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Uncertainty awareness in support service contracts

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Abstract 100 words

Through servitization, manufacturing companies are faced with various uncertainties. These can be caused by different sources such as the changed relationship between service provider and customer. However, decision makers tend to only take appropriate actions when they perceive this uncertainty. This paper presents a conceptual framework for assessing this perceived uncertainty through the expressions used by decision makers. The usefulness of this framework is exemplified for a case study in servitization where actors of different levels within the provider and customer companies were interviewed. This study showed the main areas of uncertainty as perceived by the different actors.

Keywords: uncertainty, servitization, service contracts

Introduction

Servitization has been described as a solution to keep European manufacturing companies globally competitive and offer new ways of generating revenue (Beuren et al., in press). In the context of this market development, manufacturing companies provide support services with their products. These support services centre around the product by offering for example maintenance support or the availability of the product to offer additional benefits. To achieve the additional benefit, the providers apply their knowledge and skills in processes, activities and performances (Vargo and Lusch, 2004). In this context, two main challenges have been highlighted in the literature: (i) the manufacturer's responsibility for their products increases across the whole product life cycle including operation and end-of-life decisions (Beuren et al., in press), and (ii) the service provider and customer have to collaborate in a close relationship (Sampson and Froehle, 2006). These main challenges can cause uncertainties for both sides involved in the provision and consumption of the support services. This uncertainty can be concerned with for example the change of business competencies and management structures to accommodate for support services (Geyer et al., 2003) or the integration of easy access to key components into the product design (Jagtap and Johnson, 2011).

The uncertainty inherent in a situation can be experienced differently by different actors (Langer and Roth, 1975; Kahneman et al., 1982). The *perceived* level of uncertainty is the central starting point for any further actions taken by the decision makers (Langer and Roth, 1975; Daft et al., 1987; Thomas and Trevino, 1993). Thus, it is this *perceived* uncertainty in the context of support services that is the focus of this paper. The following research question is addressed: What are the main uncertainty areas perceived by decision makers associated with support service contracts?

To address this research question, a conceptual framework is presented which aims at using uncertainty *expressions* as indicators for uncertainty *perception*. This framework was developed based on the literature extending beyond the context of servitization. This framework was applied to an empirical case study which investigated the dyadic relationship between service provider and customer. The conceptual framework of uncertainty expressions offers a novel way of assessing decision maker's perceived uncertainty and the relating areas of importance. In the context of the presented case study, this was used to identify what uncertainties influence the decision makers both on the side of the service provider and of the customer.

Theoretical background and conceptual framework

To construct the conceptual framework for analysing the perceived uncertainty in support services, the literature in the field was consulted. This section presents a short overview of the literature in the field of uncertainty perception and uncertainty expression before describing the conceptual framework.

Uncertainty perception

In the literature, different discussions can be found on the objectivity and subjectivity of uncertainty (Kahneman and Tversky, 1972; Kreye et al., 2012). Objective uncertainty refers to its nominal existence in a situation and can be connected to the probability of the occurrence of an event. In contrast, subjective uncertainty refers to the perceived situation by a decision maker in the sense of making him/her feel unsure or unconfident. A particular situation can have an inherent uncertainty, such as the time it takes to fulfil a specific task may vary between a best-case and worst-case scenario (Galbraith, 1977); however, a decision maker facing this uncertainty may feel very confident that it would take him/her a specific time value within (or even outside) this interval. This may depend on issues such as the decision context (Milliken, 1987), the way the available information is presented (Kreye et al., 2012), and the level of expertise and experience of the decision maker (Klein et al., 2006).

