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Perceptions of stakeholders in project procurement for road construction

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Abstract: Planning transport system, building, operating and maintaining public roads and railways is typically performed by public institutions in collaboration with other stakeholders, such as manufacturers, suppliers and distributors. In many cases, this collaboration is done with a procurement process. Despite the formal nature of such process, stakeholders can have different worldviews or perceptions leading to adverse effects on the final procurement result. This article is focused on how to find perceptions of stakeholders related to roadwork-related procurement processes using Q methodology. This methodology uses data from the stakeholders and searches for factors or groups within the data of participants who have similar opinions. A specific case of road procurement in Sweden is used to test the methodology. As a result, three clusters of perceptions are found. These clusters and their interpretation can be applied to many tasks that are related to complex adaptive systems such as policy-making, strategy generation, solution testing, training and others.

Subjects: Behavioral Sciences; Factor Analysis, SEM, Multilevel & Longitudinal Modeling; Strategic Management; Civil Service & Public Sector

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PUBLIC INTEREST STATEMENT

To construct a new road a buyer, consultants, construction companies and material suppliers have to work closely together to achieve good results. But they often have a difficulty to reach a common understanding because each of the parties has different needs and perceptions. To minimise misunderstanding, this work is trying to identify perceptions of stakeholders related to road construction contracts. This article introduces a methodology that searches for common groups of participants who have similar opinions and worldviews. As a result, three groups are identified based on how a road construction sector is perceived. Interpretation of these groups may be applied to many tasks, such as improving policy-making, strategy generating, solution testing, training and others.

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Keywords: project sector procurement; Q methodology; complex systems; road construction

1. Introduction

Large infrastructures, such as transport systems, cities, energy grids or water distribution systems, are managed by public institutions (Graham & Marvin, 2001), but they do this in collaboration with other stakeholders, like manufacturers, construction companies, entrepreneurs, operators and other institutions (Mullin & Daley, 2010; Wessel, Buuren, and Woerkum 2011). In many cases, this collaboration requires a legal support system that influences across the organisation and external partners. Such legal cooperation is implemented through a procurement process (Cicmil & Marshall, 2005; Kilger, Reuter, & Stadtler, 2015; Walker & Hampson, 2008).

The success or failure of the procurement process, and particularly of project procurement, is highly dependent on a proper understanding of the terms in the procurement documents (Brown, Potoski, and Slyke 2016), but stakeholders often give different interpretations to the same terms differently due to different perceptions (Dada, 2011; Hampton, Baldwin, & Holt, 2012; Li, Akintoye, Edwards, & Hardcastle, 2005). This holds especially true if there is a need to introduce new policies or incentives—understanding how the stakeholders perceive changes in the system is of high importance to design changes and apply them (Bruijn, Heuvelhof, & Veld, 2010).

Thus, it is important to understand these perceptions. However, the perspectives of stakeholders, their strategic behaviour and subjectivity in the system are difficult to research. The issue arises from the fact that traditional research methods look more at the stated behaviour, rather than the actual behaviour of the stakeholders (D'Arcier, Andan, & Raux, 1998).

In addition, as a part of the complexity, different perspectives interplay amongst stakeholders and influence one another, particularly in cases with asymmetric information and hidden incentives (Kauppi and van Raaij 2015; Papakonstantinou & Bogetoft, 2017).

Many procurement contracts for services like consultancy or for purchasing of constructions last for multiple years and require long term planning. This long-term planning of a project's execution and even longer consequences of the contracts contribute to the complexity of the projects. Dynamics in the relationships between stakeholders is an important issue. Relationships and values in contracts and in the market are not constant and they are often influenced by feedback loops, such as results of previous works, reviews, reflections and others. Perceptions of stakeholders may, therefore, have a serious effect on the results of procurement.

In order to have a project procurement process that is successful for the buying organisation, perceptions of stakeholders need to be obtained and classified (Kornevs, Kringos, & Meijer, 2014; Schermerhorn, Osborn, Uhl-Bien, & Hunt, 2011). Furthermore, perceptions have to come from experts who work in the particular field, rather than from general procurement experts, because perceptions are shaped by the contextuality of the daily routine and understanding of the sector, rather than a theoretical understanding of the procurement process.

This work aims to contribute a question on how to identify perceptions of stakeholders related to a project procurement process. A specific case of the road procurement process in Sweden is used to test the methodology. The Swedish Transport Administration is a government organisation with the responsibility of construction, operation and maintenance of state roads. These tasks are carried out in cooperation with industry. With relatively few stakeholders and important long-term decisions ahead to keep the Swedish transport system in good shape, the procurement process is a suitable research object in this work.

2. Perceptions in project procurement

Every year, the procurement process is used for obtaining services, works and supplies worth 15%–25% of the global GDP (World Bank, 2016). In many fields, such as energy production and consumption, transportation, waste management, healthcare and social care, education and public infrastructure construction, government institutions are the main buyers, and hence they are required to use a procurement process (de Araújo, Alencar, and de Miranda Mota, 2017).

