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The Space Industry of Tomorrow

How a supplier in the space industry should meet the requirements of the New Space market

Master of Science Thesis in the Supply Chain Management Programme

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Gothenburg, January 2018

Abstract

New Space can best be explained as a new market within the space industry, fuelled by a recent demand for internet accessibility across the globe. The entrepreneurs driving the development within the market clearly differ from the actors in the conventional space industry known as Old Space. They are more risk-taking and open for new ideas, solution oriented rather than product oriented and demand shorter lead times, lower costs and quality and higher volumes than the conventional actors.

This report was written with the aim to help the company RUAG Space AB identify the perceived problems within the organisation and understand how they hinder RUAG Space AB from meeting the requirements of the New Space market. For this purpose, three research questions were formulated: What are the characteristics of New Space and what requirements will it place on RUAG, what are the problems currently perceived by RUAG and in what way are the problems currently perceived by RUAG a cause to RUAG's inability to meet the requirements of New Space?

To answer these questions, employees at RUAG were interviewed about the requirements of New Space and their perceived problems within the company. The empirical findings were complemented by literature on New Space, performance objectives and other subjects pertinent to the research conducted in this report.

The result of the research conducted in this report was that the requirements of New Space can be summarised as lower costs, less strict quality requirements and a capacity to meet increased and fluctuating volumes. These requirements were in part due to actors of New Space having different preferences and priorities than the actors of Old Space and in part due to technological developments opening up new possibilities. The problems currently perceived by RUAG could be grouped into culture and attitudes, competencies and knowledge transmission, project management, management, cooperation between the product units, cooperation along the internal and external value chain, customer focus and IT and automation. Among these, four main categories were chosen for further analysis. The results of this analysis were that the perceived problems found in management, cooperation between product units, customer focus and cultures and attitudes all have detrimental effects on the ability of RUAG to meet the requirements of the New Space market. The work for RUAG does not end with this. Future research could deal with analysing the remaining perceived problems as well as suggesting how the problems perceived can be solved in ways that simultaneously help RUAG meet the requirements of New Space.

Keywords: New Space, Old Space, space industry, management, customer focus, cooperation, cultures, attitudes, performance objectives, costs, volumes, lead times, quality.

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1 Introduction

In the introduction, a background to the research topic is provided, along with the purpose and research questions for the study. Further, the company that is the subject of the investigation - RUAG Space AB - is presented, as is the scope of the study and the structure of the thesis.

1.1 Background

Today, many companies in the space industry face unprecedented challenges stemming from the emergence of New Space. New Space can be explained as a new era, market or ecosystem in the space industry. Fuelled by a recent, worldwide demand for internet accessibility for the world's population that remains offline (approximately 60%), entrepreneurs and entrepreneurial private actors have set their sights on the production of communication satellites to launch in clusters across the globe (Rymdstyrelsen, 2016). The entrepreneurs driving the New Space market clearly differ from the Old Space actors, both public and private - the traditional space market characterised by costly projects and risk-aversion (Smart, 2016). The actors of New Space are driven by innovation and entrepreneurship and funnelled by financial constraints but also a higher degree of financial risk-taking than the traditional actors. They are reshaping the space industry with their demands for higher volumes supplied with shorter lead times at lower costs and with other quality requirements.

Since its conception, New Space as a market has grown and in recent years, that growth has accelerated. In 2015 the venture capital invested in space was almost twice as much as what had collectively been invested in the 15 preceding years (Lal, 2016). The Federal Communications Commission (FCC) is an independent agency of the United States government created to regulate the interstate communications and for a company to launch a satellite, they must first apply for it at the FCC. These applications can be used to predict the market for communications satellites and within the next few years, companies such as SpaceX, OneWeb and Telesat have planned for thousands of satellites to be launched (Söderberg, 2017). For reference, there are approximately 1 400 functioning satellites orbiting the Earth today (Stuff in Space, 2017). Looking to the future, space activity on a global scale is expected to double in the next decade (Lal, 2016).

RUAG Space AB in Gothenburg is a supplier on the space industry market, and has traditionally been supplying customised low volume products with very high quality. Consequently, their product development and manufacturing are mostly project-oriented and characterised by high costs and complexity, and long lead times. This means that there exists a discrepancy between the business characteristics of RUAG Space AB (henceforth RUAG) and the requirements placed on the suppliers by the actors of the New Space market. The business environment from which the production

characteristics emerged has a significant effect upon management, organisational structure and work organisation (Koskinen, 2013). Since the traditional customers of RUAG have had other demands than the customers of the New Space market, these aspects have been adapted to the traditional space market. However, the market of New Space will require a different work organisation, organisational structure and management system and for RUAG to stay competitive in the space industry they must adapt these aspects to the new market reality.

1.2 Purpose and Research Questions

With the emerging market of New Space, new requirements are being placed on RUAG. The purpose of the study has therefore been to contribute to RUAG's ambition of staying competitive in the space industry. This report aims to link the problems perceived by RUAG to the company's inability to meet the requirements of the New Space market, thus offering RUAG a causal analysis. This analysis could then be used to spark a sense of urgency and as call to action for RUAG to assess its organisation and to adapt to New Space, in addition to serving as a foundation for future improvement work. To fulfil the purpose, three research questions has been developed.

Research question 1
To understand what requirements that will be put upon RUAG, it is important to understand the characteristics of New Space and what requirements it places on its suppliers. Hence, the first research question is:

- What are the characteristics of New Space and what requirements does it place on RUAG?

Research question 2
To understand what needs to be changed in the company for RUAG to stay competitive in the New Space market, perceived problems in the organisation need to be revealed. The second research question is therefore a current state analysis, formulated in the following manner:

- What are the problems currently perceived by RUAG?

Research question 3
In order to fulfil the purpose of contributing to RUAG's competitiveness of the future space market, the requirements of New Space have been causally linked to selected perceived problems at RUAG. The third research question is therefore:

- In what way are the problems currently perceived by RUAG a cause to RUAG's inability to meet the requirements of New Space?

1.3 RUAG Space AB

RUAG Space is one of the leading suppliers of space technology in Europe, and has an increasing presence on the market in the United States. The company is the space

division of RUAG Holding AG, a Swiss technology group also operating within the divisions of Aerostructures, Ammotec, Defence and Aviation. Together, the five divisions employ approximately 9 100 people across the globe, whereof 1 300 work at RUAG Space. The company has production sites in Sweden, Finland, Germany, Switzerland, Austria and USA. The site in Finland and the two Swedish sites are part of the subsidiary RUAG Space AB. The headquarter of RUAG Space AB and the majority of the company's operations and employees are located in Gothenburg. The operations in Gothenburg are divided into three product units; Microwave, Antenna and Digital. Product development and manufacturing are mostly project-oriented within every single production unit and the production is characterised by high product customisation, long lead times, high complexity, high quality and low production volumes.

RUAG delivers approximately 34% of their products to the public sector and 66% to the commercial (RUAG Space AB, 2017). The supplied volume of products from RUAG to the commercialised sector is however estimated to increase with 400% within the near future (Bärring, 2017), part of which can be attributed to the New Space market. Due to the escalation of the demand of supplied products to the New Space market, RUAG must be prepared for fundamental changes to meet the requirements of New Space and to stay competitive in the space industry of tomorrow.

1.4 Scope

With the emerging market of New Space, the space industry is about to undergo one of the biggest changes in its history, which is why not all aspects of that change can not be taken into consideration. The scope is therefore limited to the problems perceived by RUAG's employees and excludes a current state analysis of the physical flow of the production. Furthermore, the research has been conducted at RUAG in the light of New Space, and the research has therefore not covered how and if RUAG should supply the market of Old and New Space simultaneously.

It will also be difficult to suggest specific actions to RUAG to get them to move towards being able to meet the requirements of New Space. Because of this, the suggested actions will be presented more like directions in which the company should move rather than as concrete goals. With this said, the changes suggested must still be anchored by an estimated time horizon. Instead of choosing an arbitrary time span, the study will be based on the market demand derived from the projects included in the FCC applications from this year. These projects can be seen as representative for the space activity of the coming couple of years.

1.5 Structure of the Thesis

This thesis consists of six main chapters. The first chapter of this report has given the reader an introduction to the research topic by providing a background to the field of

study, the purpose of the research and the three research questions, a presentation of the company at which the research was conducted (i.e. RUAG) and the scope of the study.

The next chapter, chapter two, presents the research methodology and the research design. It continues with reviewing the work process model and how data was collected and ends with a discussion regarding the quality of research.

The frame of reference is presented in the third chapter and consists of five areas. The chapter begins with a review of the space industry which includes the history and market of Old and New Space and continues with a closer presentation of operations performance objectives important for New Space. The chapter also includes a literature review on customer focus, organisational culture and management - all fields important for RUAG, New Space, and by extension, the study.

The fourth chapter consists of the empirical findings and will provide the reader with the answers to the three research questions. The first research question will be answered by combining RUAG's perception of New Space and the literature on the same. The second research question is answered by a presentation of the empirical findings on the problems currently perceived by RUAG. The third research question combines literature and the problems currently perceived by RUAG in a causal analysis of RUAG's inability to meet the requirements of New Space.

In chapter five, a discussion about the research is held. The discussion touches upon the execution of the research, the results of the research and the problems currently perceived by RUAG that were not included in the third research question. The chapter ends with a discussion about change management within the scope of the research and the future for RUAG. The last chapter, chapter six, will provide the reader with a conclusion of the study.

2 Methodology

In the following chapter, the research methodology applied for the study is being presented. The approach to the frame of reference is presented followed by the chosen research design. The chapter continues with a description of the work process model used for the research and further, how data was collected. The chapter ends with a section of the quality of the research which includes of access to the data was granted, ethics and validation.

2.1 Research Methodology

When conducting research, there exist three approaches to the relationship between the use of theory and the research conducted, namely deductive, inductive and abductive (Saunders et al., 2016). Using a deductive approach, the research starts with examining the literature to build a theoretical framework, and designing a research strategy to test the hypothesis against the empirical studies (Bryman and Bell, 2015). When using an inductive approach, the frame of reference is instead generated by the findings of the empirical study, and the conclusion of the research is a result of both the empirical findings and the frame of reference. An abductive approach is a combination between the deductive and inductive approach where data is collected to explore phenomenon or patterns to modify or generate a theory which is then tested through additional data collection (Saunders et al., 2016).

When the research at RUAG was conducted, an inductive approach was used. The approach allowed the research to be explorative in its nature to create an understanding of the context, i.e. the organisation, the environment it is operating in today and the challenges imposed on RUAG by New Space. The inductive approach also allowed for a reasoning regarding the context by making sense of the interview data collected through analysis and backed by the frame of reference that was the outcome of the data collected.

2.2 Research Design - A Qualitative Study

According to Bryman and Bell (2003), the research methodologies can be divided into quantitative and qualitative research. How to classify research methodologies is a subject of discussion and while some argue that this distinction is outdated, this classification can also be useful since the two practices possess different characteristics. One way to differentiate the two is by the generation and the use of numbers in the quantitative research, and by the generation and use of non-numerical data in qualitative research (Saunders et al., 2016).

A quantitative study focuses on and examines the relationship between numerical variables and is analysed by using mathematical tools (Saunders et al., 2016). It is characterised by a series of steps that moves from theory to the conclusion of a study via

empirical findings and analysis, which is why a deductive approach to the study is favourable. However, the qualitative research is criticised for being inadequate when studying the relationship between people and their surroundings (Bryman and Bell, 2003). For a qualitative study, the object of study differs from a quantitative study since it is focused on the analysis of environments and the spoken word rather than quantification of performed experiments (Bryman and Bell, 2003). A qualitative approach to the research also allows the interviews to be more flexible in their nature (Jacobsen, 2002). A major part of qualitative research is to distinguish the subjective meaning of the collected data and to interpret the environment from the perspective of the research objects. There are also drawbacks with qualitative analysis. They are criticised for being too subjective due to the personalised relationships that form between the researcher and the research objects and for being difficult to replicate and draw general conclusions from (Bryman and Bell, 2003).

In this study, a qualitative research method was used since it is the most suitable research methodology for sampling data and conducting analysis on data that is non-numerical and difficult to quantify. Furthermore, a qualitative study commences with an inductive approach to the development of the frame of reference. A qualitative method was also suitable for the research conducted at RUAG since it allowed for the qualitative data to be interpreted and analysed by the researches and for conclusions to be drawn from the base of these interpretations.

2.3 Work Process Model

To tackle the research questions, a model for the work process was formed. The work process model details what information was necessary as input and in what way the information was used when answering the research questions. A visual representation of said work process model can be found below, in figure 1.