For example, decision makers have been found to often ignore uncertainty and are overconfident in their estimates (Lichtenstein et al., 1982). Similarly, after the outcome of a decision problem can be observed decision makers often invent a "higher rationale" to explain uncertain events. This suggests that they treat the decisions as if they involved the skills of the decision maker (Langer, 1975; Langer and Roth, 1975). In other situations, uncertainty was found to be overestimated by decision makers, particularly when it had to be assessed in relation to a specific reference point (Bolger and Harvey, 1995; Harvey, 2001). As such, it was found that probabilities of less than 50% were overestimated and those of more than 50% were underestimated (Lichtenstein et al., 1982; Diebold et al., 1997).

The purpose of this paper is to introduce a new method for assessing the decision maker's perception of uncertainty that goes beyond the mere statement of probability values. As such, the following section discusses different ways of expressing uncertainty apart from probabilities.

Uncertainty expression

Uncertainty can be expressed in different ways. Differentiations include quantitative and qualitative (Van der Sluijs et al., 2005), stochastic and non-stochastic expressions (Helton, 1997), quantifiable and non-quantifiable (Tabandeh, 1994), and verbal and numerical statements {Windschitl, 1996 #1666}. Quantitative uncertainty includes probabilistic information, but is more often expressed as e.g. value \pm uncertainty or numerical intervals with minimum and maximum values (Zimmermann, 2000). Qualitative uncertainty is typically expressed in a linguistic way {Van der Sluijs, 2005 #183}. This means that verbal statements such as “not sure” or “expected” indicate that a person is uncertain about a specific decision, task or context but may not be able to assign probabilities to the available options (Zimmermann, 2000). As such, the use of terminology can indicate the decision maker's awareness and perception of uncertainty. This use of terminology is connected to people's systems of reasoning: the rule-based and associative system (Sloman, 2002). The rule-based system includes deliberate and controlled processes which apply systematic rules. An example is arithmetic where numbers can be generated through the computation of mathematical rules (Sloman, 1996). The associative system refers to intuitive and automatic processes such as the observation of one's environment and the perception of regularities and causal relationships (Sloman, 1996).

Windschitl and Wells (1996) connected expressions of uncertainty to the two systems of reasoning. As such, quantitative statements tend to be associated with the rule-based system while qualitative statements are connected to the associative system. However, empirical studies have found that people usually prefer to express uncertainty in qualitative statements such as “expected” or “improbable” to using quantitative statements (Wallsten et al., 1993; Renooij and Witteman, 1999). As such, it seems that specific qualitative uncertainty statements can also be connected to the rule-based system of reasoning. To clarify the difference, uncertainty terms that indicate a rule-based reasoning are labelled explicit uncertainty statements throughout this paper. In contrast, qualitative statements that suggest an associative level of reasoning will be labelled implicit uncertainty statements. This differentiation is consistent with the literature in the field and has been described by e.g. Hurley et al. (2011). Based on the literature, a list of terms and phrases for both explicit and implicit uncertainty statements is developed and is presented in the Methodology section. Before, the following section describes the conceptual framework that is used as the basis for the study presented in this paper.

Conceptual framework

To guide the empirical study of individual perceptions and expressions of uncertainty, a framework was developed based on the review presented in this section. Figure 1 depicts this conceptual framework and shows the connection between the influencing uncertainty on a decision or action, the perception of this uncertainty by the decision maker and the expression of this uncertainty through the system of reasoning.