Although all procurement contracts require thorough planning, some contracts can be easier than others. The procurement process that is part of routine work, such as ordering office supplies, can be relatively simple. On the other hand, there are procurement contracts that are based on unique projects and require to be executed from scratch each time. Such projects are known as project procurement.

Project procurement is also a process of procuring supplies, services or works. The main difference between project procurement and the other forms of purchasing is the series of activities related to the procurement process that are performed during the project realisation. The needs and specifications of project procurement are based on the needs and specifications of the project which it supports. This is a crucial condition for a successful realisation of the project procurement —only with proper coordination between project management and project procurement can all objectives be realised (Eriksson, 2005).

Some of the common elements of project procurement contracts are: i) the project has a deadline with defined final outputs or results that are feasible, ii) the project is complex and has multiple tasks in it, iii) the project is unique and cannot be simplified with some premade templates and iv) the project has uncertainties and risks, and the requirements of the procurement process may change during the project's lifetime (Baily, Farmer, Crocker, Jessop, & Jones, 2008). Construction of roads, bridges and hospitals are some of the examples of project procurement.

Entrepreneurs who bid for project procurement typically operate in a market with a specific structure. Usually, it is only government institutions who order such types of work and only a few companies who offer such services. This makes it an oligopoly (a state of the market in which a product or service is offered only by a small number of producers or sellers) with oligopsony (a state of the market in which a product or service is demanded only by a small number of buyers). Oligopoly and oligopsony have more complexity and interdependency than a regular open market (Caves & Porter, 1978). These complexities allow defining a project procurement as a complex adaptive system (Rhodes & Murray, 2007; Seybolt, 2009; Van Der Lei, Bekebrede, & Nikolic, 2010; Wollin & Perry, 2004).

The complex adaptive system is complex because it is based on dynamic networks of interactions and the combined output is larger than just the results of individual stakeholders (Kornevs, Kringos, & Meijer, 2016). In the same time it is adaptive because the behaviour within the system is not constant and it adjusts to the needs of stakeholders and also to events that happen in the system.

Project procurement as a complex adaptive system cannot be looked at only from the perspective of the government institution. Such vision helps to overcome the shortcomings of seeing it only as a process outside the context, and it provides an opportunity to perceive the procurement process as a part of a bigger system that can benefit long-term planning of the sector.

Planning changes for a complex adaptive system is not a trivial task. Any change in such systems triggers a series of other changes because all elements in the system are interdependent. But also, the social factor is very important here and different stakeholders can have different reactions and understanding of the change. It is caused by the fact that everyone has their own worldview or perception of the world (Lindsay & Norman, 1977; Schermerhorn et al., 2011; Scott & Gong, 2015).

The larger the differences in perception in procurement, the larger the risks for the procurement process to be successful. Some examples of factors that affect perceptions are i) making an evaluation about a contract by comparing it to others, ii) classifying it based on a single characteristic or based on the organisation that manages the project and iii) perceiving a contract by projecting your own attitudes, beliefs and experience (Borkowski 2015).

Because behaviour and decisions of people are based on their perceptions of reality, rather than the reality itself, stakeholders in project procurement can see and interpret the same contracts, specifications and requirements differently (Pandey & Rainey, 2006).

3. Case description

A case study is used to identify perceptions of stakeholders related to a project procurement process. Road procurement in Sweden is performed by the Swedish Transport Administration. They are responsible for the construction, operation and maintenance of state roads and railways. With the constantly growing population and importance to maintain the transport infrastructure, the Swedish Transport Administration is trying to improve their work to make it more effective and environmentally friendly.

As a public institution, the Swedish Transport Administration has to follow the procurement process. Most of their purchases are done as project procurement. Over the course of time, they have tried different strategies for their procurement contracts that have received both positive and negative feedback from the public and experts (Riksrevisionen, 2012). Although changes were developed for all types of projects, in some areas of their work, changes were harder to implement. One of the sectors with the lowest level of innovation is paved road maintenance and operation (Pelkonen & Valovirta, 2015).

These types of contracts include two main parts: maintenance of roads and operation. The maintenance of the roads is related to the wearing of the top layers of the road, maintaining the road markings and road structure, as well as taking care of railings, fences, road signs, lighting, etc. The operation includes works such as sand and salt gritting in winter road maintenance, mowing, and clearing of verges, sweeping, washing of road signs, digging of road trenches, etc (Stripple, 2001). The Swedish Transport Administration procures maintenance and operation of a road by area and the contract length is four years usually with the opportunity to prolong the contract by two more years. Due to differences in region topography and population density, each of the contracts is an individual project and is obtained as a project procurement. The request for tender is published online usually in late October or early November and lasts until January. The average number of tenders is 3.6 per contract (Trafikverket, 2017), although usually there are fewer tenders in the south part of Sweden and more in the north.