When answering the first research question - What the characteristics of New Space are and what requirements it will place on RUAG's performance - a retrospective of the history of the space industry was included. New Space implied the existence of Old Space, which is why information was gathered on both. Seeing as the first research question aimed to compare the picture RUAG had of the New Space market to that of literature, some of the information gathered in the literature study was dictated by what the interviewees decided to talk about during the less structured segments of the semi-structured interviews. With this said, the empirical and literature-based information gathered for the first research question was in part determined by the authors' ideas about what could potentially be relevant when describing a market. The input to the analysis of the first research question therefore consisted of:

- The current size and forecasted growth of the New Space market, in absolute terms and relative to the space industry at large

- Actors and stakeholders of the New Space market and of the Old Space market and how they differ
- Requirements and performance objective imposed on suppliers of the New Space market and the Old Space market
- The importance of New Space for RUAG, Old Space and the space industry
- Technological advancements

The second research question - what the problems currently perceived by RUAG are - needed to be based on information coming directly from the employees of RUAG. Because of this, no literature was used when answering this question. The empirical information gathered concerned problems perceived by RUAG employees. The problems brought up were related to eight subjects chosen as a foundation for the semi-structured interviews. These were:

- Cooperation between the product units
- Cooperation along the internal and external value chain
- Digitalisation and automation today and the possibilities of further digitalisation and automation in the company
- Corporate culture and attitudes in the company
- Management and leadership at different levels in the company
- Customer focus
- Competencies of the employees and how knowledge is transitioned
- Project management

The third research question - in what way the problems currently perceived by RUAG are a cause to RUAG's inability to meet the requirements of New Space - required the results of the first and second research questions. Conducting a causal analysis by linking the selected problems currently perceive by RUAG to the company's inability to meet New Space requirements made it necessary to find literature dealing with the subjects at hand. The search for relevant literature was two-pronged, meaning that the literature research included information on the perceived problems and on the requirements dictated by New Space. The input for the third research question therefore resulted in:

- The results of the first research question, i.e. the characteristics of New Space and what requirements it will place on RUAG
- The selected perceived problems at RUAG that resulted from the second research question
- Literature on operations performance objectives relevant to the New Space market and its requirements
- Literature touching on the selected problems currently perceived at RUAG

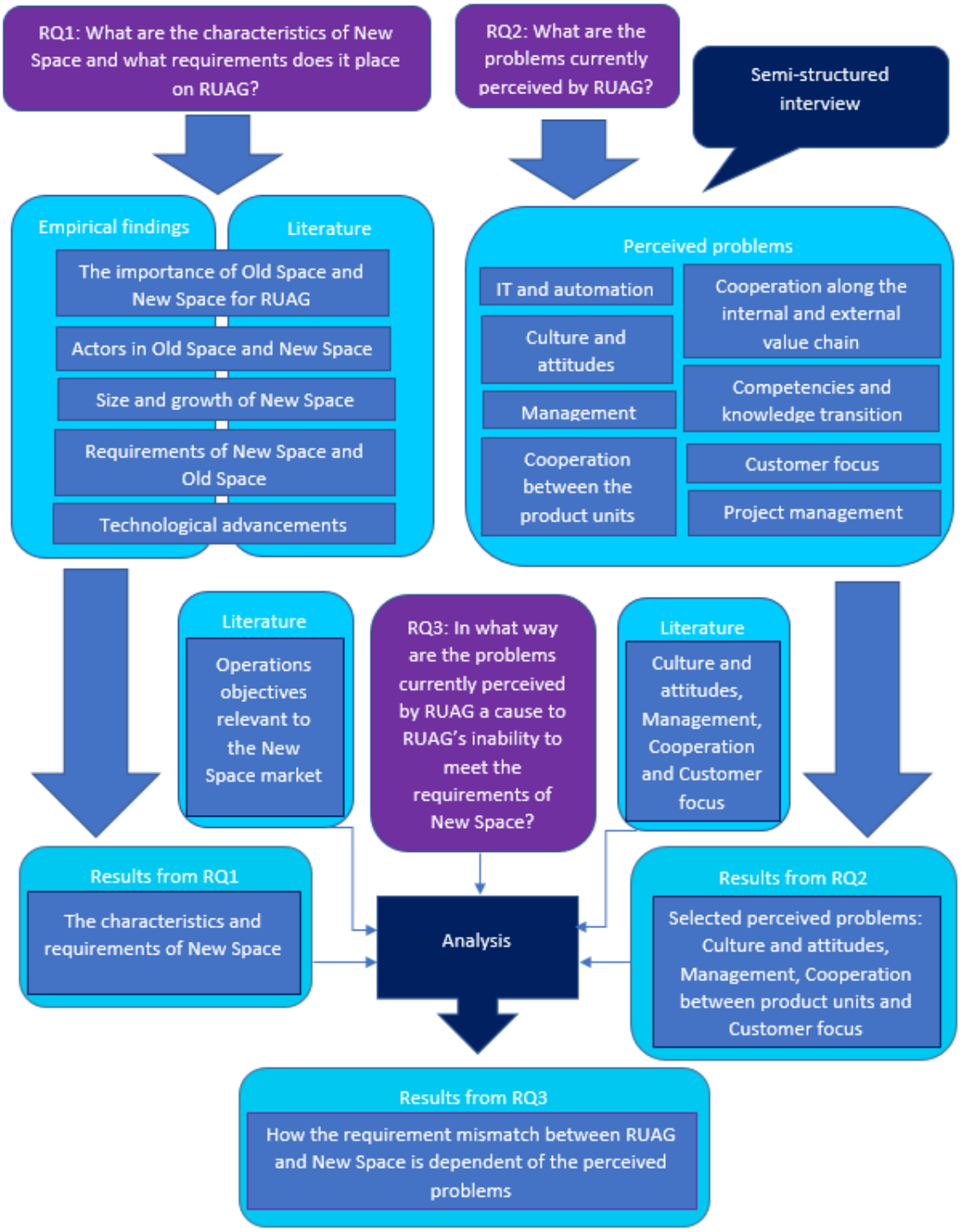

Figure 1. *Visual representation of the work process. The purple figures represent research questions and the blue boxes represent content, defined by the rounded figures in light blue. The two figures in navy blue are clarifications of how certain parts of the work were conducted.*

2.4 Data Collection

As stated in section 2.1, it was decided that the research was to be inductive with a qualitative methodology used. Hence, the data collection methods have been based on

this and to answer the research questions, a literature study has been made and interviews have been conducted.

2.4.1 Literature Study

The result of the literature study should be an assessment of the significance of the literature studied – to decide what to include in the study or not – and to provide a foundation for the research (Saunders et al., 2016). The articles and books used for the research have been critically addressed in different ways, depending on the subject of the research.

As described in figure 1, the literature study was conducted in different phases. In total, the research came to evolve around five areas: the history and evolvement of the space industry and a review of Old Space and New Space, the operation performance objectives New Space puts upon the suppliers in the industry and a review of these, the need for customer focus in a business, organisational culture and management aspects.

As mentioned, literature on the history of the space industry and the development of the New Space market, as well as the requirements it puts upon their suppliers, was addressed. These requirements were also further described and researched in detail. The literature on the space industry is a historical review rather than a subject of research. This made it difficult to question since the description of this type of history is not up for questioning. The literature describing the New Space industry and the requirements the customers put upon the suppliers in the industry was difficult to validate. Since it is a relatively new field of study and since the industry is still undergoing change, it can be difficult to predict what is going to happen in the near future due to potentially disruptive changes that might occur. The literature on New Space is however validated as trustful sources since they are produced by scientists and professors with many years of experience within space science. The other areas reviewed in the frame of reference were areas that have been researched for a long time. The review of these areas was therefore focused on combining different aspects in order to create a sound picture of them.

2.4.2 Interviews

According to Bryman and Bell (2003), interviews are probably the most widely used method in qualitative analysis. The type of interview can vary from using standardised questions and being very structured in its approach, to being highly unstructured and informal (Saunders et al., 2016). One can categorise the different interview approaches in structured, semi-structured and unstructured interviews, of which the two latter approaches are considered as qualitative research interviews.

When conducting the interviews at RUAG, a semi-structured interview approach was chosen since it allowed the interviewees to be guided through the themes and topics of investigation but also to describe the perceived reality in their own words. An interview

guide, which is found in Appendix, was developed based on a first screening of the literature related to the New Space trends and in relation to the chosen scope. This interview guide was handed to the interviewees before the interviews to give them time to prepare for the themes of the interview.

A semi-structured interview is flexible in its nature when it comes to which topics to touch upon and which questions to ask in relation to the interview objects, i.e. it allows the interview to be contextual (Saunders et al., 2016). A semi-structured interview does not always need to follow the same question order and can vary depending on the flow of the conversation. Both characteristics were beneficial when conducting the interviews at RUAG since the interviewees had different positions in the company and hence different perspectives on and knowledge about the situation within the company. The topics of the interviews was related to the product units at RUAG, how they worked together and how they worked with other departments, what the interviewees believed about the future for the company in regard to New Space and the problems currently perceived in the company for meeting the requirements of New Space. It was clear that the interviewees further up in the organisation had other perspectives than the interviewees working in production. The interviewees further up in the organisation were for instance more long-term oriented but did not have the same deep knowledge of the day-to-day operations. The mix of interview objects gave an overall interview sample that ranged from short-term and detailed to long-term and strategic perspectives.

Each interview shifted from being exploratory to explanatory. According to Saunders et al. (2016), an exploratory study is used when needed to reveal events and to gain insight into the topics of the research. The explorative interview was used to clarify both what New Space means to RUAG, but also to gain insight into the problematics with the imposed requirements the market of New Space put upon RUAG. When an understanding of the problems currently perceived by RUAG was gained, the interviews shifted to become of a more explanatory character. Saunders et al. (2016) describe an explanatory study as a study explaining causations and relationships between different variables or data, and in the interviews conducted at RUAG, the causal relationship between the problems currently perceived by RUAG and the requirements of the New Space market was examined.

Sampling of Interviews

Since both the time horizon of the project and the scope set limitations to the study, the need to sample becomes important to obtain an accurate set of data (Saunders et al., 2016). The whole population, i.e. all employees at RUAG, could theoretically have been interviewed, but it would not have been practically possible or have rendered significantly more information than only using a sample from the target population. The target population, and later the interview objects representing the sample, was decided upon together with RUAG and in relation to the scope to best fulfil the purpose of the study. This is called a purposive non-probability sample (Saunders et al., 2016) and is based on subjective judgements. The target population was decided to include the three

product units, the project management and the top management teams, and some other people possessing valuable knowledge about the space industry, since they could contribute with both the day-to-day operations closest to the production and the strategic visions for RUAG. Furthermore, an employee at the site in Linköping was interviewed due to the employee's knowledge about the market of New Space. However, some of the employees that were asked to participate in an interview declined the request, which could both be due to a high workload or a reluctance to the research itself. In total, 25 interviews were conducted, see table 1.

Table 1. *Interviews conducted at RUAG Space AB.*

Title	**Date of interview**
Chief Operating Officer	2017-09-08
Assembler and coordinator in production	2017-09-18
Test Engineer and coordinator in production	2017-09-18
Market Manager	2017-09-19
Assembler and coordinator in production	2017-09-19
HR Manager	2017-09-20
Quality Manager	2017-09-20
Security and Facility Manager	2017-09-21
First Line Manager	2017-09-22
Test Engineer and coordinator in production	2017-09-25
First Line Manager	2017-09-25
Assembler and coordinator in production	2017-09-26
IT Manager	2017-09-26
First Line Manager	2017-09-29

Communication Manager	2017-10-02
Test Engineer and coordinator in production	2017-10-02
Object Leader	2017-10-02
Vice President HR	2017-10-02
Assembler and coordinator in production	2017-10-03
HW Design Engineer	2017-10-09
Education and Training coordinator	2017-10-12
Product Assurance Manager	2017-10-12
First Line Manager	2017-10-12
First Line Manager	2017-10-12
Head of Marketing and Sales	2017-10-24

The sample size should be defined in relation to the research purpose, research questions, what needs to be researched, how many interviewees are needed for giving credibility to the study and what can be done with the resources available (Patton, 2002). In total, 25 interviewees were conducted, which is in the top of the minimum sample size recommended for semi-structured interviews according to Saunders et al. (2016). More interviews could have been conducted but it was decided that the data collection ought to be limited when additional data collection provided little, if any, new information useful for the study, i.e. when data saturation was reached.

2.5 The Quality of Research

The quality of the study involves several aspects, and in this subchapter, the quality of the study is assessed by reviewing how the access of data was gained, the approach to the research ethics during the study and how the validation of the research was conducted.

2.5.1 Gaining Access to Data

Gaining access to data is of highest importance since the ability to obtain data will depend on gaining access to valid and trustworthy sources needed to create a qualitative study. Therefore, this section will review three levels of access and how they were approached, as well as issues related to these levels.

Saunders et al. (2016) describe three levels of gaining access as external researches: the physical, continuing and cognitive. Due to the lack a relationship to the organisation as an external researcher, the physical access was the first step to be overcome. By showing a persistent interest in the organisation and an interest in the business of the organisation, the physical access was granted. This step also served as a base for building trust between the researchers and the gatekeepers, i.e. the people giving physical access to the organisation. The continuing level, which means gaining access to the organisation during a certain amount of time, was a natural step due to the length of the study and the interest the organisation had and showed to solve the issues studied. However, without accessing the cognitive level, i.e. accessing the knowledge and thoughts of the employees interviewed, the research would not have been able to be conducted in a satisfactory way since knowledge about the research issues would have been missing. Since the cognitive access was gained due to a common concern and interest for the future of the organisation from both RUAG and the researchers side, a suitable sample of interviewees could be reached and valid data obtained. The gatekeepers of the research played important roles when it came to adding credibility to the research by highlighting the importance of the research to the relevant people that needed to be interviewed to perform the study.

