

# **Taking Contracts to the Next Level: Collaborative Performance Improvement**

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## **ABSTRACT**

Maintenance companies in capital-intensive industries are facing challenges that make it more and more difficult to improve their performance. Therefore, they have to transfer their goals to their suppliers and reach collaborative performance improvement. According to the agency theory, the contract between a maintenance company and its supplier is a mean to achieve this end. This paper analyses how such a contract should be designed. The analysis is based on action research done in the procurement department of the Dutch maintenance company NedTrain BV. Literature suggests the use of Performance-Based Contracting, but semi-structured interviews with employees from NedTrain and one of its suppliers showed that the use of PBC is restricted by the buyer's internal processes, product characteristics, the industry structure, and restrictions of the public procurement law. These restrictions can result in pitfalls for which strategies are defined that help to overcome them. Within the contractual relation the elements performance, incentives, and risk need to be specified. While a pure pay-for-performance contract is not possible in the case situation, incentives and penalties can be tied to the (non-)achievement of product-related performance targets. These rewards need to balance the risk that is shifted to the supplier by the contract. Furthermore, NedTrain's supply chain can be modelled as a triad because the company is buying directly from suppliers from different tiers. The supply chain configuration leads to goal incongruence between the tiers and complicates collaborative performance improvement. Previous research suggests that a social contract between supplier and buyer helps to align their goals.

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## **Keywords**

Performance-Based Contracting, triads, performance improvement, inter-organizational relationships, contractual relation.

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# 1. INTRODUCTION

The strategic importance of maintenance in capital-intensive industries is rising: Maintenance significantly contributes to the success of a business by making the best use of the physical assets in place. Recent developments create challenges that require well organized maintenance management. Among these developments is the pace of technological change which is speeding and is not expected to slow down in the near future. Furthermore, societal expectations have become tougher than ever when it comes to safety and sustainability. Waste and pollution need to be eliminated or at least limited which requires adjusted use of material and processes. Besides that, social and demographic changes have influenced peoples' perception of work which becomes visible in modified labour laws and agreements. Last but not least, new operation strategies such as lean manufacturing and just-in-time production ask for an efficient use of equipment, facilities, and manpower (Tsang, 2002). These developments require managers of maintenance companies to build inter-organizational relationships and collaborative processes in order to improve operations and performance. Contracts formalize buyers' and suppliers' responsibilities and determine the relationship between them. When carefully drafted, contracts can encourage cooperation and collaboration resulting in improved performance. Therefore, the design of the contractual relation deserves special attention to be able to facilitate the successful operation of the involved parties in their demanding environment (Singh Panesar & Markeset, 2008).

The challenge of establishing a fruitful contractual relation can be observed in the following real-life case: NedTrain BV is responsible for maintenance, repair, and overhaul (MRO) of the passenger trains riding on the main Dutch railway network. The company is looking for opportunities to improve its services and thereby the performance of the trains. A train consists out of several integrated systems such as the brake system, the engine system, and the toilet system which are produced by various Original Equipment Manufacturers (OEM). Among others, the toilet system is an essential part of the train as it has a direct impact on the customers' satisfaction with the train journey. Therefore, the rule is in place that an Intercity train may only run on the rails when at least one toilet on board is working. In the Netherlands, Intercity trains are equipped with two toilet systems and in case of a malfunction of both systems, the train is not allowed to ride further than its final destination where it is brought into one of NedTrain's maintenance shops. Thus, a reliable and well-functioning toilet system is crucial for the operation. Since defects of the system and its individual components have such a great impact on NedTrain's performance, the company wants to make an effort to improve its components as well as the related processes. Among the components of the toilet system is the vacuum toilet, which is produced by the OEM SVT<sup>1</sup> for some of NedTrain's train series.

In the past, the contact between the companies has been limited to ordering and delivering spare parts. However, both companies have the intention to change this situation by making new agreements, which are supposed to be formalized in a contract. This contract as well as the related processes and the given circumstances in the railway industry are addressed in this paper.