The issue with the maintenance procurement in Sweden is the low interest level of suppliers, the high level of conservatism in the sector, and high resistance to innovative approaches (Riksrevisionen, 2012).

Currently, the Swedish Transport Administration aims to improve maintenance and operation projects by i) having a larger number of tenders for each contract, ii) increasing the level of innovation and iii) increasing the level of service. Since all these goals require changes within different levels of the Administration with external partners, they have to be done through the procurement legal process (Shreenath, Kornevs, Raghothama, & Meijer, 2015). However, it is a very risky process to experiment with. Since the lifetime of a road is about 13 years (Svenson, 2014), the feedback loop takes too long a time to evaluate changes in the real world. Beside it, procurement contracts are complex enough with all the specifications and requirements, and changes here can decrease the number of tenders that is already low.

So, in order to test policies and changes for the contracts, it is important to understand how stakeholders perceive the situation before any changes can be made. This will help to know what type of changes can be made and to predict their consequences before their application.

4. Methodology

A method that works with experts and that deals with subjectivity is needed to obtain stakeholders' perceptions. One such method is Q methodology (Exel and Graaf, 2005). The main purpose of this methodology is to study the subjectivity of viewpoints. It collects both qualitative and quantitative data and gives good results, even when based on a small data pool.

Q methodology is used to systematically study subjectivity, a person's perceptions, viewpoints, opinions, beliefs, attitude, etc. (Brown, 1993; Durning & Osuna, 1994). It is used in many fields, such as political and communication sciences, psychology, medicine, education and media, to name a few (Kennedy, 2013). Often it is done using the opinions of specialists in the specific field in order to understand their opinions better. Hence, Q methodology appears well suited for investigating the subjectivity of road procurement, but this has not been reported before.

The Q methodology process, as seen in Figure 1, starts with defining the concourse or collection of statements. The concourse represents the entire spectrum of opinions and thoughts within the topic. A Q-set is selected from the concourse as a sub-set of the concourse still representing all the main opinions from the spectrum, although it is small enough to be manageable for a participant to sort. The Q-set is then distributed to the participants. The set of participants is referred to as a P-set. The participants then have to order the statements in a forced quasi-normal distribution. The ranking goes from strongly disagree to agree. Each filled rank ordering, or Q-sort, is collected and then analysed. This is typically done using a statistical analysis program (Schmolck, 2014).

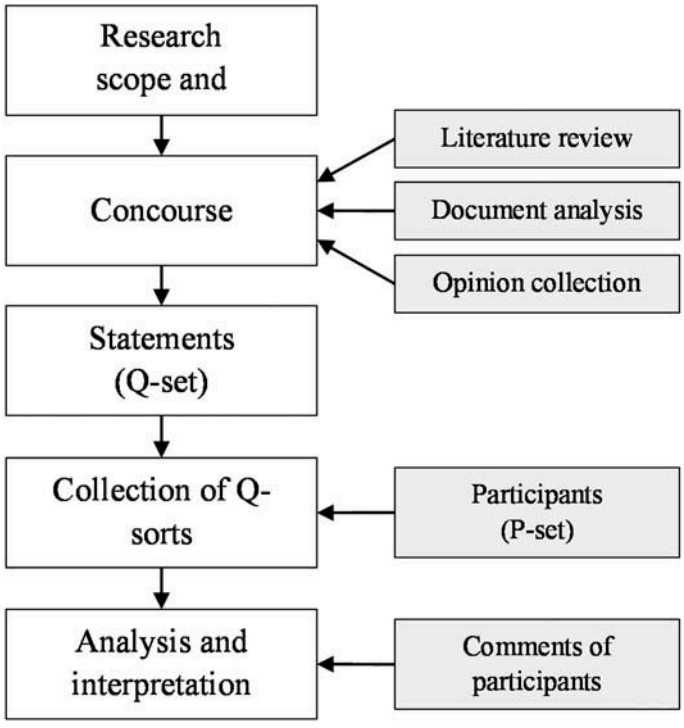

Figure 1. Steps in Q methodology.

4.1. Concourse

Q methodology statements can have different forms, opinions, objects, pictures, etc. and can be expressed in any way (Brown, 1996; McKeown & Thomas, 1988; Stephenson, 1953). They are typically obtained by literature review, document analysis, opinion collection, etc. In this work, the concourse was determined based on what is important in road procurement, and a list of actions related to road life was analysed. These actions can be grouped into the following categories: preparing procurement documentation, evaluation and awarding, project management, design, material supply, construction, maintenance and operations. Documents about procurement strategies and business models, handbooks, training materials, past tenders and literature and interviews with some stakeholders are reviewed to collect the foundation to build statements. Thematic content analysis showed that most of the collected data is related to the following 16 aspects: chance for tender to be awarded, costs of the project, durability of the road, environmental effects, freedom of specification in the procurement process, incentives for green procurement, individual market position, level of innovation, market balance, number of award criteria, precision of predictions, opportunity for recycling, project risks, safety, successful previous collaboration and warranty for the work (Kornevs et al., 2014). Then, combinations of these aspects contributed to populating the concourse.