2.5.2 Research Ethics

When conducting research, ethical aspects needs to be considered, especially when humans are involved (Saunders et al., 2016). Research ethics are defined by Saunders et al. (2016) as the standards of behaviour that will function as a guide of conduct in relation to the rights of the research objects or in relation to those who are affected by it. In this qualitative study, the ethics have been a concern since they are dealing with sensitive structural issues and potential problems within RUAG's organisation. The main approach to the research has been respect for the interview objects, the organisation, its values and confidential information. This has been taking into consideration both when formulating the questions and during the interviews, but without affecting the integrity and objectivity of the research, which also is an important aspect of the research process. The interviewees have not been forced to participate in the interviews and have had the opportunity to cancel at any time. Furthermore, they have chosen if they want the interview to be recorded or not and if wished for, they have had the opportunity to read and comment on the transcribed interview. Although they have had the possibility to do so, the research integrity and objectivity still needed to be taken into consideration. The main content of the interview has not been affected by these corrections, which is why they were allowed to be made. The interviews are also

anonymous to protect the interviewees if any criticism against the organisation has been revealed. This is in line with the four critical issues described by Bryman and Bell (2015): harm to participants, lack of informed consent, invasion of privacy and deception.

2.5.3 Research Validation

Validating the research is important since it verifies the trustworthiness of the research data. Easterby-Smith et al. (2015) believes that transparency when performing the data collection and analysis is an important aspect. This has been done by a detailed transcription during the data collection and by having an open communication about the process with the organisation researched.

Saunders et al. (2016) describe two methods to validate the research, participant validation and triangulation. Participant validation, which involved letting the interview objects validate the data, was also a part of the ethical considerations during the research process, which is why it will not be further described. To strengthen the study, triangulating by using more than one source of data was used. By using triangulation, depth and width was given to study as the vast majority of the interview objects had similar descriptions of the reality. By comparing their interviews and interpreting their answers, structures and organisational issues could be revealed. Qualitative research is, as Bryman and Bell (2003) describe, a subjective interpretation of the gathered data but by adding multiple perspectives to the study by using several sources of data, this aspect is marginalised.

3 Frame of Reference

In the frame of reference all literature used in the report can be found. The contents support the research questions of this report and should therefore be seen as complementary to them, rather than as a stand-alone chapter with a self-contained logic. In this frame of reference one finds information on the history and market characteristics of the space industry, operation performance objectives, customer focus, organisational culture and management.

3.1 The History and Market of Space Industry

To understand the space industry and why different actors, such as suppliers, have developed in a certain direction it is important to understand the space industry as a whole. Therefore, the history and the markets of Old and New Space are presented in the following sections. This chapter will also bring light to what implications the current development in the space industry will have on the suppliers.

3.1.1 The History of Space Industry

Despite its age, the space industry remained static for many years, without changing much or straying far from the foundation laid during the Cold War. One of the reasons for this is the nature of space technology being "dual use", meaning that technology used for civil purposes could also be used for defence purposes. The same military potential that made space endeavours a priority for the superpowers of the Cold War also led to them becoming protective of said knowledge and technology. The result was an environment in which large and powerful states were virtually alone in the development of space programs.

With the end of the Cold War came relaxations on the restrictions on information sharing. Dual use became an advantage in the sense that space technology became of interest to a wider variety of actors and since progress in one area translated into progress in the other. Public-private partnerships (PPPs) permitted commercial actors to become involved through collaboration with government agencies and served as a stepping stone for privately financed actors eventually being able to act on their own.

3.1.2 Defining the Markets of Old and New Space

Old Space and New Space are not clearly defined, possibly because New Space is still being shaped and since the definition of Old Space - as a point of reference - changes with it. Before continuing, it is therefore important that Old Space and New Space become defined.

The nomenclature of Old Space versus New Space implies a chronological distinction between the two. Although there is a historical link that connects Old Space to New Space (as described in the section above), other proponents suggest that it would be

more correct seeing Old Space and New Space as two different markets. Greg Autry, a professor of clinical entrepreneurship at the University of Southern California and a student of New Space communities, opined in the aforementioned round table discussion that Old Space and New Space should be considered as two separate markets. He motivated his reasoning by referencing Michael Porter and saying that industries are bound by the similarity of a group of companies and by the consequently substitutable goods or services they provide. When looking at the players involved in Old Space and New Space it becomes apparent that they don't compete with each other and should thus be seen as two separate markets (Hubbard et al., 2013).

Although the Old Space market exists alongside New Space, there is a clear trend pointing toward New Space taking over more and more, all the while Old Space is adopting New Space attributes, thus blurring the line between the two. New Space's modus operandi has sent ripples that have affected actors in the Old Space market as well. Government agencies and other actors the public sphere have for instance as a result started to re-evaluate their standpoint concerning the commercialisation of their own projects and their utilisation of commercial solutions (Lal, 2016). Despite the market distinction between the two, Old Space consumers are gradually behaving more and more like the ones of New Space. For suppliers, the distinction between Old Space and New Space therefore becomes less important as their requirements consolidate.

3.1.3 Performance Objectives Imposed on the Suppliers by the New Space Market

New Space was and still is being shaped by the introduction of new private actors characterised by entrepreneurship, risk-taking and new models of financing, management and R&D (Paikowsky, 2017). By having a better understanding of these new customer requirements, suppliers will have a better idea of which directions to choose when adapting their production organisation for the space industry of tomorrow.

Cost Reductions

In contrast to space programs launched by public actors, whose utility was difficult to value in monetary terms (often being motivated by bolstering national security, gaining a military edge, serving society through economic growth and development and increasing a nation's international prestige), space activity for private actors is more often than not seen as an investment to pay dividends through profit. For the entrepreneurs of New Space, every cost is weighed against a prospective benefit (Paikowsky, 2017). For suppliers to decrease their prices, this might mean utilising more ready-made components and modules, and somewhat simpler material (Rymdstyrelsen, 2016).

Increased Volume

A second requirement brought by New Space has to do with volumes. One part of this has to do with the steep increase of venture capital in the private sector, as mentioned in

chapter 1.1. The other part has to do with the type of projects many of the New Space entrepreneurs have envisioned. As an illustrative example one could glance at companies such as Google and Facebook: aiming to expand their consumer base by untapped millions that still live their lives offline, they intend to put thousands of communication satellites in orbit to create clusters serving as networks (Rymdstyrelsen, 2016). Volumes the likes of which the space industry never has seen are expected to be demanded in the years to come.

Lower Quality Requirements

Old Space and New Space differ not only in their spending behavior, but also in their attitude toward quality. In Old Space, projects were characterised by large costs, long lead times and long periods of time in space slated for them. Combining these factors with the impossibility of repairing objects in space, projects were risk averse to the extreme. With time, technological driving forces enabled the shrinkage of satellites and costs decreased, as did lead times and time spent on R&D. Due to the projects of New Space being different in their aim from the ones of Old Space, satellites spent shorter periods of time in space as well. All of this led to higher risk acceptance in New Space. Instead of aiming for being flawless, New Space R&D often aimed for "good enough" and became much more innovative in the process (Paikowsky, 2017).

It falls unto the lot of the suppliers in the space industry to meet the requirements of the market of New Space. Given how recent these developments have been, many of the suppliers in the space industry have yet not had the time to adapt. The new requirements on volumes, quality and cost will translate into changes in the level and type of technologies requested from the suppliers. These, in turn, will have a large influence on the structure of the organisations of said companies (Koskinen, 2013).

3.2 Operations Performance Objectives

With the emerging market of New Space, new performance objectives are being imposed on the suppliers in the industry as described in the previous section. Hence, the following chapter will review the characteristics of the performance objectives cost, volume flexibility and quality.

3.2.1 Cost

For companies having price as one of their market winners, cutting costs is a major objective in order to stay competitive since low costs can keep the prices down. It is however important for businesses that do not compete on price to keep their costs down as well, since it allows for investments. Costs are incurred from staff, facilities, technology, equipment and materials (Slack, 2013).

Productivity highly correlates with the output of an operation, and if the productivity is to be improved, input costs and waste during the operations need to be reduced while maintaining the output (Slack, 2013). Low costs in productions are achieved by and are

dependent on good performances in flexibility and speed. They can also be affected by the input costs of staff, facilities, manufacturing technology and cheaper components. Mass production is the most typical example on low cost manufacturing. It is characterised by high volumes, systematic production, standard procedures, specialised staff and high repeatability. A production with high unit costs is on the contrary characterised by low repetition and less systemisation.

3.2.2 Volume

When planning capacity, there are three main options for dealing with fluctuations in demand: levelling capacity, chasing demand and managing demand. Having a level capacity plan means that one does not change the capacity to accommodate fluctuations in demand. Chasing the demand, on the other hand, entails doing the opposite, i.e. adapting the capacity through a variety of different tools in an attempt to match the capacity with the demand. Managing the demand focuses, as the name implies, on trying to steer the demand so that it matches the current capacity, e.g. through price mechanisms (Slack, 2013).

A level capacity plan is based on keeping the capacity unchanged and storing the overproduce during periods of low demand so that it can be sold during periods in which the demand surpasses the capacity. Because of this, level capacity planning is best used in conjunction with non-perishable products, standardised products and products with an assured future demand (Slack, 2013). A different rationale for adopting a level capacity plan is volume flexibility. By having a capacity that is higher than the demand (as is often the case when using a level capacity plan), volumes become flexible. If the capacity and the demand match, production won't be able to accommodate for last-minute orders or unexpected surges in demand (Slack, 2013).

A chase demand capacity plan can be arranged in different ways. One way of doing this is through the use of overtime (Slack, 2013). Another is by increasing and decreasing the size of the workforce to match demand. Despite certain advantages one must also account for costs related to recruitment, training and lost productivity during said training. Other immaterial costs to this practice include a dampened spirit among employees and the potential tainting of a company's image in the labour market. Another, similar solution consists of shuffling the workforce. By making the boundaries between areas of responsibility elastic and by designing the jobs to be flexible, a company can increase and decrease the size of the workforce at different workstations. By employing this method, a company will be able to move employees from less busy sectors to ones in need of reinforcements as demand shifts (Slack, 2013). Using part-time employees can be seen as a way of employing and laying off employees as the demand changes. Although the company might avoid the disadvantages earlier mentioned concerning morale and image, the costs related to recruitment, training and lost productivity remain.

Subcontracting is accomplished by buying capacity from another company. Advantages to this is that the company doesn't have to invest in extra capacity during the subcontracting period. The disadvantages are that subcontracting is often very expensive, that the subcontractor might not be as invested in the success of the order as the company buying the subcontracting (which in turn could negatively affect quality, delivery time and more) and that there is a risk that the subcontractor ends up entering the market and thus becoming a competitor (Slack, 2013).

3.2.3 Quality

Quality is a key concern in most organisations since one of the fundamental ways for a customer to evaluate a product is to evaluate its quality. Quality can however mean different things for different stakeholders and is a concept of many interpretations, and the meaning of quality differs between Old and New Space customers. The actors on the New Space market are manufacturing higher volumes of communication satellites at a higher pace than the actors of the Old Space market. These satellites to be launched will be placed as clusters around the Earth and one satellite could cover for another if one were to fail. Because of this, the New Space actors need to be more innovative and have a shorter time to market and therefore the definition of quality is changing with the space industry.

Garvin (1984) argues that there exist five approaches to defining quality. According to the transcendent approach, there exists an elemental, absolute and uncompromising excellence of a product and the ability to judge and recognise it can only be gained through experience. The product-based definition emphasises quality as a measurable variable and highlights the differences in quality as difference of attributes possessed by a product, e.g. lifetime, reliability, performance, number of components or features. The manufacturing-based approach concerns the engineering and manufacturing practices and quality is in this sense to meet the pre-established specifications of the product and to eliminate mistakes in the process. According to this approach, production according to the specifications not only affects the customer positively but also has an internal impact at the supplier since it leads to more stable and efficient processes (Slack, 2013). The lack of mistakes in the processes will both save time and cost since no resources will be used to correct them. The value-based approach takes it one step further by claiming that quality is perceived to be excellence at an affordable price.

The user-based approach has its starting point at the customer, meaning that each customer has their own preference on what characteristics the concept quality needs to possess. Hence, user-based quality can be seen as "fitness for use" (Juran, 1951) or the degree of fit between expectations and customer perception of a product (Slack, 2013). If the expected quality for the customer is less than the perceived, the quality will be considered as good whilst vice versa would result in the quality to be considered as poor.

There can be several reasons for mismatches between the quality supplied and the perceived quality at the customer (Slack, 2013). First, there can exist a mismatch between the suppliers' quality specification of the product and the customer specification. Secondly, the product concept might differ from the internal specification of quality. Thirdly, perceived quality could be poor since the internal specification of quality does not match with the end-result of the manufactured product. Last but not least, if the perceived quality differs from the expected it could be a result of insufficient external communication regarding the product and the actual delivered product.

3.3 Summary of the New Space Market and its Requirements

In the following section, a summary on the New Space market is provided that describes the evolvement of the space industry and the requirements of New Space.

The space industry stands on a threshold of a paradigm shift with new actors entering the market. These actors are entrepreneurs, many of which aim to seize the opportunity to produce high volumes and launch clusters of telecommunication satellites to meet the demand for internet accessibility across the globe. Traditionally, the space industry has been dominated by governmental organisations such as ESA (The European Space Agency) in Europe and conventional private customers, ordering products in relatively small volumes, having clear specifications of the products required and high demands on components used. This market has come to be known as Old Space, which differs from the new market now dubbed New Space. New Space was and is being shaped by new entrepreneurs that are more risk-taking and are applying other models of finance, management and R&D than the traditional actors. The market of New Space has been growing and in the near future, New Space companies will launch thousands of satellites to accompany the 1 400 functioning satellites orbiting the Earth today.

Due to the new models of business the New Space customers are applying, they are valuing other performance objectives than the traditional customers of Old Space. High qualitative products have traditionally been one of the main objectives for the customers. However, this has changed with the customers of New Space and even if quality still is important, fitness for use and quality to the right price is even more so. The customers of the New Space market value suppliers being able to supply high volumes to a low price, and are willing to accept products being "good enough" and the higher risk of product failure that often comes with lower costs.