## 1.1 The Complexity of the Railway Industry

NedTrain is wholly owned by NS Groep N.V. (NS Groep N.V., 2016) which is in turn in the hands of the Dutch government (Ministry of Finance, 2015). NS has been granted with the current passenger transport concession which is valid until 2025 (NS Groep N.V., 2015). The government has specified the requirements that NS has to fulfil and these are translated into goals of its subsidiaries. In the case of NedTrain, the main focus lies on the maximization of the aspects Reliability, Availability, Maintainability, Safety, Health, and Environmental friendliness (RAMSHE) of the trains as well as on the reduction of Life Cycle Costs (LCC) of systems and spare parts. These goals differ from those of most privatized companies which often mainly pursue objectives such as maximization of profit or wealth of shareholders (Movares Nederland). NedTrain is searching for possibilities to include these goals into its contractual relations and to pass them on to its suppliers. However, this challenge has not been managed yet.

NedTrain operates in a complex supply chain because the maintenance company is not only buying from first tier suppliers but also from second and third tier suppliers during different stages of a train's lifespan, as depicted in Figure 1. The lifecycle starts when NS buys a new train from a train manufacturer that has a two-year guarantee. Due to the guarantee, all spare parts needed during the two years are ordered from the train manufacturer. NedTrain has defined purchasing strategies for the period after the expiration of the guarantee: spare parts are either further purchased from the train manufacturer or else from the system OEM (second tier) or even from the component OEM (third tier). Since the vacuum toilet has a high impact on the operation, the spare parts are bought directly from the component OEM SVT. The duration of this phase is 18 years in the chosen example but can differ per train type. When the train has been in use for 20 years, it becomes refurbished completely by NedTrain's internal overhaul department Refurbishment NedTrain. This modernization of the train is necessary in order to adapt to new technologies, changing safety regulations and customers' preferences. Only the car body remains while completely new systems are built in the 20-year old train. This procedure is less costly than buying a new train. The new systems have again a two-year warranty period which is followed by 18 more years on the rails. Similar purchasing strategies are in place as in the time before the modernization. After forty years in use, the lifespan of a train ends.

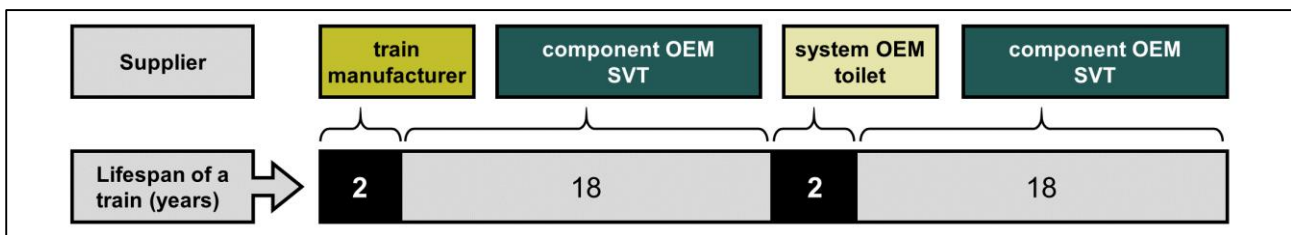


Figure 1. The different suppliers throughout the lifecycle of a train.

<sup>1</sup> In order to respect the privacy of the supplier, the abbreviation SVT (Supplier Vacuum Toilet) is used.

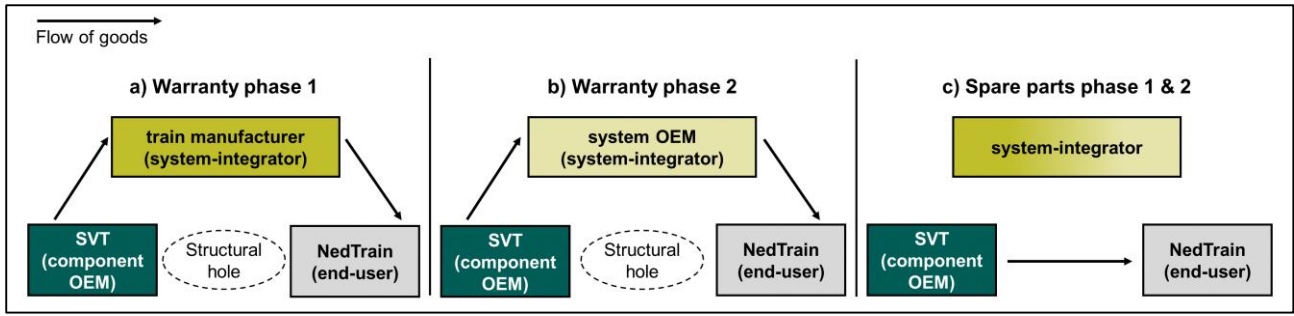


Figure 2. The supply chain configurations during the different stages of a train's lifecycle.