4.2. Q-set and P-set

A Q-set is a sub-set concourse. Typically, a concourse can be extremely large, and it is important to decrease its size to 40–50 statements (a typical Q-set size that is used). It is done because participants are asked to sort statements by comparing them. Too many statements in a Q-set make the sorting process more complicated or even impossible. Therefore, there is a need to resize the concourse so it becomes more manageable. It is typically done by focusing on the most important aspects, removing statements that have the same idea, or focusing on the most important elements of the problem.

In this work, the number of statements was reduced by removing statements with variables that have no direct effect on each other and where the effect is known from the literature. For example, the pair of the procurement process and the environmental effects was removed because there is no direct effect. It is true, that the procurement process influences recycling and innovation, that in return affect the environment; nevertheless, there is no direct connection between the procurement process and the environment.

Most of the statements are built by comparing two different aspects. An example of such is the statement “Roads with high durability will always cost more” or the statement “Contracts with the lowest cost increase risks”. However, not all the statements used followed the same structure. Some of the statements came directly from the client, and some were created without sticking strictly to these guidelines. As a result, the Q-set has 43 statements in it, as seen in Table 1.

Typically, participants can be experts in the field, the target audience, consumers of a service or product, etc. Diversity (work experience, work position, age, gender) is considered to be a benefit. The number of participants is usually less than the number of statements, with some authors suggesting using a statement-participant ratio of 3:1 (Webler, Danielson, & Tuler, 2009).

In this study, the P-set, or participants for Q methodology, was chosen from a identified specialists from the different stakeholder groups. The main criterion for selecting the participants was that they had to work within the procurement process.

With the support of the Swedish Transport Administration and some other organisations, participants for the experiment were selected. All participants work with procurement contracts and represent all main stakeholders in the road field: buyer, construction, material supply and consultancy. Twenty-one participants participated in Q-sorts. The participants work in nine

Table 1. List of statements

	Statement
1	Contracts should always be procured for the lowest costs
2	Contracts with lowest costs stimulate innovation
3	Innovation during project planning period leads to risks
4	Environmentally friendly procurement for maintenance contracts requires long-term relationships with the contractor
5	Contracts with the lowest cost increase risks
6	The durability of a road is the largest risk in contracts
7	It is riskier to maintain roads consisting of recycled materials
8	Safety of road workers of the contractors in maintenance contracts is an important risk for the Swedish Transport Administration
9	Uncertainties in the predicted pavement life cycle are a large risk for the Swedish Transport Administration
10	Changes in the market balance between the different major contractors are a risk for the Swedish Transport Administration
11	Warranty on pavement life takes out all risks for the Swedish Transport Administration
12	Innovation in contracts justifies an increase in costs
13	Aiming for lowest costs will not be a blockage for innovation
14	Green procurement leads to innovation
15	When applying innovation, major improvements in the durability of pavements can be expected
16	Greenhouse gasses can be reduced by 50% through innovation
17	Through requirements on recyclability, innovation can be stimulated
18	The safety requirements of the Swedish Transport Administration take out all incentives to innovate for contractors
19	Any innovation will lead to more insecurity in the predictability of pavement life
20	The most innovative contractor will increase its market position significantly
21	The current market balance is the result of the push for lowest costs
22	The Swedish Transport Administration should not ask for a warranty when simultaneously asking for innovation
23	Tenders should be awarded by both projected costs and CO2 emissions
24	Roads with high durability will always cost more
25	Pushing for the lowest cost contract imposes challenges on the road safety
26	Warranty on a road reduces the costs over the road's life cycle
27	The current market balance is the result of the push for lowest costs
28	By selecting more awarding criteria than costs, the buyer can influence the market balance
29	Green roads will never be a reality if the Swedish Transport Administration keeps the same requirements on durability
30	A shift from technical to functional requirements will lead to innovation
31	A recyclable road is a green road
32	Contractors should give warranties on the CO2 performance of a contract
33	It is better to have a recyclable non-durable road than a durable non-recyclable one.
34	The lower durability of a road leads to more traffic incidents
35	The prediction methods for durability of pavements need to be improved
36	The contractor with a track record of durable roads should have an advantage in procurement
37	Projects that require a warranty never result in more durable roads
38	Contractors with recycling capability should be rewarded more in procurement
39	A push for recyclability will force some contractors out of the market

(*Continued*)

Table1. (*Continued*)

	Statement
40	The contractor that is best in predicting the pavement life cycle will dominate the market
41	Successful previous work should not be taken into account in awarding tenders
42	Changes in the market balance between the different major contractors are a risk for contractors
43	Contractors outside Sweden have similar capability to that of Swedish companies

different organisations with work experience ranging from 6 months to 30 years. When possible, interviews happened in the presence of the observer, who recorded oral comments and provided technical assistance. A collection of Q-sorts and comments were completed in Swedish and later translated.