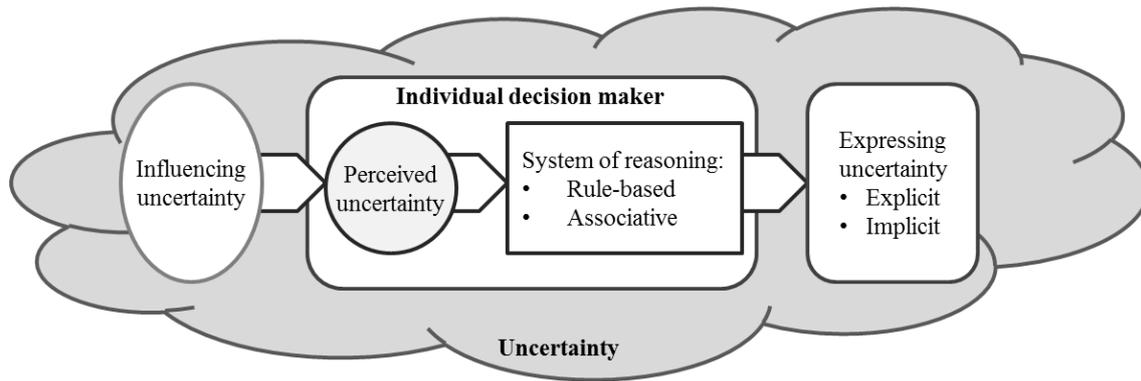


Figure 1: Conceptual framework for perceived and expressed uncertainty

A situation or decision problem may be influenced by specific uncertainties. For example, the repair of a product failure may be influenced by factors such as the scale of the damage, the availability of appropriate tools, and the maintenance engineer's condition on the day. The individual decision maker interprets this influencing uncertainty which yields a perceived uncertainty that s/he uses for his/her reasoning and decision making. Depending on the system of reasoning – rule-based with deliberate and controlled processes or associative with intuitive and automatic processes – the decision maker is able to express this perceived uncertainty in their statements. As such, a decision maker may be able to make explicit uncertainty statements which indicate that the person stating them is aware of this uncertainty and can express it in such a way. In the context of contracting, this may be the case when uncertainty modelling techniques such as Monte Carlo Analysis or Sensitivity Analysis are used to identify key factors influencing project outcomes or when a probabilistic confidence value is connected to a statement. Implicit expression of uncertainty means that the decision maker may not be aware of the concept itself. In other words, the decision maker may be unsure or insecure about a statement s/he is making, but may not be able to relate it to the uncertainty concept as described in the literature. Examples for implicit uncertainty references are the statement that a specific event may be “possible” or “potentially” harmful.

Methodology

To apply the framework, this research used a case-study approach which allowed the collection of a rich data set and explanation of the context (Stake, 1995). The case study focused on a contractual arrangement between one manufacturing company as a service provider and their customer in the UK. The contractual arrangement included the maintenance and repair services for actuators in the water industry. The service provider was a manufacturer of actuators, operating on an international level. They made a strategic decision to move into the service provision for their products and internally allocated resources in developing a competence base in this area. The customer was a local water-management company that supplied both private customers and businesses. They had already had some experience with receiving support services prior to the contract used as a case study in this paper, however, not with this service provider. At the time of data collection, both companies had had three years of experience of working with each other and the contract was still on-going. This offered a detailed discussion of very recent events in the business history which gave a rich picture of the support service.

The contract included the repair and maintenance of different types of actuators for the customer. As the service had been provided by a competitor previous to the case study described in this paper, the maintenance and repair activities included the competitor's as well as the service provider's products. Thus, a failure could occur to different types of actuators as well as products by different manufacturers.

Data collection

To collect the data for the industrial case study, semi-structured interviews were conducted with different actors both on the service provider and customer side. These interviewees were involved in the support service contract at some stage and were chosen based on their experience and levels of involvement in the case study contract. The interviewees included contract and service managers as well as engineers and equipment operators. A total of eight interviewees were chosen to participate in this study. This approach of multiple perspectives on the case study contract in addition to secondary data was chosen to eliminate bias. The data was collected using the critical incident technique (Gremler and Taal, 2004) which meant that the interviewees were asked to choose the main events that influenced the overall performance of the case study contract. The interviewees were encouraged to talk about these events, the contexts in which they appeared and how they influenced the project performance. This offered a rich qualitative description of the support service contract and issues that arose.