Due to the unusual supply chain, NedTrain is receiving vacuum toilets and spare parts directly from SVT during some phases while ordering the products via an intermediary in other phases. The resulting supply chain configuration can be modelled as a triangle that consists out of the component OEM SVT, the train manufacturer or the system OEM, and NedTrain as end user. This triangle is shown in Figure 2. In order to avoid that the model becomes too complex, the role of a system OEM that can sit between the component OEM and the train manufacturer, is neglected here. Such an interrelated triangle is called *triad* in literature. It consists out of three nodes (SVT, the train manufacturer or the system OEM, and NedTrain itself) and the links between them. Choi and Wu (2009b) argue that triads should be studied because contrary to dyads (two nodes and one link), triads capture not only how a node effects another node but also how a link effects another link. Therefore, a triad is suitable for studying the behaviour of a network. However, as it is the smallest unit of a network arrangement where these effects can be observed, this approach is still sufficiently straightforward to stay within the reach of a company (Choi & Wu, 2009a, 2009c).

As shown in Figure 2a and Figure 2b, there is no direct link between SVT and NedTrain during warranty phase 1 and 2. This lacking connection between the two nodes has been called *structural hole* in literature (Burt, 2009). In these two phases, the system-integrator forms a bridge between SVT and NedTrain and acts as go-between and gatekeeper of information (Li & Choi, 2009). According to Burt (2000, p. 353), structural holes “create a competitive advantage for an individual whose relationships span the holes”. Among these advantages is the access to more information: as the system-integrator is in contact with SVT and NedTrain, he receives information from both parties and is aware of their activities. Furthermore, he can control the amount and type of information that flows from SVT to NedTrain and vice versa and can exploit the information flow for his own advantage (Burt, 2000; Li & Choi, 2009). Since this paper focuses on the contract between SVT and NedTrain, it is thus necessary to detect if the system-integrator makes use of its bridge position and to which extent the arrangements between SVT and NedTrain are affected by his influence.

When the warranty expires, NedTrain orders spare parts for the vacuum toilets directly from SVT (Figure 2c). Spare parts are required for two different types of maintenance, namely preventive and corrective maintenance. Most systems and their components have a significantly lower lifespan than a train. This means that certain parts need to be exchanged after a number of years in order to keep the system running and to prevent malfunctions. This procedure is called preventive maintenance and is scheduled beforehand. On the contrary, corrective maintenance is required when a malfunction occurs nevertheless. As explained before, these malfunctions have a great impact on the daily operations and can lead in the worst case to unavailability of a train. In order to avoid these situations,

NedTrain would like to have more reliable vacuum toilets that require less or ideally no corrective maintenance. However, there are more characteristics that the product needs to fulfil: it should be easy to maintain and the spare parts have to be available at the right time. Moreover, the LCC should be minimized and last but not least, the product should be save, environmentally-friendly, and not causing any danger for the health of the people using it. These demands regarding the product are summarized in the above mentioned abbreviation RAMSHE LCC.

