case of successfully recording a business implication together with a customer need and successfully distilling knowledge from the market information, there is still a challenge to *see the forest from the trees* when acting upon the knowledge. Some of the symptoms of not meeting this challenge can be found when studying the cases where employees have been left as *ignorant* or *misinformed* in Structures Inc.. Understanding a requirement's business implication is thus necessary in all phases of processing market information and in all parts of the organization. Therefore, tackling the problem of not seeing the forest from the trees needs a holistic, organization-wide approach.

What is then needed in order to see the forest from the trees? We believe that supporting processes and IT infrastructure needs to be present to ensure that the market information can be collected and processed systematically. Apart from the underlying infrastructure, more advanced mechanisms are needed that will alleviate the challenges in the *sense-making* and acting upon *knowledge* phases. Such mechanism has clearly been emerging in Structures Inc. in the form of a roadmap, which can be defined as a document that specifies the release dates and the features implemented in each of the forthcoming versions within a certain time window. We identified the following purposes for a roadmap in Structures Inc.:

- *Roadmap as a planning tool* that helps in planning the content and the schedule of the forthcoming releases.
- *Roadmap as a market sensing tool* that helps in opening the discussion with potential and existing customers in order to get early feedback about the chosen direction of the product.
- *Roadmap as a communication tool* that helps in taking the plan of the next release into action and in communicating the forthcoming features and business implications behind them to all relevant stakeholders.

## 5. CONCLUSION

What did we learn from the case of Structures Inc.? Based on the gathered data, we were able to distinguish three elements of market information processing, namely, *sensing the market*, *making sense of market* and *acting upon knowledge*. These identified elements are well in line on what can be found from the existing literature of market orientation (e.g. [6, 17]). Furthermore, we found that different sources of market information have their limitations and to be able to construct a good understanding of the market, several sources of market information must be utilized. In Structures Inc. the market information was gathered both by *listening the staff in the front line* and by *listening the periphery*.

The major challenge identified in the phase of making sense of the market was the problem of creating meaningful knowledge from the gathered market information. This problem is related to the theory of organizational knowledge creation and the work of Nonaka [12] is therefore an excellent source for further guidance. In addition of the problem of distilling market information into knowledge, Nonaka [12] also gives insight to the challenges of *acting upon knowledge* by suggesting different organizational models for basis of efficient sharing of information.

When looking market orientation from the viewpoint of software product development, we identified two focus areas to concentrate on. Firstly, a movement was visible from clear functional distinctions between specialized teams towards active interfunctional participation. The consequence of this progress is that more and more diverse skills such as marketing, social and communication skills are needed from a Software Engineer. This finding is in line with [15]. Secondly, we identified a repeated theme of a need to understand the business implications behind requirements. This implies that requirement management practices should be developed further for the purpose of managing business needs as also suggested by [14]. An example of extending requirement management processes towards a market-driven direction can be found from [13].

The central document for managing market needs in Structures Inc. was the roadmap for which we identified purposes of being a *planning tool*, a *market sensing tool* and a *communication tool*. An example of a development in this field can be found from [1].

Based on this study, it can be said that market orientation has already been widely studied from the managerial and cultural viewpoint, but the practical perspective of market orientation from the viewpoint of software product development is still to a large extent uncovered.

## 6. ACKNOWLEDGMENTS

The authors would like to thank the employees of Structures Inc. that participated in the interviews for this study.

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