To guide the interviews, a list of questions was prepared that divided the relationship between the contractual partners into two phases. The first phase included the pre-contract phase and included any relationship before the case-study contract was signed. The second phase included the contract itself. The questions the interviewees were asked focused on their experience around main events that influenced the performance of this contract in a positive or negative way. An assumption of the critical incident technique is that the fact that an interviewee remembers a stated event qualifies this as a significant incident (Gremler and Taal, 2004). Of the eight interviews, seven were recorded with the interviewees' permissions and transcribed to allow for subsequent analysis (five for the supplier side and two for the customer side). The eighth interview was, however, used for confirmation or rejection of the issues mentioned by the other interviewees.

Data analysis

A content analysis of the interview transcripts was conducted with regard to explicit and implicit uncertainty statements. Based on the literature in the field, a list of 93 terms indicating explicit and implicit uncertainty references was compiled. Table 1 lists these terms as used in the data analysis. Due to the limited length of this paper, the terms are simply listed and not connected to the original references that used them in reference to uncertainty. The subject areas reviewed in the process of compiling this list include management, engineers, computer sciences and communication research and included references such as Friedman et al. (1999) and Hurley et al. (2011). Based on the content analysis for these terms, a further analysis of the context was conducted. In other words, when the interviewee used one of the terms stated in Table 1, the full sentence and context of that statement was analysed with regard to the target of this uncertainty. This combination of quantitative and qualitative analysis of the interview transcripts offered a rich picture of the respondents' perceived uncertainties.

Table 1: List of explicit and implicit uncertainty statements

Explicit uncertainty statements	Implicit uncertainty statements
Uncertainty, uncertain, risk, risky, variation, vary, chance, confident, confidence, not confident, imprecise, imprecision, not precise, ambiguous, ambiguity, numerical expression in probabilities using e.g. “x%”, probable, probably, on average, mean, uncertainty modelling techniques such as Sensitivity Analysis or Monte Carlo, confusion, confused, confusing, not sure, unsure, unknown, not known, don’t know, not clear, unclear, not defined, undefined, conflicting evidence, disagree, conflicting interpretations, ignorance, ignorant, ignore, vague, vagueness, vaguely	Re- (e.g. redone, renegotiate, reschedule), Mis- (e.g. miscommunicate, miscommunication, misunderstand), change, changed, likely, unlikely, expected, expectation, expectedly, unexpected, possible, impossible, not possible, possibly, potential, potentially, maybe, alternative, alternatively, otherwise, may, could, can, suggest, almost, undecided, not decided, predict, forecast, estimate, guess, think, seems to, available data, available information, some evidence, available evidence, lack of, not enough, missing, (knowledge, information, data etc), is thought to, is supposed to, is/are presumed, based on experience, inexperience, inexperienced, conflicting evidence: interviewee contradicting his/her own previous statement, preliminary

Results

Based on a mixed-method approach for the data analysis, this section presents the results. These are described with regards to the uncertainty perception of the interviewees and the main issues of uncertainty.

Uncertainty perception

Through a simple count of the times the different terms for explicit and implicit uncertainty expressions were mentioned by the interviewees, a “measure” of their perceived uncertainty can be created. This is depicted in Figure 2 for the seven interviewees on the service provider (service technician, senior service technician, service manager, sales manager and general manager) and the customer (electrical and mechanical technical managers). This measure is not to be seen as an absolute value, nevertheless, it allows for comparison between the amount that explicit and implicit statements were used and for a comparison of uncertainty awareness between the interviewees.

It can be seen that the uncertainty is perceived differently by the different interviewees. As such, the electrical technical manager (customer) seems to perceive a higher level of uncertainty than for example the service technician (service provider). Similarly, it can be seen that the two technical managers from the customer’s side, whose roles in this contract are very similar and differ mainly in the type of equipment they were responsible for (electrical and mechanical equipment), have different levels of uncertainty perception. The electrical technical manager mentions more than twice as many uncertainty terms as the mechanical technical manager. This suggests that the electrical technical manager may have some personality characteristics such as experience that triggered him to perceive a higher level of uncertainty. However, further research in this area needs to be undertaken.