4.3. Q-sort

The Q-sort process defines the process of experiment. During the interview, the participants were required to place each statement into one of seven categories (strongly disagree/agree, disagree/agree, slightly disagree/agree, neutral). The number of statements that can be in each group was specified (forced-choice condition). In this way, the participants had to pay closer attention to the statements because decisions on their placement are very important due to the limitation of spots. The number of statements in each group (see Figure 2) is similar to a normal distribution but is more equalised to give more freedom for the participants to tell which statement is more or less important.

Since many of the stakeholders were located in different cities it was impossible within the project to meet them all personally. Therefore, electronic sorting was chosen. The first choice was using the available web-based tool FlashQ (Hackert & Braehler, 2007) but in the process we learned that it still could not provide all the functions required (more data collecting mechanisms, using a personal style and combining two sorts to look like one), the decision to develop a new tool was made (see Figure 3). In this way, we were able to record more decisions of the participant and to give a more appealing look to Q-sorts.

The participants were instructed on the topic of research and answered some questions about their background. Then they saw statements one by one and chose if they agreed, disagreed or were neutral towards each of the statements. Then the person needed to sort statements into one

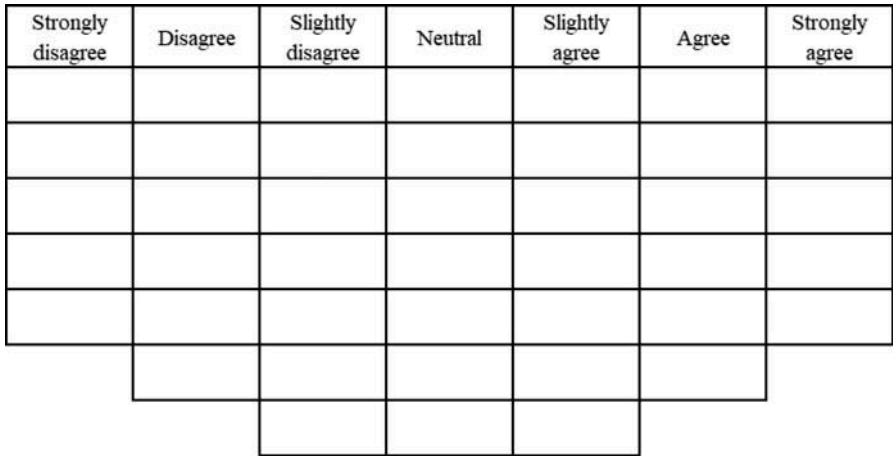

Figure 2. Q sort response matrix.

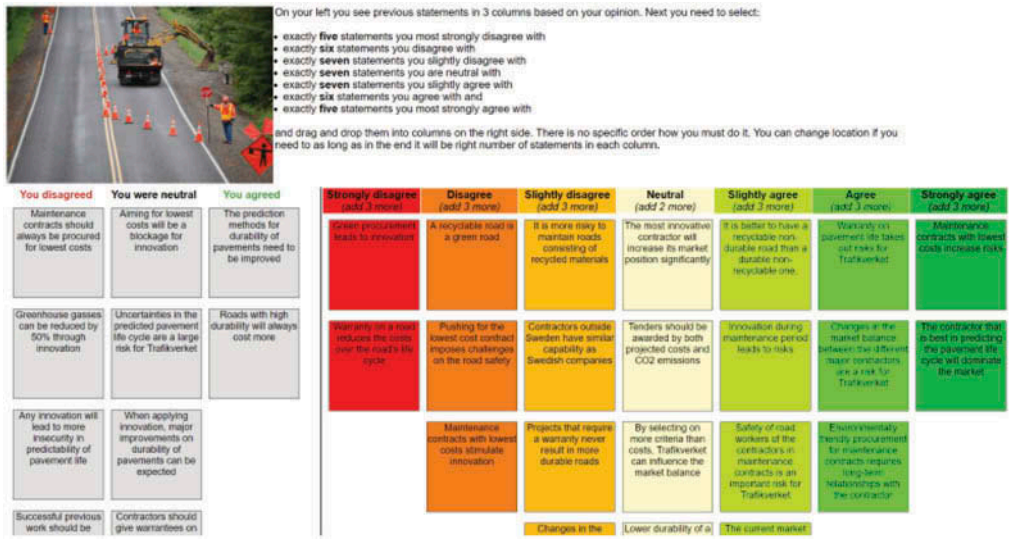

Figure 3. Web-based tool for Q methodology.

of seven piles. When all statements were sorted, the person was asked about the decision behind strongly disagreeing and strongly agreeing with the statements.