## 2. RESEARCH GOAL AND RESEARCH QUESTION

The previous section has highlighted why NedTrain wants to maximize the RAMSHE aspects and minimize the LCC. Within the context of this research, the term *performance improvement* will be used as overarching concept that summarizes the maximization of the RAMSHE aspects and the minimization of the LCCs. The contract between buyer and supplier is an important instrument that can help reaching this goal because it determines a large part of the relationship between them (Aberdeen Group, 2007). However, the procurement process consists out of several steps and includes not only signing the contract but also preparing, managing, and reviewing it (Thai, 2008). Therefore, this research focuses on the contract as well as the processes related to it, summarized as the *contractual relation*. As the term relation already implies, the contractual relation is not supposed to be one-sided but a *collaborative* process that requires the input from both organizations. To sum it up, the research goal is to define how the contractual relation between NedTrain and the component OEM SVT should be organized in order to promote collaborative inter-organizational performance improvement. The results will be presented as concrete advice for the given case study. The research goal implies the following research question:

*How should the contractual relation between NedTrain and the component OEM SVT be designed to promote inter-organizational collaborative performance improvement?*

In order to be able to answer the question sufficiently, the following sub-questions are defined:

- Which contract type(s) is (are) most likely to promote performance improvement?*
- Which elements need to be specified in the contractual relation to promote performance improvement?*

Since the contractual relation between NedTrain and SVT is not isolated from the surrounding supply chain, a third sub-question is formulated in order to analyse to which extent the system-integrator influences the contractual relation:

- Is the contractual relation between NedTrain and the component OEM SVT influenced by the system-integrator and if*

*so, how does the system-integrator influence the contractual relation?*

The remainder of this thesis is structured as follows: first, the data collection procedure that has been used to answer the research questions will be explained. Next, the results of the three data collection steps, namely an analysis of the status quo of the relation between NedTrain and SVT, a literature review on the key topics, and interviews at the case companies, will be explained. Afterwards, the results are synthesized into a recommendation for the case companies as well as a reflection on the existent scientific knowledge and suggestions for further research.

### 3. RESEARCH DESIGN

This research has been initiated by the purchasing department of NedTrain in order to find solutions for the described problem. The paper aims to solve this practical problem by applying the existing theory. The observations made during this process are used to test and modify the theory and thereby the research makes an addition to the scientific knowledge. This research approach is called action research: "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework." (Myers, 2013, p. 71). This approach helps to overcome the often criticized aspect of business research that the results would not be sufficiently relevant to be useful. The complexity of institutions cannot be fully captured in isolated research and methodologies need to be tested in real-world situations and then be adjusted (Avison, Lau, Myers, & Nielsen, 1999). Since action research includes a cooperation between academics and business organizations, it ensures that the results are practically relevant (Myers, 2013) which is essential for this research. However, a disadvantage of the approach is that it is riskier than other qualitative research methods because the analysis can be subject to many external influences at the case company. Fortunately, it was possible to overcome this obstacle by scheduling the moments of data collection ahead and by having frequent meetings.

Susman and Evered (1978) modelled action research as a cyclical process that includes the five stages diagnosing, action planning, action taking, evaluation, and specifying learning. Due to the limited time frame of the research, only the first two stages have been completed. During the diagnosis stage, the problem has to be identified and defined. NedTrain identified the problem itself and thereby initiated the process. Therefore, defining the core of the problem is the first step of the following analysis: the current agreements between NedTrain and SVT are analysed by evaluating the status quo of the contractual relation and talking to different employees of NedTrain's purchasing department. During the second stage, namely action planning, alternative courses of action are considered for solving the problem. For this purpose, an exploratory review of the scientific literature has been conducted as well as several semi-structured interviews with employees from NedTrain and SVT. The goal of the literature review was to gather input from the existing scientific knowledge for possible solutions. A search was conducted for the key terms of the research questions as well as for industry developments and practices used by comparable companies. Where available, previous literature reviews have been used.

Next to the literature review, interviews at NedTrain and SVT have been conducted. Interviews allow the gathering of rich data