Comparing the ratio of explicit and implicit uncertainty statements, it can be seen that this varies for the interviewees as well. This is surprising, as literature suggests that people use more implicit than explicit statements, especially in situations where they are not prompted to think about uncertainty or risk (Windschitl and Wells, 1996). The presented sample suggests that both types of statements are used equally often. However, to allow for more robust conclusions, a bigger sample size will need to be tested.

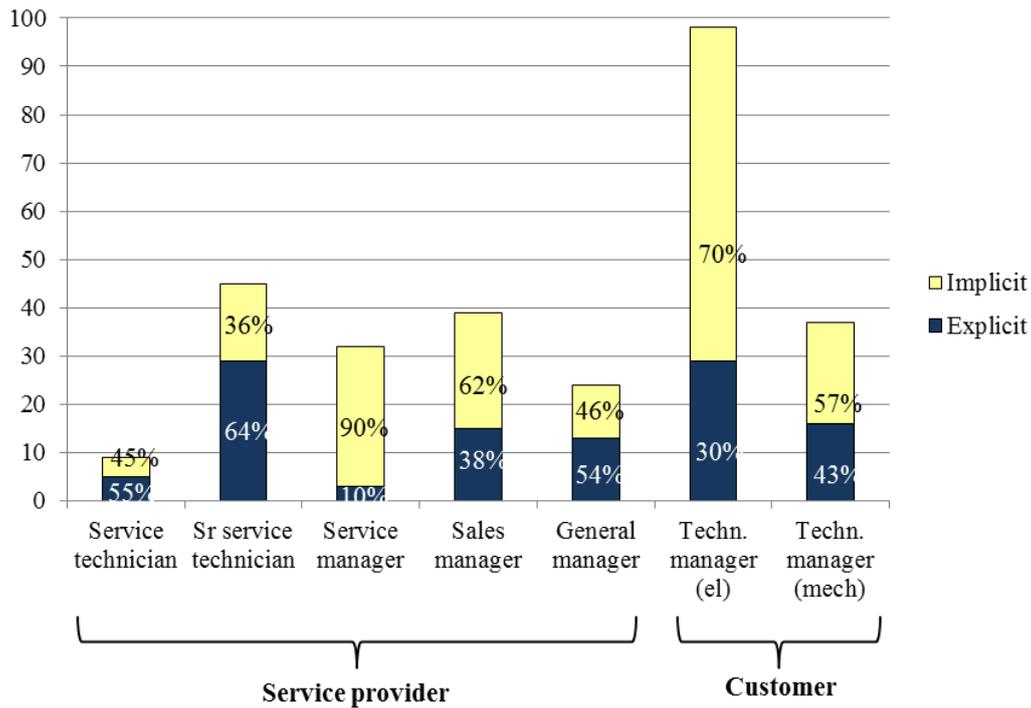


Figure 2: Uncertainty measures for different responsibility levels within the exemplar support service contract

Main areas of uncertainty

Based on the use of the uncertainty terms, main areas of concern could be identified by an analysis of the context described by the interviewees. As such, each of the stated terms, both explicit and implicit) were coded with regards to the main issue they related to. Table 2 depicts these main issues as perceived by the service provider and customer in descending order of importance which was determined by the total number of uncertainty terms referring to this issue. Due to limited space, the table only presents the number of explicit and implicit statements; the total number of uncertainty statements was calculated by adding these two numbers.

This analysis offers the identification of techniques and methods for the management or mitigation of these main areas of uncertainty. These techniques and methods would have to be connected to the following points;

- Competence and structural management to facilitate the change from a product supplier/receiver to service supplier/receiver, including management and development of skill sets.
- Information management to allow for an accurate and complete information exchange between customer and service provider.
- Appropriate techniques for monitoring and analysis of financial aspects of the contract.
- Appropriate techniques for managing the relationship and level of involvement between service provider and customer at the different contract stages.
- Management of competitive market environment.