4.4. Analysis

QMethod v2.35 software is used to analyse the results gained from the Q-sorts (Schmolck, 2014). The software was developed to perform all needed steps for analysis. It starts by performing a correlation comparison between all sorts. The correlation shows how well two individual sorts, or two perceptions, agree with one another. The value range is between 100% for full agreement and −100% for full disagreement.

A correlation matrix can be used for data interpretation, but usually, it is just a step in the factor analysis. Centroid factor analysis looks at sorts that have a high correlation between them and clusters them together. As a result, a factor matrix is calculated. To better determine the values of factors, they are rotated. The rotation clarifies the factors' relationships with each other by maximising the data sets' angles towards each other. After the rotation, it is possible to determine the dominant factor for each sort by choosing the highest value.

Based on the factor matrix, PQMethod finds the factor arrays, or "the perfect sorts" for each of the factors. These arrays help to find common characteristics of the people who participated in Q-sorting. These factor arrays are used for each factor interpretation.

5. Results

Q methodology uses centroid factor analysis to find common groups of sorts or factors. Horst 5.5 Centroid factor analysis with iterative solutions for communalities was used in this work. This type of analysis determines when to stop extracting factors based on a number of statements and the residual correlation between factors (Horst, 1965). In this work, three factors satisfy the requirements of the analysis, and all Q-sorts are clustered to one of these factors.

When clusters were found, a varimax rotation of the factors was performed to make borders between factors more clear to ease interpretation (Abdi, 2003).

After this, the factors are ready, as seen in Table 2. Each value shows how much in common each Q-sort has with each factor. The factor with the highest value is a defining factor for each of the sorts. Sometimes the defining factor can be not very clear, as, for example, in sort 1. In this

Table 2. Factor matrix with defining sort

Sorts	Factor 1	Factor 2	Factor 3
Sort 01	0.39	0.32	**0.40**
Sort 02	0.35	**0.68**	0.38
Sort 03	0.32	−0.06	**0.69**
Sort 04	0.27	**0.59**	0.06
Sort 05	**0.58**	0.29	0.14
Sort 06	**0.54**	0.02	−0.10
Sort 07	**0.58**	0.17	0.22
Sort 08	**0.57**	0.46	0.22
Sort 09	0.26	0.39	**0.45**
Sort 10	**0.62**	0.36	0.38
Sort 11	0.06	**0.29**	0.21
Sort 12	**0.32**	0.22	0.30
Sort 13	0.25	**0.69**	0.05
Sort 14	0.22	**0.60**	0.08
Sort 15	0.20	**0.47**	−0.12
Sort 16	0.02	**0.45**	0.28
Sort 17	−0.10	0.39	**0.63**
Sort 18	0.16	**0.64**	0.32
Sort 19	0.09	**0.63**	0.34
Sort 20	0.17	0.00	**0.64**
Sort 21	−0.05	0.36	**0.55**
Total	*6*	*9*	*6*

case, there is a close connection between all three factors. This means that the participant shares the attitudes of all factors rather than determining only by the variables of one factor.

The three identified factors are factor 1 (Administration orientated), factor 2 (Business orientated) and factor 3 (Service quality orientated). Each factor represents a set of attributes and values based on how participants in these factors perceive the road maintenance project procurement. Table 3 shows the correlation between the factors. The high correlation between factor 1 (Administration orientated) and factor 2 (Business orientated) shows that there are similarities between these two factors and they are doing more with management and longer-term planning. Factor 3 (Service quality orientated) stands out distinctively from other factors and deals more with product quality and shorter-term goals.

An interpretation of each of the factors is given below based on factor arrays and the comments of the participants.

5.1. Factor 1: Administration orientated

Participants within factor 1 looked at project procurement from the administration point of view. They were concerned about market structure, organisations and structures within organisations,

Table 3. Correlation between factors

	Factor 1	Factor 2	Factor 3
Factor 1	1.000	0.522	0.143
Factor 2	0.522	1.000	0.216
Factor 3	0.143	0.216	1.000

the experience of stakeholders and cooperation between companies in the market. For them is important that all the processes are running smoothly and all management is done properly.

Statements that participants strongly agreed with typically show a connection between the market and work of the Swedish Transport Administration. These statements are "The current market balance will be disrupted by pushing for innovation", "Changes in the market balance between the different major contractors are a risk for the Swedish Transport Administration" or "The current market balance is the result of the push for lowest costs". Other statements that are highly agreed with in these factors also deal with the market, such as market balance from the perspective of the companies ("Changes in the market balance between the different major contractors are a risk for contractors") or qualification of the market ("Contractors outside Sweden have similar capability to that of Swedish companies").