from people from various perspectives (Myers, 2013). During the interviews, data has been collected from employees at NedTrain whose responsibilities at the company are related to the contractual relation and/or the process of purchasing spare parts. The topics covered during the interviews were on the one hand the internal processes at NedTrain and the relation with SVT in the past years to gain a more in-depth understand which solutions are feasible for the companies. On the other hand, questions were asked about the suggestions found in the literature review in order to reflect which of them are applicable to the case. Semi-structured interviews have been chosen because they combine the best of structured and unstructured interviews while minimizing their risks: This technique allows the interviewer to ask additional questions that emerge during the interview while still keeping some consistency between the different interviews (Myers, 2013). Myers and Newman (2007, p. 17) highlight the importance to interview people that "represent various voices". The first interviews were conducted with employees who are obviously related to the contractual relation with SVT such as the contract manager. During these interviews the interviewees were asked which roles are involved in the contractual relation and additional interviews were planned with these employees. All interviews were conducted by one interviewer and recorded on tape. The interviewees were asked for their permission to record their answers. Furthermore, the opportunity was offered to make additional statements off-record at the end of the interview. Since most of the respondents made critical statements while being recorded, it can be assumed that the tape-recording did not influence their answers. Notes were made afterwards based on the recordings. This procedure assured that the interviewer could give the interviewee the full attention while eliminating information bias. In addition, all interviewees were asked if they were available for clarifications after the interview and responded positively. Since all interviews were conducted by the same interviewer, it might be the case that an interviewer bias occurred. The interviewer participated in training sessions for the improvement of interview skills to overcome personal influence. Besides, the interviews were conducted in the interviewees' usual workplace and in their native language to avoid any influence of the environment or the language.

Next to the interviews with NedTrain employees, an interview with two representatives of SVT was conducted while they visited one of NedTrain's workshops. The circumstances did not allow to record the interview, thus notes were taken by two persons and compared afterwards to assure the correctness of the data. Unfortunately, it was not possible to have an equal number of interviews with employees from NedTrain and SVT and to interview system-integrators to recheck the statements that SVT made about the relation between SVT and the system-integrators. Therefore, more emphasis has been put on the literature for answering sub-question c. For this purpose, articles have been selected from the database SCOPUS that contain the search term "triad" within their keywords and use triad in the context of business relationships.

When all interviews were completed, the suggestions found in literature were compared with the interview results. It was analysed which of the suggestions prove suitable for NedTrain given the internal processes, the external market conditions, and the statements made by SVT. Suggestions made by the interviewees were added and the results synthesized into an advice and action plan for NedTrain.

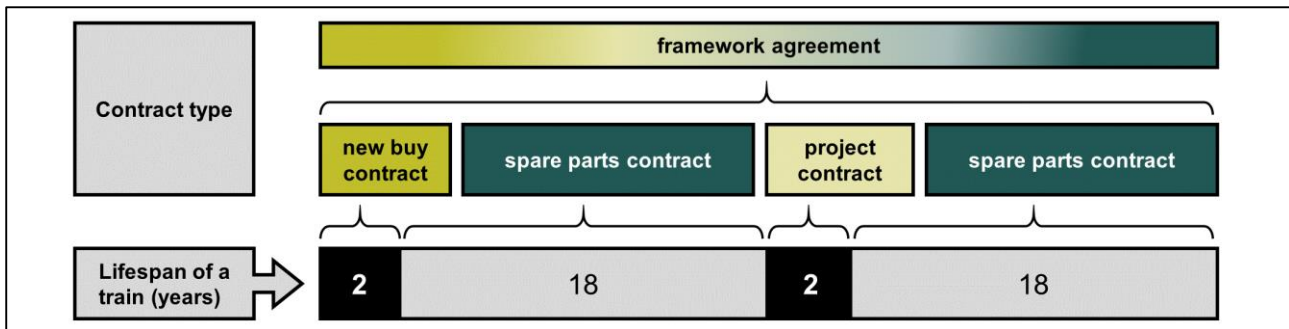


Figure 3. The different contract types used by NedTrain.