Table 2: Uncertainty areas on service provider and customer sides

Uncertainty area	N ^o of explicit statements	N ^o of implicit statements
<i>Service provider</i>		
Recalling of events or times	11 (19%)	11 (13%)
Incorrect, incomplete or missing information from customer	13 (23%)	4 (5%)
Organisational issues on customer's side (not right person on site)	3 (5%)	10 (12%)
Profitability of contract	2 (4%)	11 (13%)
Management of tender process	1 (2%)	10 (12%)
Experience with customer pre contract	4 (7%)	6 (7%)
Expertise of customer's engineers (personal)	4 (7%)	6 (7%)
Experience with customer during contract	3 (5%)	4 (5%)
Organisational issues on service provider side (location of site etc)	7 (12%)	0
Future renegotiations	3 (5%)	4 (5%)
Differing expectations between service provider and customer	0	6 (7%)
Change of own management and organisation	0	4 (5%)
Staff management (personal development, re-training, informal feedback from own technicians within provider company)	1 (2%)	2 (2%)
Incorrect or incomplete database of product types by customer	2 (4%)	1 (1%)
Pointing towards other people with expertise in specific area	2 (4%)	1 (1%)
Personal relationships with customer engineers	1 (2%)	1 (1%)
Relationship to competitors (pre-tender and potential future ones)	0	2 (2%)
<i>Customer</i>		
Service activities by supplier	5 (12%)	15 (17%)
Evaluation of service provider and relationship	2 (5%)	17 (19%)
Change of own management practice	2 (5%)	16 (18%)
Management of tender process	6 (14%)	9 (10%)
Using competitive supplier model	7 (16%)	6 (7%)
Recalling of events and times	3 (7%)	8 (9%)
Issues with supplier in early contract phase	5 (12%)	1 (1%)
Experience with supplier pre-contract	3 (7%)	3 (3%)
Fairness of arrangement	0	6 (7%)
Referring to expertise of other people within company	4 (9%)	1 (1%)
Learning of service provider during contract	0	5 (6%)
Technical ability of own engineers and technicians	3 (7%)	1 (1%)
Introducing new processes into the agreement	1 (2%)	1 (1%)
Previous relationship with competitor provider	1 (2%)	0
Lack of knowledge about other parts of own company	1 (2%)	0

These areas should form the main focus of management activities of companies involved in servitization. However, the presented results are only preliminary, based on one case study with a small number of interviews and will need to be further validated by future research.

Discussion and conclusions

This paper presented a framework for using uncertainty expressions to derive areas of uncertainty perception and its application to an exemplar case study in servitization. This method offered the identification of specific management areas that need to be addressed by companies involved in servitization. These areas include competence and structural management, information management, monitoring and analysis techniques, relationship management for involved companies and monitoring techniques for the competitive environment. However, it is to be noted that these are preliminary results that will need to be validated through further research and the collection of further case studies. The presented research is an initial analysis of an on-going research project and will be validated through further interviews.

This research contributes to the literature in two ways. First, the presented conceptual framework is a novel approach to connect the perception of uncertainty and expression of this uncertainty in the management literature. This connection was made through the two different systems of reasoning as described in psychology research. These are rule-based and associative systems. Furthermore, based on the literature in the field, different terms and expressions that indicate uncertainty were connected to these two systems of reasoning. This is a novel method for analysis and can potentially be used in various contexts. This paper presented the application of this framework to an exemplar support service contract. The second contribution is connected to this case study. The description of the main uncertainties that are perceived by the actors of different levels of responsibility within the customer and provider companies offers insights into the main issues that can harm or benefit the performance of a support service contract. Including the situation contexts of the support services into the analysis yielded rich insights into the changed relationship between the service provider and customer. These insights can be used by future research to identify preventative, mitigating and management actions for these uncertainties on the different levels of responsibility.

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