3.4 Customer Focus

To examine how well a company is living up to the standards and requirements set by their potential customers it is important to also consider if the company is applying a customer focus in their operations. Therefore, the following section will examine what customer orientation is and how it can be applied in the operations.

The greatest assets of a company are, as emphasised by Michael LeBoeuf (2000), its customers because without customers there is no company. Kutner and Cripps (1997) also indicated a similar standpoint. Customer needs and the art of keeping them satisfied should therefore be of highest importance to a company and García-Murillo and Annabi (2002) claim that customer knowledge is the most crucial source of information for a company. Hence, companies must create value for customers through their assets and processes – they must be customer-oriented (Doligalski, 2015). The customer offering all starts with understanding the customer and if a company does so, they can tailor their offering to maximize customer value. A certain flexibility when it comes to adjusting the value proposition to match the customers' expectations and needs are crucial when companies act customer-oriented. This relies on building relationships with the customer, listening to their needs, incorporating customer-delivered information in the processes, involving employees in the creation of increasing value to customers and delivering the desired value to the customer (Doligalski, 2015).

Flint (2008) argues that value is disconnected from the product, service or system and only based upon customer perception of the delivered solution. To deliver what is valuable for a customer, a company must put the customer first in an organisation is by applying Demand Chain Management. Demand Chain Management incorporates the cost-oriented Supply Chain Management with demand driven marketing. Demand driven supply chain management explores the customer's situation, its needs, priorities and the problem the company aims to solve. All this information is implementing backwards in the value chain (Jüttner, Christopher and Baker, 2007). Here it is important with the sharing of knowledge and information throughout the organisation, that the functions understand the same information and that they have the ability to act on the same information. An organisation should also avoid conflicting performance measurements of the different functions, since that could lead to sub-optimisation within the organisation (Jüttner et al., 2007). Lee et al. (2005) emphasise that an organisation should improve its processes and enhance customer value by aligning the organisation around a common plan, improve coordination within the supply chain and exploit the organisation's processes by understanding customer requirements.

According to LeBoeuf (2000), customers do not care about how much their suppliers know before they know how much the suppliers care about their own products, services and customers. He further highlights that customers will close a deal based on two things: good feelings and solutions to problems. A supplier could be the leading actor when it comes to qualitative products, but it is how customers feel about a product that will be fundamental for how successful a business will be. Another important aspect of LeBoeuf's reasoning is that customers buy purely for their own reasons, and not for the suppliers'. What matters the most is not what the supplier knows, but how the supplier is known to the customer.

To be a solver to the customer's problems, a company must define the customer's situation and wants. Having the answers to this helps the supplier decide if and how the

problem can be solved, i.e. if they can meet the customer's unmet want. Working towards the goal of doing so, there are according to LeBoeuf (2000) several things a company could do. Being customer-oriented starts with defining the markets instead on focusing on the company's talents and strengths, as well as asking the customer about their unmet want. It is also important to spot market trends to be proactive on the market, and to move quickly once the company has decided to move, but to also be aware of and prepared for the possibility of many ideas not panning out.

According to Brown and Hagel (2005), becoming relevant in a value chain requires a shift in market strategy, from the traditional "push" to the innovative "pull", i.e. producing according to customer needs. They further argue that a new management approach needs to be established – one that will identify and manage the value chain position. Hence, implementing a customer-oriented approach starts with the management, as it has to be led by their actions (LeBoeuf, 2000). That means that the leaders of an organisation need to meet and talk to customer representatives, find out their wants and needs, expectations and constraints, as well as understand how the employees, with their processes and operations, could be supported so that they, in turn, can help the customers.

3.5 Organisational Culture

Every organisation has a certain culture that affects its performance. In this section, organisational culture is defined and some classifications of organisation culture are reviewed, followed by an explanation of tribalism, career identity and cooperation within an organisation.

3.5.1 Defining Organisational Culture

Organisational culture has been defined by several researchers throughout the years. Kroeber and Kluckhohn (1952) claimed that organisational culture consists of patterned ways of thinking, feeling and reacting, and that the essential core of culture consists of traditional ideas and the attached values. Jaques (1952) has a similar definition, i.e. that culture is customary and based on the traditional way of thinking and doing things in a business. This is shared by all its members and needs to be learned or partially be accepted by new members. More researchers agree on similar definitions. Louis (1980) claims that culture is a set of understandings or meanings shared by a group of people and passed on to a new group of people, and Drennan (1992) shares a similar view when emphasising that 'Culture is how things are done around here', the habits, attitudes and the accepted and expected behaviours typical for the organisation.

When French and Bell (1990) describe an organisation, they describe the concepts of the formal and informal organisation and use the metaphor of an organisational iceberg. The formal organisation is mainly what is visible as well as measurable, and consists of their goals, strategy, structure, systems, procedures, financial resources, management, products and services. The formal organisation is driving the company, but the informal

organisation is also recognised as a very important influencer of the performance of an organisation. The informal organisation consists of values, attitudes, beliefs, organisational culture, management style, behaviours, politics, conflicts, power and informal groupings.

Schein (2004) is further dividing the aspects of organisational culture in three levels: the level of artefacts, the espoused beliefs and values and the basic underlying assumptions. The level of artefacts is the most shallow one, and consists of the visible phenomenon of a group, i.e. its language, the physical environment, manners, its technology and products, the stories of an organisation, its published values and its rituals and ceremonies. The espoused beliefs and values are reflections of an organisation's members and consist of the published rules of moral and ethics to guide new and old members. These are also expressed as an organisation's philosophy or ideology. The deepest level of organisational culture is the basic underlying assumptions. These are difficult to pinpoint, confront or debate, which makes them very difficult to change. The basic underlying assumptions are assumptions taken for granted, and assumptions which do not differ throughout an organisation. To change these, an organisation must resurrect, re-examine and change the basics of the cognitive structures, which destabilises the human mind and releases anxiety.

3.5.2 Classification of Organisational Culture

Robbins (2005) presents seven scalable characteristics of organisational culture. The characteristics include to which degree the organisation is innovative and risk taking, is paying attention to details, is working around teams, is focusing on maintaining the status quo rather than focusing on growth and to which degree people are aggressive and competitive. Furthermore, these characteristics involve to what degree the management is focusing on outcome instead of processes and how people-oriented management is when making decisions.

Kanter (1983) means that there exist two extremes in organisational culture, the segmentalist and the integrative culture. The two differ in the attitudes of the people working in them but also in their structural characteristics. In a segmentalist culture, an organisation consists of segmented structures with the departments being walled off from each other and with resources divided among them. People see problems as narrowly as possible and assume that problems can be cut into pieces and be solved by assigning the problems to specialists who work in isolation. A segmentalist organisation is not willing to take any risks and avoid experimentation, as well as they are avoiding conflicts and confrontation, have weak coordinating mechanisms and stress precedent and procedures. An integrative culture is on the other hand outward looking and are willing to move beyond already retrieved knowledge and look for novel solutions to problems. An integrative organisation creates mechanisms for exchange of information and new ideas, combines ideas from unconnected sources and sees problems as wholes,

related to larger wholes. They are willing to challenge established standards and tend to measure themselves by looking at visions of the future rather than standards of the past.

3.5.3 Cooperation Within an Organisation

When faced with an uncertain future, fearfulness can cause people to bond in a tribe-like manner against a perceived common enemy. This enemy can take the shape of a boss, new competing employees, more modern technologies, new cultures and ideas and more. This can often lead to an "us vs. them" mentality to take root in the organisation (McGee-Cooper, 2005).

One reason why it is important to prevent tribalism from spreading in a company is that it slows down the ability for change and decreases its chances of being successful. This is in part due to the high degree of trust needed for working together as a team when shifting resources to maximize synergies (McGee-Cooper, 2005). Sveningsson and Alvesson (2003) echo this sentiment, saying that identity is, among other things, central to relations within and between groups and to the ability to collaborate within an organization.

In organisations, identities are in part shaped by one's role in the company. With roles come role identities that consist of different values, goals, beliefs and more. Role identities are, as to not become muddled with one another, separated by role boundaries. These boundaries are often made concrete through physical boundary markers, e.g. buildings (Ashforth, 2014).

3.6 Management

The management of a company is important for leading the way by communicating where the company should be headed and how it is going to get there. Management is also important in its role in being able to influence attitudes and behaviours in a company.

3.6.1 Management of Behaviours

Indirect consequences are often overlooked or outright ignored by decision-makers. Part of the reason why is that decision-makers usually only receive credit or blame for the direct or immediate effects of their decisions. One organisational remedy is to make the decision structure of the organisation boundaryless by identifying and formalising or making the interdependence of decisions and their subsequent effects more transparent. By doing this one can raise awareness surrounding the potential indirect effects of decisions, which, in turn, leads to more effective decisions being taken at the organisation (Frankel, 2009).

Attitudes in companies are shaped by the incentives put in place by the organisation. Behaviours relating to risk-taking, innovation, collaboration, taking initiative beyond

the work description and more can, and should, therefore be managed by the organisation. This can be done by updating incentives and rewarding actions that are desirable for the company (Frankel, 2009).

3.6.2 Leadership

Managers and leaders are most important for the sparking of or continuation of change in organisations. Leadership involves the creating and developing of an organisational culture that is suited the organisational and its goals. As such, organisational cultures greatly influence the economic performance of organisations. To create and develop an organisational culture, leaders must instil a vision in its employees, motivate them and build the momentum that will move the company forward. A vision consists not only of a destination, but also of the path the leads there, i.e. what the company must do to attain its goal (Ionescu, 2014).

3.6.3 Strategy

According to Michael Porter (1980), strategies can be categorised in three generic groups: cost leadership, differentiation and a focus or niche strategy. Cost leadership amounts to beating competitors by having the lowest prices. Differentiation is accomplished by offering the market a unique product offering. This can be done in a variety of ways: through brand image, new technology, standout design and number of features. The third generic strategy is known as a focus or niche strategy, which consists of focusing on a specific type of product, geographic market or customer segment and achieving cost leadership or differentiation in that niche. If a company doesn't commit to one of the three generic strategies they get stuck in the middle, which translates into low profits (Eldring, 2009). With this said, there is no consensus on the subject, as other research has found that hybrid strategies are superior to pure strategies and lead to firms performing better (Pertusa-Ortega et al., 2008).

4 Empirical Findings and Analysis

In the following chapter, all the empirical findings and the analysis derived from them can be found. The empirical findings and analysis sections have been layered in accordance with the research questions of this report. However, some of the empirical findings that deal with former research questions are used in latter ones as well. The chapter starts with a review of New Space and its implications for RUAG which will answer the first research question, followed by the problems currently perceived by RUAG. Last but not least, a causal analysis to RUAG's inability to meet the requirements of New Space is made.

4.1 New Space and its Implications for RUAG

The purpose of this section is to answer the first research question: what are the characteristics of New Space and what requirements does it place on RUAG? The section has been divided into two parts. The first part is empirical findings based on the interviews conducted at RUAG and will describe what New Space means to RUAG according to them. The second part combines the empirical findings with the literature on the characteristics of New Space to answer the first research question as a whole.

4.1.1 The New Space Market According to RUAG

The empirical findings relating to what New Space is for RUAG are limited to being based on the interviews with the top management of the company since they have the greatest insight into the market and of the position RUAG has in it. In the section below, their thoughts are laid out on what New Space is today, in what direction the market is headed and on what requirements this will place on RUAG moving forward.

The Importance of New Space

The market share belonging to New Space actors is increasing both in Europe and the United States. Despite this, the traditional private and institutional markets will continue to be very important for RUAG. To retain business in the Old Space market it will be important to become successful in New Space. The rationale is that the requirements of New Space will influence those of Old Space. In other words, it is only a matter of time before e.g. ESA-projects start requiring lower costs as well. Institutional business in the space industry is losing ground to commercial business, some of which being won by New Space actors.

How New Space Actors Differ from Old Space Actors

Several differences to New Space in comparison to Old Space have been observed. For one, New Space actors are much less preoccupied with unproven reliability of technologies, placing significantly less weight to a technology's track record as a decisive factor during procurement. This attitude has also led to many of the new actors coming with new solutions to challenges such as launching satellites. For the industry,

the institutional market is losing ground to the commercial market. This shift in market importance is driven by technological developments and by a different approach to how projects are financed.

New actors in the space industry are also, in contrast to the traditional actors, much more accepting of financial risks. It should be noted that this, however, does not mean that their requirement on quality are lower by default than those of Old Space actors. The actors of New Space differ from the traditional actors of the space industry in several other ways. They are often characterised by an entrepreneurial spirit, positiveness to new ideas, a system approach and speed, exemplified by taking a shorter time from decisions to R&D and production.

Pre New Space, customers used to specify products technically, listing specifications and technologies desired in detail. Contrast this to the procurement behaviour of some of the newer, private customers: New Space actors often tell their suppliers what they need the product they wish to buy to accomplish and then place their trust on said supplier to find a solution. By stripping the specifications of all that is not essential for the product and its intended purpose, these customers can usually secure a lower price than if they had specified their needs technically. Other customers have gone one step further, asking suppliers what they can get for a certain amount of money, i.e. starting with a predetermined budget and taking it from there. Another behavioural difference noticed has to do with speed. When dealing with Old Space customers, delivery review boards can take up to two days while New Space customers only require 45 minutes.