Commenting on the current situation of the market, one of the participants mentioned that the current situation of the market with only a few big stakeholders is a result of a push for the lowest cost because "it is easier to bid for contracts for bigger companies, for they can offer low cost due high volumes [of work that they do]". But at the same time, participants in this factor do not feel responsible for individual failures: "I don't see that [changes from the Swedish Transport Administration] have to push contractors from a market. It could be, but it depends on how contracts are handling these requirements. They can find other works, or there could be more calibration between the contractors. I don't see that market misbalance must happen, but it depends on how a market will adjust to changes". They are aware of strengths in organisations: "The Swedish Transport Administration has a good knowledge of the sector and processes" and "competence of contractors is high", and they are aware of strengths in the processes that are characterised as "national uniform standards, transparent actions, good calculability, structure, and content are consistent over time".

The typical participant for this factor is a worker of the Swedish Transport Administration (83% of all sorts for factor 1), male (67%) and worked in an industry on average for 18 years.

5.2. Factor 2: Business orientated

Business-orientated participants look at individual contracts and related aspects rather than administration aspects. They want to have contracts with the lowest costs. They are interested in the procurement process, finance models, innovation and incentives.

Statements that describe this factor are related to project procurement costs: "Contracts should always be procured for lowest costs" and "Aiming for lowest costs will not be a blockage for innovation". They also are trying to gain benefits in the long term: "The contractor with a track record of durable roads should have an advantage in procurement" and "Environmentally friendly procurement for maintenance contracts requires long-term relationships with the contractor". They want to innovate: "The most innovative contractor will increase its market position significantly" and "Innovation in contracts justifies an increase in costs", although they understand that innovation can be an issue: "Any innovation will lead to more insecurity in the predictability of pavement life".

General comments were acceptance of innovation: "I think when [the Swedish Transport Administration] will stop telling exactly how to do contracts, and instead of telling what they want to have, it will help to be more innovative. Currently, specifications are more in details 'you should put posts every 2 m or 4 m', but it should change to more functional, for example, 'posts should stop a vehicle at this velocity and at this weight'".

The typical participant in this factor is a consultant (44%), is male (89%) and has work experience from half of a year to more than 30 years.

Sometimes borders between administration-orientated participants and business-orientated participants are not as clear, which is also seen in the high correlation between factor 1 and factor 2, but it is still possible and needed to see them as two different groups to gain more insights into their perceptions.

5.3. Factor 3: Service quality orientated

Participants in factor 3 emphasise statements that are about service quality, such as the environment, quality, road characteristics and work process. They look not as much at management processes, but rather into the goals of the project.

Service quality-orientated participants choose to agree with statements about the environment: "Greenhouse gasses can be reduced by 50% through innovation" and "Contractors should give warranties on the CO2 performance of a contract". They are also concerned about recycled materials: "It is riskier to maintain roads consisting of recycled materials", about durability: "When applying innovation, major improvements on durability of pavements can be expected", about safety: "Safety of road workers of the contractors in maintenance contracts is an important risk for the Swedish Transport Administration" and other service quality-related aspects.

Their comments also show that they perceive project procurement through aspects of quality, for example: "I think for a green future, we must set up very high standards; for example, green machines, because everything needs to reduce CO2". Also, their concerns are more about practical, operational issues, rather than longer-term problems. However, this does not mean that they are unaware of the importance of the procurement process. They understand the role of procurement in the process and focus on how the procurement process can improve the service quality by suggesting that "roads should be procured to the best combination between cost, environmental factors, safety, durability, previous experience and innovation".

The typical participant in this factor is employed either by the Swedish Transport Administration or by a material supplier company (50% and 34%, respectively), is female (67%) and has worked in the industry for an average of 11 years.

5.4. Comparison across factors

Q methodology allows not only interpretation of individual factors but also a comparison of the factors.

When factor 1 ("administration orientated") and factor 2 ("business orientated") are compared, it is seen that they agree on some aspects, while on some other aspects they do not agree. For both factor 1 and factor 2 aspects of market balance, warranty and level of innovation are very important. At the same time, they have different views about tender-awarding aspects, successful previous collaborations, environmental effects and incentives for green procurement. These may come from combining expectations with real experience; for example, participants in factor 1 agree with the statement "By selecting more awarding criteria than costs, the buyer can influence the market balance", while participants in factor 2 strongly disagree with this. Differences might also be explained by the differences in defining terms and concepts. For instance, the statement "A recyclable road is a green road" is supported by factor 2, but participants in factor 1 strongly disagree with this.

Factor 1 and factor 3 ("service quality orientated") also have shared aspects: environmental effects, incentives for green procurement, the opportunity for recycling and the costs of the project. As an example, both factors highly agree with "Green procurement leads to innovation" and disagree with the statement "A recyclable road is a green road". However, these factors have different views on successful previous collaboration, the chance for a tender to be awarded and the number of award criteria.