Summarising the interviewees' observations about how New Space actors differ from Old Space actors, the following points can be made. New Space actors are generally:

- Less concerned with the proven reliability of technologies (not to be confused with the actual reliability or quality of technologies)
- More open to new ideas and more willing to use new solutions
- More likely to procure functionally than along technical specifications
- Much more sensitive to cost
- Faster, taking shorter time to shift effectuating ideas into R&D and production

Technological Advancements Observed

Seen from a chronological perspective and as a contemporary state of affairs, New Space is very much connected to recent technological advancements. The market shift toward New Space was largely initiated and driven by technological developments and by the possibility of launching satellites in clusters.

One of the disruptive trends shaping the development of satellites can be described as disaggregation. Satellites have traditionally been large, few in quantity and multifunctional. Disaggregation has led to satellites becoming smaller, more numerous and individually able to do less - although this last point can be remedied by having the

satellites work together. For satellite producers, increased quantities translate into an increased repetitiveness in production and, consequently, a lower piece price. Technological advancements have changed the requirement on satellite durability as well. Perhaps counterintuitively, these advancements have led to satellites not having to – and not being expected to – last as long as before. The reason for this is that the rapid technological developments now render satellites dated at a much faster pace. The required satellite life spans have therefore decreased from 10-15 years to approximately seven. Since satellites have become much cheaper, it has now become feasible to send up several satellites for a mission instead of one. Cheap satellites are seen as disposable and one – or several – of them malfunctioning or breaking mid-mission is no longer that great of a deal as long as other satellites that can finish the job are left. This is one of the reasons why quality becoming usurped by cost as the most important purchasing factor for many of the New Space actors.

Another reason why satellites employed by New Space actors for commercial use are today constructed to last a period of approximately seven years instead of 10-15, is that the rapid pace of technological developments now render the satellites obsolete at a much faster pace. Keeping satellites in operation longer is no longer beneficial. These technological developments have led to satellites needing to become smaller, more numerous, cheaper and constructed at a faster pace, i.e. with shorter lead times. Developments in launching technologies, on the other hand, have not had the same drastic impact. Launching costs are still very high and because of this, the quality requirements on launches remain largely the same as before.

In brief, one could say that the technological advancements accompanying the developments in New Space are the following:

- Satellites are now expected to last approximately seven years instead of 10-15.
- Shorter lead times and development times have become necessary as a result of satellites now having shorter economic life-cycles
- Satellites have become smaller and more numerous as a result of disaggregation
- When being employed as a cluster, having one of several satellites break isn't that serious. Quality requirements on satellites can therefore be lowered.
- Satellites have become cheaper
- Launches are still very expensive and therefore still subject to high quality requirements

What New Space Means for RUAG

The requirements of New Space translate into a necessity to become more agile and flexible in order to be able to quickly respond to market changes, e.g. with regards to volume. To be able to respond to these market changes RUAG will also need to develop the technologies and competencies in the organisation. Strong partnerships across the supply chain, from suppliers to customers, will be needed as well. In addition to all of this, RUAG will need to lower its prices to be competitive, meaning being prepared for

smaller margins. Finally, RUAG will also need to become better at handling shorter and faster projects with bigger volumes.

RUAG (in this case referring to RUAG Space at large, and not to RUAG Space in Gothenburg) will also have to establish itself in new markets, e.g. in Finland and in the US. The rationale behind this expansion is the need to be closer to customers.

The list below details the interviewees' conclusions about how New Space is affecting and will continue to affect RUAG and comparable companies:

- Become more agile and flexible
- Develop technologies and competencies in the organisation
- Strengthen partnerships across the supply chain, in some cases entering and establishing themselves in other countries as a result
- Lower its prices and subsequently costs, alternatively be prepared for smaller margins
- Become better at handling shorter and faster projects with bigger volumes

4.1.2 The Requirements Placed on RUAG by New Space

The developments of the space industry are happening on a global scale and are described as an aggregation of trends. Because of this, it is necessary to examine to what degree the changes brought by New Space correspond to the observations and experiences of RUAG employees. The analysis will therefore start by examining to what degree the literature and empirical findings gathered match with regards to what New Space is, in what direction it is headed, how New Space and Old Space actors differ from one another and what the requirements of New Space are. After that, the analysis will shift to deal with some of the implications of the emergence of New Space actors for RUAG. These findings deal with the consequences for RUAG derived from the requirements of New Space in the context of production and organisation.

How the Literature on New Space Matches and Differs from Empirical Findings

The literature and empirical findings agree that the New Space actors are different from the Old Space, or traditional, ones. One difference between Old and New Space is that high quality no longer is a priority as much as the right quality at the right price is. Also related to quality, a higher risk of product failure in satellites is in many cases acceptable by New Space actors. This trend is supported by the technological acceleration that renders satellites obsolete at a faster pace and by the New Space modus operandi of sending satellite clusters, thus creating a quantitative buffer for satellites malfunctioning. New Space actors require cheaper products, in part due to the disaggregation of satellites leading to satellites becoming smaller and cheaper, but also in part due to low costs being a top priority. A demand for higher volumes is something else which the literature and empirical findings support. This too goes hand in hand with satellite clusters and disaggregation.

The literature and interviewees found common ground in their observation that the Old Space actors will move toward New Space by emulating their behaviour and as a result of cheaper products becoming the new standard.

From Old Space to New Space to Outside the Space Industry

RUAG employees have said that RUAG is tailored to the needs of Old Space customers such as ESA but unequipped and unprepared to deal with the needs of New Space. One could therefore state that they implicitly agree with Greg Audry in his statement about Old Space and New Space being two separate markets today. The needs of Old Space and New Space customers differ enough to warrant their market segmentation. Unless RUAG finds a way of catering to their traditional and to New Space clients at once, it must choose to prioritise the needs of one over the other. There are several arguments that speak for RUAG choosing to prioritise New Space actors over traditional buyers such as ESA. One of these has to do with where the market is heading: for every day that passes, the private space market is growing in relation to the public sector. This development is also supported by internal testimonies about RUAG now having a harder time due to the decrease of state-backed geo return activities. Secondly, the public sector is expected to adopt private buying behaviours in the future, meaning that the convergence of Old Space and New Space is moving toward the New Space side of the spectrum. RUAG employees are in agreement, saying that Old Space actors will probably adapt and change their behaviours to emulate New Space in the future. Although Old Space and New Space are seen as separate markets today they won't necessarily be seen as such in the future.

The lines between Old Space and New Space do not seem to be the only ones that will be blurred. Several interviewees expressed the need for RUAG to consider taking contact with and using suppliers outside of the space industry. By defining industries as Greg Audry, who said that industries are defined by the similarity in substitutability between actors' goods or services, such a change in sourcing strategy would require that RUAG not only monitor and adapt to New Space developments, but to developments traditionally outside of the space industry as well.

Lower Costs

The literature on New Space lifts costs as one of the most, if not the most, important factor for New Space actors and RUAG employees are unanimous in their belief that RUAG needs to lower its costs if it wishes to be competitive in the New Space market. Modular and ready-made components along with simpler materials are mentioned as solutions New Space suppliers might have to adopt as a means to cutting costs. RUAG is on board with the idea, demonstrated by their current exploration of the possibility of using COTS (commercial off the shelf) components and by toying with the idea of sourcing from cheaper suppliers outside the space industry.

Other ways in which costs can be lowered are numerous, as laid out in the literature. Some of these methods, such as through increased (if not mass) production, standard procedures and high repeatability, can be seen as "universal truths" of production that apply in most environments. Despite this, RUAG employees talk about these as if they were especially relevant to the environment of New Space. The reason for this has to do with the significantly increased volumes of New Space. The need for lower costs will not only force RUAG to re-examine its procurement practices – as these won't be sufficient to lower the costs to a competitive level by themselves – but even to change the design of their products and their processes to accommodate for a more cost effective production.

Another way of becoming cheaper is by avoiding costly over-specifications. To do this, RUAG will have to become oriented toward problem solving and help its customers order the products they truly need. This might require that the present and future clients of RUAG adopt a functionality-based approach when procuring instead of a technological-based one. There are signs of buyers, particularly new actors, already doing this and in some cases driving the change themselves, but that doesn't mean that RUAG can't attempt to influence or steer its customers in a certain behavioural direction. Just as importantly, RUAG must be willing to deviate, if not abandon, the strict requirements on certifications of e.g. ESA.

Quality

Quality is a key concern in most organisations and one of the fundamental ways for a customer to evaluate a product is to evaluate its quality. Quality means different things for different stakeholders and when it comes to Old Space and New Space actors, the contrast between their ideas on quality is stark. Old Space actors generally demand a higher reliability and quality than New Space actors. The reason for this is that the actors on the New Space markets are manufacturing higher volumes of communication satellites at a higher pace than the actors of the Old Space market. These satellites to be launched will be placed as clusters around the Earth and one satellite could cover for another if one were to fail.

Regardless of the preferences of Old Space and New Space actors with regards to risk, there is another reason why RUAG will have to loosen its views on quality. Technological advancements have sped up, exemplified by customers no longer wanting or needing satellites that can last up to fifteen years since these will become dated before the satellite's technical life cycle is over. This development is something else that speaks for reliability becoming less important moving forward. These changes to quality will not only require new products. As a result of this, RUAG will also have be prepared to change at a faster pace than earlier, possibly requiring a more agile product development cycle.

Increasing and Fluctuating Volumes

When discussing low and high volumes in production, one must be aware of what constitutes a high respectively low volume for a certain industry, as they might all have different points of reference. For the space industry, the volumes expected in the coming years are unprecedentedly high, this due to market growth and the disaggregation trend in satellites. However, these volumes would still be considered low for other industries, e.g. the automobile industry. This means that although increased production will be necessary, mass production might be out of the question. Although RUAG claims to have had the capacity required for projects of larger scale, being able to meet capacity will not necessarily always be the case. Reaching a higher capacity might require new processes which in turn might require the products to change, e.g. through standardisation.

Even though the volumes required by the New Space market are much larger than those of Old Space, they are still small enough to be markedly influenced by a single customer's order. Because of this, the demand is expected to fluctuate greatly, putting additional requirements on the flexibility and capacity of RUAG. According to the literature, RUAG will have to choose whether to adopt a levelling capacity plan, chasing the demand or managing the demand (alternatively combining all three). The analysis of these three methods follow:

- Level capacity plan: The level capacity plan requires products to be standardised to a degree that guarantees the future sales of products yet not ordered. Today, many of RUAG's products are engineered to order and very customer specific; a situation unsuited for a level capacity plan. With this said, RUAG could use a level capacity plan for certain standardised components.

- Chasing demand: Chasing the demand can be done in different ways. One of these is through the use of overtime, part-time employees and subcontracting. Another is to make RUAG's workforce more flexible. Both options are feasible but might require changes to RUAG's organisation, its recruitment practices, and its approach to training and education of employees.

- Managing demand: With cost becoming increasingly important it is not unreasonable to believe that demand can be steered through pricing. However, as RUAG is currently too expensive for most New Space clients, the first priority must be lowering costs. Managing demand through pricing thus becomes a one-dimensional tool and redundant as an explicit strategy since RUAG already knows it must become cheaper to attract any New Space customers at all.

The conclusion to the issue of fluctuating volumes is that a chase demand strategy would be the most suitable, mostly due to elimination of the other two strategies:

managing demand and level capacity plan. A level capacity plan should however be examined and could prove useful as a complement to a chase demand strategy.

4.2 Problems Currently Perceived by RUAG

This section will answer the second research question: what are the problems currently perceived by RUAG? The perceived problems are based on the interviews conducted during the research. Since the interviewees work in different parts of the company and have different sets of experiences, the empirical findings have resulted in a patchwork of perceived problems. The problems currently perceived by RUAG has been grouped together in categories to aid the reader, see figure 2 for an overview.

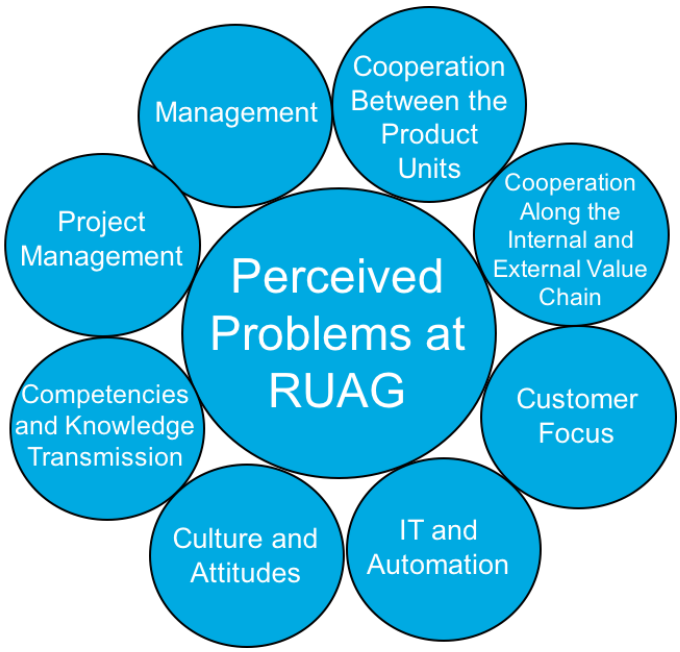

Figure 2. *Categories of problems currently perceived by RUAG.*

4.2.1 Culture and Attitudes

At RUAG, the staff turnover is low, the average years of employment is approximately 20 years, the average age of the employees is nearly 50 and 20% of the employees are retiring in the next five years. Many employees emphasise that these numbers are a proof of RUAG being a very good company to work at, but they also accentuate that since the staff turnover is low, new ideas are missing and a mentality and the mind-set of "we have always worked like this" is deeply rooted within the organisation and many are unwilling to learn new tasks or to take responsibility for meeting the new market requirements. The change spirit is low and if changes occur, the pace of change is slow. There is however people who wants to implement changes, e.g. the operators in the Microwave unit, but the process of implementing changes is too bureaucratic and the improvement work is often done reactively rather than proactively. RUAG is resistant regarding changes and possible improvements which is due to a conservative and slow

production, influenced by a lot of standards and quality requirements imposed on the products by e.g. ESA and traditional private actors as well as RUAG itself. Some people who try to change the way to work or attitudes are either burned out or quit.