Factor 2 and factor 3 share their opinions about freedom of specification in the procurement process, individual market positions and the number of award criteria. At the same time, they disagree about environmental effects and incentives for green procurement, as well as safety and project risks.

5.5. Factor validation in maintenance procurement workshop

The results gained in Q methodology were validated during a workshop with the employees of the Swedish Transport Administration. The workshop was focused on developing new strategies for maintenance work for roads. In the workshop nine people participated that were divided into four groups.

During the workshop participants in their groups had to perform an analysis of the current situations and develop new practices for the procurement process. Each participant was asked to perform a sorting of statements to determine their defining factors. These results were compared with the answers that the group gave.

Group 1 had two participants: one who was business orientated and one who was administration orientated. During the analysis of the current situation, most of their remarks (64%) were related to business practices, 27% comments were related to administration, and 9% to quality and service. The strategies they chose were business and administration orientated, including improving incentives for companies and making project management more efficient.

Group 2 had two participants and both belonged to the administration-orientated factor. Two-thirds of their comments from the analysis were about administration processes and the rest were related to business. Their strategy was to fully replace inner policies and templates within the organisation. They wanted to make documentation clearer and easier to read.

Group 3 had one participant whose result was between business orientated and service orientated, and other participants' results were between administration orientated and service orientated. During the analysis of the current situation, the majority of their replies (78%) was regarding the service of the road ("Road user needs are met to a large extent", "The property quality may decrease"), and the rest were equally split between business and administration. Their strategy was related to improving the work process.

Group 4 consisted of three people: two were administration orientated and one was business orientated. Half of their replies were business orientated, and the rest split between business orientated and service orientated, with many comments being close to several orientations. For example, the comment that the "structure and content of projects are consistent over time" or that "documentation is transparent" is between business and administration.

The strong correlation, which was observed in the results, shows that factors from Q methodology match the decisions that participants made. This can benefit the development of policies and gives insights into the discussions between stakeholders.

6. Conclusions and discussion

Perceptions of stakeholders in project procurement for road construction in Sweden were obtained using Q methodology. Twenty-one specialists in road procurement participated in this research. Based on their answers, three factors have been identified. Factor 1 and factor 2 are orientated on management and longer-term planning, where factor 1 is focused on administrative processes like market structure and experience, and factor 2 is focused on business decisions, like contracts or prices. Factor 3 is service and quality orientated and it deals more with product quality and shorter-term goals.

The finding of these 3 strong factors proves the feasibility of using Q methodology for obtaining diversity in perspectives in a sector organised via procurement procedures. It also shows that the factors are not limited to the organisation that people work for, revealing internal diversity that is

otherwise difficult to structure. Q methodology allowed to elicit actual behaviour of the stakeholders instead of stated behaviour as in most traditional research methods.

Information about the factors and their interpretation can be applied in many tasks that are related to complex adaptive systems. This includes, but is not limited to, policy making, strategy generation, evaluation of dilemmas, solution testing, training and teambuilding focusing on different perspectives in the team.

Policies related to public project procurement are difficult due to the long lifetime and high costs of the project. In the case of road construction, a road serves for many years to decades before it needs to be rebuilt, and decisions on where to build new roads can have an effect for thousands of years (some roads nowadays are built over roads and paths from ancient civilisations). Also, contracts are very expensive with the prices going to hundreds of millions of USD. Knowledge of the perceptions of the stakeholders eases decisions on what incentives are needed to successfully work with each factor. It also helps to develop policies that are targeted to specific groups.

Factors can be useful for strategy generation and improvement. Since it is known that not all perceive project procurement in a unified way, having people with different worldviews drastically improves strategies. Findings from each factor can contribute by providing a fuller understanding of the process, but also it can be used for brainstorming strategies to make sure that the final strategy will satisfy the needs of all stakeholders in the system.

Many discussions in project procurement literature deal with dilemmas between several aspects. For example, a dilemma can be a choice between an expensive, environmentally friendly solution or a cheap solution that pollutes the environment around it. Evaluation of such dilemmas can be done based on the perceptions of stakeholders. Sometimes, as in factor 1, one of the aspects will be always more prioritised than the other. But sometimes, as in factors 2 and 3, priorities can change over time. In a similar manner, different solutions can be evaluated.

Knowledge of different factors can be used for training stakeholders. It can be used either to focus on and recognise different perceptions and learn to use them in project procurement, or to change perceptions and target training at some areas that might need to be changed, for example, to change some priorities or to increase the time of an oscillation period.

Factors can be used as an exercise in organisations to improve team performance. Determining the perceptions of each team member and discussing some of the differences and strengths that are present in each type of factor will help the team be more aware of different perspectives and how they can benefit daily work processes and decisions.

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