Given how long RUAG has followed ESA's requirements, it is natural that they have also been largely responsible for shaping the attitudes to quality in RUAG. At RUAG, employees take pride in the quality of their products. Although it is discouraged (as a greater functionality also increases the risk of a malfunction), many employees see it within the realm of possibility - or have heard of instances where - constructors have designed a product so that it becomes more functional or of a higher quality than specified or requested by the customer. The vigilance over quality is also seen in the production. There, not speaking up about a mistake made - regardless of how seemingly insignificant it might be - is not an option.

Some of the sentiments expressed by interviewees at RUAG had to do with the lack of a certain mentality. Certain employees at RUAG - some of which coming from outside the space industry and some coming from other companies in the space industry - thought RUAG was too careful and slow. It was also said that RUAG was too tame, especially when dealing and negotiating with customers; too rigid when dealing with requirements and specifications.

People do not have the urge or mentality to question one's own or other's work, or to challenge the prerequisites of performing the daily operations, for example regarding processes, tools, facility, organisation and customer efficiency. The employees and managers on various levels are seen as to agreeable and as people who goes with the flow without reflecting upon the operations or processes. The process of decision-making is in general slow, and people are philosophising too much instead of thinking outside the box and be courageous enough to try new things to see how they work. For example, many employees do not dare to move towards a "good enough" mentality, but prefer to have quality margins even though they might not be necessary. On the other hand, the "good enough" standard has not been defined by RUAG even though the perception is that it is a lower quality requirement than what RUAG strives for today. As one of the interviewees that has been working in the company for a long period of time, and who now is working with e.g. communication internally and externally, expressed:

RUAG identifies themselves as who they have been rather than who they need to be.

At RUAG, there exists an "us against them" and "yours and mine" mentality between the different product units but also between different levels in the value chain, and people are protectionistic regarding one's own work. When it comes to performing the tasks, RUAG is letting the tasks take the time it needs, instead of pushing for a deadline. Many interviewees highlight that RUAG is too nice and forgiving as a company, that

the company do not demand enough from its employees and that there exist no real consequences for e.g. delays.

4.2.2 Competencies and Knowledge Transmission

In production, the operators are certified to perform certain operations, and the operators are in the most cases not educated to perform operations in both the Microwave and the Digital product units. This means that it is difficult for them to change units when needed, e.g. as a result of fluctuating volumes. Furthermore, the testers and assemblers within the same unit are not certified to perform each other's tasks either. In times of high volumes, consultants are being employed and educated for a long time. Some operators are experiencing a lack a proactiveness from the company when employing consultants in the production. When the volumes drop, RUAG is letting the consultants go despite the effort and financial resources used to educate them.

As mentioned previously, 20% of the workforce is retiring within the next five years. According to several interviewees, the retention and the interchange of knowledge as well as competence development is not performed in a structured way, which means that single sources of knowledge could leave the company without documenting their knowledge and that positive synergies throughout the company are rare because of this. Furthermore, a challenge is to find employees with managerial skills within the company, i.e. employees who want to lead.

4.2.3 Project Management

According to the interviewees knowledgeable on project management, RUAG is missing a structured process to plan the projects. Sufficient support during the process is missing as well and the ability to set, discuss and follow up deadlines is underdeveloped. One interviewee highlighted the difficulty to sometimes set deadlines due to the high level of product customisation, but emphasised that an assumption and a plan still need to be set. A holistic view of a project, from project start, to the delivery time of components, production start and the planning of resources to secure a seamless flow throughout the project, is missing.

4.2.4 Management

RUAG's management is unclear about the future of the company and in what direction it is headed. The feeling of the interviewees is that the management do not know how to communicate, they are actively avoiding conflicts and problems in the organisation (e.g. the problems between Microwave and Digital), are disconnected from the rest of the company and do not have the passion for making the operations more efficient and effective. They are trying to adopt an old management system on all the products without taking into consideration that the products and the processes have different needs. As expressed by one interview object working at different levels at RUAG, e.g. in production, during a sufficient amount of time:

Top management are trying to adapt the products to the processes rather than the processes to the products.

RUAG's top management is not proactive enough when it comes to change management to adapt to the future market reality, and it is difficult for the organisation to act on improvement suggestions. For example, the work, preparations and improvements of the operations for the a very large project (which RUAG did not win) did not get implemented even though it would have been beneficial for the future of the production.

Earlier, in the chapter about culture and attitudes, it was mentioned that certain employees consider RUAG to be too lenient, e.g. when it comes to having consequences for delays. This problem relates to management, as it is they that have the authority, and thus the responsibility, for repercussions being missing or being perceived as missing.

4.2.5 Cooperation Between the Product Units

The cooperation between the product units in the production is not working optimally and positive synergies between the production units are rare. As many interviewees describe, there exist "walls" and conflicts between the different units, e.g. due to disputes regarding the common resources such as equipment and facilities but also prestige. Furthermore, the assemblers are mostly assigned to one product unit and seldom work in another product unit due to sub-optimisation of the employees. The units are operated as separate islands even though Microwave and Digital is somewhat similar in what they do. The managers of the product units are mainly looking after their own unit rather than taking the overall state in production into consideration. They have different mind-sets and priorities regarding production planning and seek contact with each other when issues need to be solved rather than having daily control of the operations in production.

A huge problem is the non-existence of a common production manager and a common production strategy. Each product unit is responsible for its own budget, which, according to some interviewees, is one of the reasons to the sub-optimisation of the production units undermining RUAG's competitiveness. The coordination of resources, e.g. staff, between the product units is also a problem. The lack of a common production manager means that there is no role close to the production that has the mandate to make decisions about the whole production department, which is also a factor leading to sub-optimisation.

4.2.6 Cooperation Along the Internal and External Value Chain

There exists conflicting goals between different departments and phases of a project and an "us against them" mentality. The construction phase is for example "eating up" and using production time, which results in the production department receiving the projects

in the last minute. Furthermore, the operators are experiencing that the construction and the drawings are not always complete when handed to them, leading to production errors and that drawings need to be sent back to the construction department. The production is also experiencing a lack of understanding of the used equipment in production from the construction department and they believe that more communication and cooperation between construction and production would be beneficial to avoid delays in the production process. Many issues are also related to an insufficient quality of the components bought from suppliers and RUAG is mainly communicating with the suppliers when quality issues are discovered, rather than involving them and forming partnerships with them, or having several suppliers to choose from when needed. Furthermore, conflicting goals between the supply department and the production department have also been revealed – the supply department is, according to some employees engaged in the projects, focusing on low costs by purchasing large batches of supplies rather than on getting the supplies on time.

The people working with production technique are the people working with optimising the production equipment. They are spread out physically and organisationally between production units instead of having their knowledge accumulated in one place. They are also sitting far from the production unit and the impression is that they are lacking a proactiveness when it comes to developing the equipment used in production.

As a consequence of tough quality requirements, RUAG prefers to not be changing suppliers. This has been problematic in cases when suppliers have not been able to deliver things in time, as RUAG has not been able or willing to contact alternative suppliers. This too becomes an issue with regards to cost, especially in light of the New Space requirements. RUAG doesn't scout the market enough for new potential partners or suppliers and have a blind spot outside the space industry in particular. RUAG ought to be looking more at suppliers outside of the space industry since they are generally cheaper and have greater experience with high volumes and mass production. Ignoring the aforementioned complaints, RUAG doesn't either work as close with its suppliers as it could. Because of this, they miss opportunities for suppliers giving feedback on construction designs that, if addressed, could be beneficial to both. RUAG could boost their quality if suppliers were involved more at an earlier stage.

4.2.7 Customer Focus

At RUAG, a customer focus is missing. RUAG is good at constructing and producing products according to a customer specification which traditionally has been the specifications of e.g. ESA. They have had very high quality requirements which has led to RUAG producing products with as high quality as possible. This, in turn, leads to high costs and long lead times. RUAG has never questioned what requirements other, potential customers might have regarding their expectations, desired technology, costs or lead times. RUAG is in other words over-optimising the products for customers that value other performance objectives, and they do not question the standards set by the

traditional actors. However, RUAG is fully aware of what the New Space customer need and expect, but they do not have the urge to change their mind-set regarding quality and they lack a sense of urgency for the change to happen right now. There is a discrepancy between what RUAG think they know about their potential customers and what they actually do know.

One of the reasons why RUAG holds on to the requirements that garner e.g. ESA projects is that RUAG believes that long term projects are important for its credibility on the market. This credibility is seen as important not only for securing projects in the public sector but the private sector as well.

4.2.8 IT and Automation

The IT department do not play an active part in the operational development of the organisation and believe that the production and its future requirements is unrelated to the strategy and goals of IT. However, many interviewees believe that there is too much manual work being performed in the production today and that more automation in combination with digitalisation will be necessary to meet the future market requirements. For example, production is lacking a statistical process control. They do not know what errors occurs, the costs of the errors, how much time it takes to reconstruct the products or exactly what they use the time for. Data is needed but the errors are tracked analogically, which means that it is difficult to get an overview of a full set of data and identify the roots of the production problems. The IT department does not understand the needs of the production or the rest of the organisation and they are not working proactively with the technological development.

4.3 A Causal Analysis to RUAG's Inability to Meet the Requirements of New Space

The answer to the third research question – in what way are the problems currently perceived by RUAG are a cause to RUAG's inability to meet the requirements of New Space – will serve as a causal analysis that translates the perceived problems at RUAG into reasons why New Space requirements remain elusive to the company. Four categories of perceived problems have been chosen for the causal analysis since they have been seen as the most interesting: culture and attitudes, management, cooperation between product units and customer focus. An overview of the chosen perceived problems is to be found in figure 3. The connections between the New Space requirements and the perceived problems at RUAG will be made with the help of literature. The result of this analysis will make it clear why it is important to solve the problems perceived by RUAG if RUAG wishes to become competitive in the New Space market – paramount for creating a sense of urgency for change.

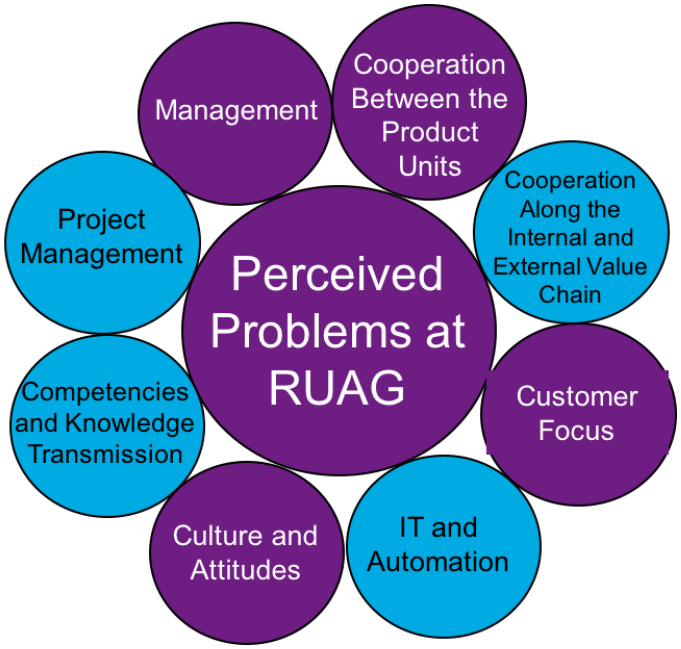

Figure 3. *Highlighted in purple are the categories of problems currently perceived by RUAG chosen for the causal analysis.*

4.3.1 Culture and Attitudes

The space industry has a long history of conservatism. This doesn't only mean that attitude change – or that any change for than manner – will be difficult to effectuate at RUAG but also that an unwillingness or resistance to change is an attitude in and of itself. The reasons why attitude change is so important are numerous. For RUAG to have a chance of becoming successful with New Space customers, they must, among other things, become faster in their way of thinking and acting, more daring (e.g. by being prepared to leave their comfort zone), more willing to take initiative, disposed to question the status quo and more creative when it comes to problem solving. The changes necessary to attitude seem to be well known within RUAG. The question therefore becomes what is holding attitude change back and why has it been so difficult to bring to actualisation? One reason has to do with the low employee turnover in the company. This issue is examined below.

RUAG has a large number of employees that are older and that have worked in the company for many years. Although these are often correlated, that is not always the case, and older employees should therefore not be seen as synonymous with employees that have worked at the company for many years.

Older employees aren't a problem in and of themselves. The problem arises when too many of the older employees of the same or similar age approach retirement age. If a large batch of employees retire all at once, replacing them could prove very difficult, especially when considering how new employees have to be eased into the work in an unrushed manner and with the helping hand of someone with more experience. Another

hypothetical reason why a too great concentration of employees that are older (or of any other age) could be problematic is the same as why it could be problematic to have too many people of one gender or a non-diverse workforce. Although interviewees at RUAG said that many people apply to the company because of an interest in space and/or technology, one should not forget that having a younger workforce could prove to be beneficial when trying to attract other, young employees as well.

Experienced employees that have worked in the company for many years aren't problematic either. On the contrary, in most cases it is something positive. For example, it is among RUAG's veterans that one finds the most flexible workers, this due to them being having partaken in other product units' work prior to organisational restructuring. With this said, having too many people that have worked at the company for too long can lead to the company becoming stale. Unless the company is constantly expanding, people staying at RUAG happens at the expense of new employees not joining. A low employee turnover can be negative in the sense that it can hamper much-needed injections of new people with fresh ideas that could benefit the company. The low turnover of employees can partly be traced to how "nice" and forgiving RUAG is as a company, as described by several of its employees. To make one's employees truly enjoy working for one's company is admirable and something many employers struggle to do. However, in RUAG's case, this well-meant mission might have led to some unintended consequences.

There is one other problem related to all of this that some ascribe to employees being older and from another era and that some ascribe to employees having worked at RUAG for too long and thus having become too comfortable in their day-to-day life. Interviewees mentioned that some of the older and/or more experienced workers are resistant to change and unwilling to learn new tasks for the sake of flexibility. The staleness at RUAG caused by a low turnover of employees has consequences that reach further than employees becoming too cosy in their jobs. The organisational culture, which has been researched being a consistent way of thinking, feeling, reacting and doing things in a business, shared by almost all members and needs to be learned to be accepted in the organisation, is in research recognised as a big influencer of the performance of an organisation. The organisational culture and attitudes, being shaped by a collective of people, has within RUAG become cemented as natural basic underlying assumptions and are therefore difficult to change. This is also problematic since it leads to the loss of driven employees that push for change. RUAG employees have witnessed fellow workers burning out or quitting after attempting to change things at the company and failing to make a dent or after feeling that the internal resistance was too strong. Therefore, the turnover of employees becomes skewed precisely toward those employees that push for change.

Another reason why attitudes – in particular with respect to quality – have been difficult to change has to do with extensive quality requirements and strict certifications, imposed by ESA or others, that have been drilled into all employees since day one. It is

clear that the visible phenomena of RUAG's technological requirements and its products has had a large impact on how the culture and attitudes has been shaped. As long as these requirements remain, the corresponding attitudes will as well. Prompting employees to embrace a "good enough" mentality will not work before certifications are loosened and before employees feel secure that something they do differently (as a result of the "good enough" mentality) will not lead to catastrophic consequences for themselves, RUAG or its clients.

The organisational culture at RUAG can be seen as segmentalistic, where for example the different production units are walled off from each other with little cooperation or sharing of resources between them. RUAG is also unwilling to take risks and experiment, and to do and make things differently than before in their day-to-day work, exhibiting a mind-set of "we have always worked like this". Since the requirements from the customers are changing, the expectations on RUAG as a supplier are becoming different, and they will need to find other ways of working and implement another mentality in order to be able to meet the requirements of New Space. The mind-set of the organisational culture of RUAG will not be applicable in the new reality where flexibility, cost and other quality requirements are important. The "we have always worked like this"-mentality will soon, if it hasn't already, become obsolete and if they are going to meet the new customer requirements, they will have to find other ways to work as well as become more open to change. RUAG needs to strive toward a more integrative culture that is willing to look and move beyond the traditional solutions of construction and production. They also need to create a learning culture, i.e. where the different departments are exchanging knowledge and learn from each other to enhance their overall performances. Doing so creates a more integrated culture but also forums for new ideas to bloom and the feeling of problems being part of a larger whole rather than problems needed to be solved in isolation. RUAG segmentalistic culture also expresses itself in the tendency to measure their products' quality by looking at the standards set by big and quite conservative actors and rely on what the company has been good at rather than trying to adapt their operations to the future requirements.

4.3.2 Management

The leadership of an organisation must instil a vision in their employees, motivate them and create momentum (Ionescu, 2014). Whatever the vision of RUAG is with concern to New Space, it is unclear to its employees how the organisation will reach said vision. Motivation for change is also low, and with change being as slow as it is, momentum is lacking.

If RUAG is serious in its wish change as to adapt to the New Space market, the company's leadership must be clearer in communicating its vision. Although some of the problems currently perceived by RUAG might have easy solutions to them, thus placing them within the reach of enterprising problem solvers with the mandate to deal with them on their own, other perceived problems have less obvious solutions to them.

The vision of a RUAG that is competitive in the New Space market can be reached in different ways. The same variety of options applies for many of the problems currently perceived by RUAG. Because of this, it is important for the leaders of RUAG to show the way, i.e. what needs to be done for their vision to be reached. Without top management spearheading the change initiative, people further down in the company will not only not be able to influence, but neither know toward what to aim. Not having a coordinated effort driven by the whole company could serve an explanation to why certain individuals at RUAG have been burned out or quit. It is not a great leap to assume that trying to do so much by oneself and without support from the rest of the company can be very tolling. Other RUAG employees, knowing the fate of those that have tried to change by themselves, might in addition draw the conclusion that trying to change the company is a pointless and psychologically punishing endeavour.

One of the most talked-about problems in production is that the product units are too independent, acting on their own instead of in cohesion. This problem ties in part to management – or rather the lack thereof – since there is no person at RUAG that is responsible for optimising the three product units as a whole. Not having one person in charge of all product units wouldn't necessarily have result in sub-optimisation if one made the decision structures of the organisation boundaryless, meaning that one makes the indirect consequences of decisions known (Frenkel, 2009) – knowledge that can either be used to limit negative bi-effects or to not miss out on synergetic effects. RUAG and its management has, as made apparent by the sub-optimisation that occurs in production, not succeeded in putting these structures in place. Sub-optimisation can also occur as a result of incentive structures, i.e. by how performance is measured and by what behaviours are rewarded respectively overlooked. In this case too, the perceived problem of sub-optimisation of the product units can be traced to the management of RUAG.

Internal delays and gliding project deadlines, are problems that can partly be pinned on leadership. RUAG is too forgiving and devoid of any real consequences for delays in projects. For internal deadlines not to be seen as recommendations there needs to be a sense of accountability and a person higher up that establishes and enforces consequences to delays in a stricter manner. Here, management must create incentives to avoid unwanted behaviours. The reason why internal delays are important despite the near perfect, if not perfect, delivery reliability of RUAG to its customers, is that internal delays lead to uneven processes and to projects taking longer time than necessary. This, in turn, can limit the perceived feasibility of improvement work with concern to lead times.

4.3.3 Cooperation Between the Product Units

The product units at RUAG work separately in part as a result of the performance of the product units being evaluated separately. Product units working separately does not necessarily have to be an issue. At RUAG however, the tasks performed by the different

product units require the usage of common resources and the occasional aid of workers from other product units. As a result of this, their performance measurements become conflicting. A common resource being used by one product unit might be at the expense of another in need, and loaning workers to another product unit might mean sacrificing potential improvement work at their native product unit. This problem isn't only found between product units but also between production and other departments within RUAG, e.g. the supply department. In this case, the conflicting goals are more direct. While production needs to have a steady supply of components and materials, the supply department prefer to buy these components and materials in much larger volumes due to economies of scale. This conflict of interests between production and the supply department has therefore led to sub-optimisation through material shortages.

One possible explanation to the divisiveness and the "us vs. them" mentality between the units can be linked to the lack of worker flexibility. Since people identify themselves through their roles in their job (Ashforth, 2014), an inflexibility in work tasks could lead to RUAG workers seeing themselves and identifying themselves as a "microwave assembler" or "digital assembler" exclusively, rather than as an "assembler at RUAG". These role boundaries are reinforced by boundary markers (Ashforth, 2014), e.g. by having the different product units working in separate rooms. Clear role distinctions can in some cases be a positive thing, if not outright necessary, but for RUAG and for the assemblers in the microwave and digital product units this might not be the case. Certain RUAG employees seem to have reached the same conclusion, stating that Microwave and Digital are not different enough to warrant their division and that the division of product units could make sense for a larger company, but not for one of the size of RUAG. The division of the product units cannot be seen as anything else than as an unnecessary source of friction of collaborative work.

Breaking down the problem one step further, the lack of worker flexibility at RUAG (which, as earlier mentioned, partially explains the divisiveness between the product units) can depend on several reasons. One of these is that RUAG hasn't been diligent in training its employees and expanding their capabilities. The oft-mentioned budget constraints in relation to training and education can be seen as indicative of this as well. With this said, it is possible that RUAG already has a pool of flexible employees sufficiently large to handle most - albeit not all - situations in which flexibility is needed, e.g. when chasing demand. If flexibility is seen only as a factor of production this could be said to make sense, but when seen as an instrument for increasing unity in the company – particularly between product units – it becomes apparent that an opportunity has been missed.

The second reason why worker flexibility is low at RUAG has to do with certain employees refusing or not being willing to learn new tasks. This phenomenon can most easily be explained by the attitudes of the workers themselves. However, it can also be blamed on a lax attitude on the part of RUAG. By not demanding enough of its employees the company enables employees' inaction.

4.3.4 Customer Focus

Considering the great amount of care and attention that has gone into the products of RUAG with regards to quality and delivery reliability, saying that RUAG historically has not been focused on serving its customers would be misleading. The crux of this issue is that the prospective customers of RUAG, and of the space industry at large, have changed and that RUAG has not been quick enough in adapting.

According to García-Murillo and Annabi (2002), creating a compelling customer offering commences with understanding what the customers' needs. The problem is not here, as RUAG seems to be aware of what New Space customers want and in what ways they differ from Old Space customers. It is probable that more problems will appear later on, but before reaching those, the main problem at hand has to do with execution, i.e. actually tailoring the offering to maximise the value for New Space customers.

Seen through the lens of Porter's generic strategies, RUAG is currently employing a differentiation strategy; one which is largely incompatible with the focus on low cost required by New Space customers. Although there are arguments for hybrid strategies being possible, becoming "stuck in the middle" is still a risk when trying to employ several strategies as once, e.g. differentiation and cost leadership. RUAG reasons that it is the difficult and challenging projects that, thanks to the experiences and trustworthiness gained, enable the simpler and smaller projects. This statement is might very well be true for state actors and private actors of Old Space alike, but it is doubtful that this applies to New Space actors as well. The prestige and trustworthiness that comes from being involved in ESA and NASA projects are surely seen favourably by New Space actors, but they are hardly prerequisites for business. When analysed only from the viewpoint of whether or not something is problematic for RUAG's success in the New Space market, holding on to a differentiation strategy with the motivation of it being necessary for Old Space business can only be seen as problematic in this context. According to LeBoeuf (2000), being customer oriented requires companies to focus on the market and its needs rather than at the company's own strengths. Because of this, the strengths of RUAG (e.g. the high product quality and the trustworthiness gained from being involved in ESA and NASA projects) ought to be examined only on the basis of whether or not they are useful for the New Space customer offering rather than as a starting point or position of power from where to tackle the New Space market. With the priorities of Old Space and New Space customers differing so much, the conclusion becomes that in most cases they are not.

A RUAG employee that has been on the other side of the supplier-client relationship (i.e. working for a client interested in buying products RUAG could supply) talked about how the client used to dismiss RUAG as a supplier off the bat since its products were perceived as too expensive. The products might be priced correctly by RUAG

given their quality, functionality, and more, but as LeBoeuf (2000) claims, how a supplier is known to the customer is more important than what the supplier knows.

Prior to the entry of the New Space actors on the market, RUAG has been delivering products according to customer specifications, while the new actors sometimes ask of their suppliers to supply them with a solution to a problem instead. As being researched, customers tend to close a deal based on good feelings and solution to problems, and for the New Space customers also price. At RUAG it is clear that the price is difficult to push, and is of course important, but the cost for their products seems to be caused by the over-optimisation of quality in relation to customer needs, where quality includes the process from when the constructors are over-optimising the quality of the products to the use of too expensive components in production. The end-usage of the products for the New Space customers differs from the end-usage of the Old Space customers in the number of years they need to function, but also in how well they need to function. The Old Space customers were ordering small number of products for big science projects or for telecommunication satellites aiming to last up to 15 years, while the new actors are sending up clusters of telecommunication satellites. If one is failing, another satellite could cover for it and due to the fast pace in the technological development, the New Space actors only aim for them to last approximately seven years. The New Space actors are willing to compromise on quality in favour for lower price, they are satisfied with products being "good enough" which is a mentality and mind-set RUAG has not embraced. The interviewees emphasise RUAG's need to focus on having as high quality as possible, while the new, potential customers is valuing other performance objectives, first and foremost price, over quality.

4.3.5 How the Problems Currently Perceived are Connected to RUAG's Inability to Meet the Requirements of New Space

To summarise the preceding analysis, a compilation bullet points has been made. These describe how the problems currently perceived by RUAG have been linked to the requirements that are essential for RUAG to become successful in the New Space market.

- A general *attitude* against change limits the possibility to make changes indirectly affecting *costs*, *volumes*, *lead times*, *quality* and more.
- *Attitude* change is necessary to be able to let go of the attitudes that make workers spend too much *time* and *money*, consciously or unconsciously, on products of an unnecessarily high *quality*.
- A corporate *culture* and a *management* that is too soft and forgiving can lead to delays affecting the perceived possibility for *lead time* improvements
- *Customer focus* is paramount to understanding what the right *cost*, *volume*, *lead time* and *quality* are for New Space customers
- Not enough *cooperation between product units* leads to sub-optimisation, which in turn leads to higher *costs* for RUAG

5 Discussion

New requirements are being placed on RUAG due to the market of New Space, and the purpose of the study has been to contribute to RUAG's ambition of staying competitive in the space industry. With the purpose as a background, a discussion regarding the study is held. It starts with a discussion regarding the research execution and the problems currently perceived by RUAG analysed in the study, followed by the remaining perceived problems. Furthermore, a discussion is held regarding change management at RUAG and the future for the company.

5.1 Research Execution

The aim of the research has been to contribute to RUAG aim of staying competitive in the space industry. Even though a solid plan of dealing with the problems lifted in this research has not been presented, the hope is to have put a light on relevant problems for the company to work with in the future. The hope is also that the research will create a sense of urgency for the problems currently perceived. If they would have had the sense of urgency and if they had known how to change, they would already have started the journey towards becoming a more New Space-oriented company. Even though some initiatives have been implemented and Ph.D. students are studying the space industry of tomorrow at RUAG, the company do have a real journey ahead in order to become more flexible, customer-oriented and faster in their decision making. It is a slow-moving company, the size being one aspect of the problem, but also a company which lacks the direction of where they are going.

When conducting the research, a sufficient amount of time was spent on the empirical data collection process, i.e. interviewing the employees. Conducting research with interviews as one of its fundamentals is in some ways a risk, since the empirical findings depend on the researchers' interpretations of the spoken word. Due to the dependence of the spoken word, the possibilities to reveal subcultures within the company exist, and if the interviewees happen to be a part of the same subculture, the research will be affected by it. No research is however fully unaffected by the circumstances in which it is performed. The research will be affected by RUAG and its' structures, both the people being interviewed and the people affecting the study indirectly such as gatekeepers and other stakeholders, as well as the researchers' attitudes to the project. However, all these aspects have been taken into consideration when conducting the research.

5.2 Discussion of the Results

Even though there was a general consensus surrounding most of the problems perceived by the RUAG employees, it can be discussed whether or not some of the problems perceived truly are problematic according to all. For instance, one problem perceived had to do with RUAG being too nice as a company. It is doubtful that the whole of

RUAG would agree with this statement. In addition, there is a possibility that RUAG being too nice as a company was only perceived as a problem by people who had personally made the same analysis this report makes, namely seeing it as a problem only in the context of it being a hindrance for RUAG matching with the requirements of New Space.

The problems perceived described in this report are not only a cause to RUAG's inability to meet the requirements of New Space, but they are also linked to one another. The categorisation of the problems currently perceived should therefore only be seen as pedagogical and for purposes of comprehension, rather than as a statement saying that the problems perceived can be grouped into separate, non-dependent islands. This perspective is particularly important to keep in mind when discussing potential solutions to some of the problems perceived. Certain, in some cases seemingly obvious, solutions might therefore prove ineffective - if not detrimental - if implemented individually, in the wrong order or in disregard of how it can affect other parts of the company. On the upside, this also means that certain solutions can solve several of the problems currently perceived at once, all while bridging the gap between RUAG and New Space requirements in a way that is compatible with the overall strategy of RUAG as a company.

One example of one such, multi-purpose solution consists of making the workers at RUAG more flexible. The most straightforward reason for doing this is that RUAG will be able to use its employees more effectively, transferring them from one task or product unit to another depending on where they are needed the most. A more flexible workforce ought to be beneficial for the higher and fluctuating volumes of New Space. Another argument for a more flexible workforce is that it could help employees separate their identities at work from individual product units, making them feel more like RUAG employees than as assemblers for the microwave unit (as an example). Making the workers of RUAG more flexible is dependent on RUAG being able and willing to spend resources on training and educating its workers. This also hinges on RUAG giving the workers tasks with a variation matching their new competencies after their training period, lest they forget everything they've learned. The success of a flexible workforce is contingent on workers not always being stationed in the same product unit, executing the same set of tasks. Finally, RUAG must find a way to incentivise, if not demand, workers to be more willing to learn new tasks. This ties into attitudes at the company, both on the part of RUAG as a company and of its workers.

In some cases, it is not guaranteed that an optimal solution for a perceived problem might exist. As solutions have not been investigated in detail in this report, and since certain solutions require changes with consequences that are impossible to foresee, one cannot dismiss the possibility that certain problems currently perceived are necessary evils or the best option available. With this said, the difficulty RUAG has for change speaks against the company having attempted to solve all of its perceived, existing problems.

5.3 The Perceived Problems Not Touched Upon

During the research, eight categories of problems currently perceived by RUAG were found and they are all likely to have an impact on RUAG´s performance on the market of New Space. The four categories of problems chosen for the causal analysis are a result of a subjective assessment, but the four remaining are also of value to touch upon. No perceived problem exists in a vacuum. They are all interconnected and therefore, a short discussion about the remaining four will be conducted.

5.3.1 Competencies and Knowledge Transmission

For RUAG to meet the requirements of New Space, the competencies need to broaden within the production department. RUAG will need to educate their operators to become more flexible and multi-skilled, which is beneficial when the volumes are fluctuating. People will be able to perform more tasks along the production chain to create a better flow of products and RUAG will also take advantage of the full capacity of the employees. To broaden and develop the employees' competencies, not only the employees' attitudes needs to change, but also the attitude of and the engagement from the organisation of RUAG. The lack of competence development will not only affect the RUAG's future competitiveness, but also their pool of employees since competent employees with high ambitions to develop and to be challenged in their professional role might leave.

To avoid sub-optimisation and to make use of all the competencies within the company, RUAG must tear down the walls between the product units. The knowledge transmission between them is highly interconnected with the ability to cooperate, and knowledge transmission can only be achieved if and when the walls are torn and RUAG cement the culture and attitude of being one company. Due to different experiences, the product units have a lot to learn from each other and with other perspectives, new ideas would bloom. That is why forums to enable the knowledge transmission will need to be created. Such an initiative will also be likely to, to some extent, tear down the walls being built between the product units and if done right, it will increase the feeling of being one company striving towards the same goal, rather than belonging to different departments that are sub-optimised. Such initiatives will also have the ability to prevent single sources of knowledge.

5.3.2 Cooperation Along the Internal and External Value Chain and Project Management

The polarisation between the different departments along the value chain is noticeable, which also increases the feeling of "us and them" and not working as one company. A greater understanding across the company of the different departments and their processes and challenges will be needed as a first step for the company to be able to transform their project processes so that it involves as many parts of their internal value chain as possible. This will be needed to optimise the project rather than every single

process step of it. Doing so, planning the projects and setting deadlines with a consensus across the internal value chain will be easier, but also to communicate the consequences for missed deadlines. It is important to have in mind that no department is more important than another. No company or no value chain is stronger than its weakest link. This is also noticeable when the problems with the supplies are revealed. Even though delays occur due to returns of supplies since they do not live up to the standards required, probably due to the suppliers' performance, there are ways to handle the problems from RUAG's side. A first, but challenging, solution might be to conduct a solid supplier review to examine the possibilities to change the suppliers. A second solution could be to communicate the importance of RUAG's business to the suppliers and cooperate with them in a greater extent. This will hopefully make the suppliers feel like a part of RUAG's vision, strengthen the relationships with the suppliers and optimise the external value chain.

5.3.3 IT and Automation

The technological development is both affecting and driven by RUAG's customers, and is therefore affecting RUAG as well. If they cannot live up to the standards set by the actors on the New Space market, they will not stay competitive in the industry. The technology is constantly developing and RUAG needs to, if not keep up with pace, at least develop toward becoming more aware of and have the willing to implement new technological solutions. Automating parts of the production process with the existing technology would, according to the interviewees, be possible and with some extent of automation, lead times will shorten as well as the costs over time.

One of RUAG's currently perceived problems is that they are missing people and groups having both the mandate to and the want to drive the change. The IT department's reactive approach to RUAG's technological development is surely an issue since business technology will and is driving businesses today. They, or another department or group having a similar mandate, such as the group responsible for production technology, must play a more significant role if RUAG is going to stay competitive in the market of New Space with shorter lead times and lower costs.

The requirement for a more efficient production will also require a greater control over where the errors occur in the production. The errors in the production today are mostly tracked analogically which will not be efficient or effective enough if RUAG will supply the customers of New Space. Even if RUAG has other problems to solve before being able to meet the requirements of the New Space customers, the need for automation and IT support in their processes will need to be prioritised.

5.4 Change Management

In this research, several problems currently perceived by RUAG have been revealed. Change management has not been a subject for the research but rather to give RUAG a

sense of urgency for the need to make the journey that will be needed to stay competitive in the space industry. For such a change to occur, RUAG will need to establish a sense of why they would want to drive such a change, and it needs to be anchored with the people having the mandate to drive it. This research can give them a hint about why, but it cannot force the sense of urgency upon them as that is something they have to feel themselves both at an organisational level and at an individual level. Change management is connected with the need to integrate and align technical, social and strategic goals. This will require cross-functional teams to be established to set frames for the change as well as a goal, even though the change required will need continuous and persistent work over a long time span. A plan for a change might not have been well received since the not-invented-here syndrome might have appeared, i.e. an eventual plan for change might not have been accepted since it was not a plan developed at RUAG. Developing such a plan and also examining the likelihood for change would probably have broadened the research to unreasonable proportions.

This report in itself can hopefully serve as a first step for RUAG in its improvement journey. The first step to solving any problem is identifying the problem and its underlying causes. Therefore, linking the problems currently perceived by RUAG with their success or failure in meeting the New Space market requirements could be used to help create a sense of urgency in the company and help motivate future changes in the organisation.

5.5 The Future for RUAG

Today, RUAG is not meeting the requirements of New Space – they are good at the business they have today but need to adapt to another market reality than the one they are in today. They are doing things right, but not the right things. This research serves as a base for revealing many perceived problems but to reverse the trend, future studies will have to be conducted. Studies on how the IT infrastructure could support the processes and what possibilities there is to automate parts of the production chain would definitely be beneficial as well as studies on how material flows will be handled with a high volume and flexible volume scenario. Also, the communication strategy will need to be looked over, both regarding the internal communication between the departments and throughout the value chain, but also towards external stakeholders, e.g. suppliers and future employees (employer branding). Another highly interesting topic of study would be to study if there are any possibilities to start a subsidiary, only producing for the New Space customers. Doing so might even be more effective than implement changes in the existing production line, but is as mentioned a future topic of study.

The hard truth is that huge companies that are world leaders in their field have disappeared, such as Kodak, Hasselblad and Facit for not being able to keep up with the market changes. The key for RUAG will be to adapt to the New Space customers' requirements as soon as possible, or risk meeting the same destiny as the mentioned companies. RUAG cannot live on their old merits even if they have been to their

advantage when building a good reputation of producing high qualitative products. To stay competitive, they will have to leave their comfort zone and aim for the stars to keep the company alive to infinity and beyond.

6 Conclusion

With the advent of the New Space market, veteran actors in the space industry with the ambition to remain competitive have been forced to adapt. At the time of the writing of this report RUAG was experiencing difficulties in adapting to the New Space market and its set of requirements. This report therefore undertook the search for why this was the case. This was done with the aid of three research questions posed to answer what the requirements of the New Space market were, what problems RUAG employees perceived within the company and what effect these perceived problems had on RUAG's ability to meet the requirements of New Space.

This report concluded that the requirements of the New Space market could generally be described as a need for lower costs, high product volumes, shorter lead times and solutions in line with functional purchasing strategies. For a single, individual supplier such as RUAG the industry-wide increase of product volumes includes the caveat of high volume fluctuations as well. Albeit not a requirement per se, the New Space market was also found to be more accepting of risks and in some cases, lower quality in comparison to what was required by the Old Space market.

This report also found several problems within the company perceived by its employees. These ranged from IT and automation to culture and attitudes, management, cooperation between product units, cooperation along the internal and external value chain, competencies and knowledge transition, customer focus and project management. Some of the problems currently perceived would have been considered problems even in a context devoid of the New Space market and the introduction of new requirements to meet. In answering the final research question, this report did, in fact, find causational links between the incapacity of meeting New Space requirements and the perceived problems at RUAG.

Attitudes against change limited the possibility to make necessary changes pertaining to costs, volumes, lead times and quality. Attitudes to quality were also found to be uncalibrated to the requirements of New Space, leading to an overestimation of the importance of quality for the new customer segment. The corporate culture was also found to be too forgiving, fangless consequences for e.g. delays negatively affected internal deadlines. A lack of customer focus directly affects how New Space customers' requirements are interpreted. The suboptimal cooperation between product units lead indirectly to unnecessarily high costs, opposite of what the New Space market required.

The final conclusion of this report is that there exist several areas of improvement that could be addressed today or in the near future that would serve to benefit RUAG in its endeavour to become competitive in the New Space market. Although this report acts as a case study first-hand, it can also serve as one of many case studies highlighting the connection between the competitiveness of a company and operational excellence.

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Appendix

The Interview Guide

The production units at RUAG Space AB

- ❑ Human capital
- ❑ Attitudes
- ❑ Organisation inside and outside each production unit (intra vs inter)
- ❑ Processes in the units
- ❑ Communication between and within the units
- ❑ Retention of knowledge
- ❑ Problem solving

  Changeability

The future market per production unit

- ❑ Customer demands
- ❑ Customer adaptation
- ❑ Market winners
- ❑ Requirements on the production

  Volumes? Lead times? Costs? Quality? Etc.
- ❑ Standardisation on a company vs industry level

Future production and organisation at RUAG Space AB

- ❑ Automation
- ❑ Internet of things/Industry 4.0
- ❑ Space 4.0/New Space
- ❑ Production units and organisation
- ❑ Competencies
- ❑ Vision and envisioned market share, positioning and differentiation