#### 4. STATUS QUO: CURRENT AGREEMENTS

As explained earlier, a train runs through different phases during its lifespan and the phases require different contract types (see Figure 3). The contractual basis for the purchase of new trains are new buy contracts between the train manufacturer and NS. NedTrain serves as an adviser but does not own the trains technically. Since NS is owned by the Dutch government, it is considered to be a public organization. Therefore, it is obliged to follow the European law on public procurement. The law prescribes that all procurement contracts with a value that exceeds the threshold defined by the European Commission need to be awarded by a public tendering process ("Directive 2014/25/EU of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal service sectors"). Trains are not bought as individual units but in bulk orders and the value of such a bulk order exceeds the threshold. When publishing a tender, NS and NedTrain already look ahead to the spare parts phase: the tender includes the intention to buy spare parts throughout the first half of the train's lifespan in the form of spare part agreements. In addition, when a train manufacturer wants to make a bid for the tender, it needs to agree that it will sign back-to-back agreements with its suppliers upon request from NedTrain. These agreements allow NedTrain to purchase spare parts directly from the sub-supplier under the same terms and conditions as agreed in the spare parts agreements. Such back-to-back agreements are used when the system has a high impact on the performance of the train, the customer experience, and/or the costs. Spare part agreements come into force when the two-year guarantee period expires. In the case of the toilet system, such spare parts contracts are signed with the component OEMs due to the high impact on the customer experience. After 20 years, it is not sufficient anymore to maintain the systems with spare parts and Refurbishment NedTrain needs to buy new systems for the modernization of the train series. This purchase is again a bulk order with high value and needs to be awarded by a public tender like the order of new trains. Similarly, such a tender includes also spare part agreements and the right to make back-to-back agreements. These procurement contracts are called project contracts. NS owns different train series, e.g. double-decker Intercity trains and the Sprinter Lighttrains. The train series have been purchased in different years and their lifespan phases overlap. Therefore, NedTrain aims at signing framework agreements with its contracted suppliers that formulate the general responsibilities of the companies and the conditions for the exchange of goods. The arrangements made in the framework agreement apply for all spare parts and project contracts with the same supplier.

Vacuum toilets from the component OEM SVT are already built into different train series that are riding on the Dutch railway and now it is about time to renew the framework agreement. The

current contract includes the following statement: "NEDTRAIN, as the company responsible for the maintenance of the rolling stock of carriers and owners, is obliged to strive for and accomplish maximum rolling stock availability; to NedTrain, lowest Life Cycle Costs and timely and adequate availability of goods are of the utmost importance in this respect; SVT recognizes these objectives and will do everything in its power to help attain these objectives". This statement represents NedTrain's aim of transferring responsibility for its goals on to the supplier. However, the objectives are not further specified in the agreement and neither are the consequences. The contract mentions five indicators that NedTrain uses to record SVT's performance: delivery achieved within confirmed delivery time, delivery achieved within contractual delivery time, number of order confirmations, quotation lead time, and delivery quality. Clearly, all five performance indicators are focused on logistics and the quality at the moment of delivery. None of the indicators measures SVT's performance concerning NedTrain's RAMSHE and LCC goals. Furthermore, the contract states that NedTrain will inform SVT periodically about its performance without specifying 'periodically'. Likewise, the only type of penalty mentioned is for a delay of the delivery. For every day that the delivery is delayed, NedTrain will deduct a specified percentage of the order's value from the total price. The penalty is limited to a specified percentage of the order value. There are no penalties related to the performance of the product or other responsibilities of SVT and neither are any incentives mentioned.

Next to the delivery of the goods, SVT has several responsibilities that are related to the flow of information between the two companies. First, SVT has to update the goods list, which is an attachment to the contract, regularly and at least once per year. Furthermore, the component OEM has to inform NedTrain in writing if any alternatives for the goods are available as well as if the production of one of the goods is terminated. In that case SVT has to provide an alternative for it. Besides that, SVT has to report if there are product design modification, changes in material, modifications in the production process, or interruptions of the supply or production. Moreover, SVT has the obligation to provide NedTrain with the documentation that is necessary for all maintenance activities related to the goods and updates in case the documentation changes. It is not mentioned in which language the documentation has to be. Considering that the two companies are based in two different countries, the language should be stated in the contract. Last but not least, SVT has to inform NedTrain about any changes of its financial situation like mergers or takeovers. As already mentioned, there are no consequences named for the case that SVT neglects these responsibilities.

The contract has a validity of five years and an early termination is not allowed. During this period, the prices of the goods may be adjusted once per year based on a given price escalation formula.



The formula includes price indexes that are calculated by the national Department of Statistics of the country where the supplier SVT is based. NedTrain has to pay the invoices within 30 days net after the date of receiving it. The goods have a warranty period of several months and is clearly mentioned in which cases the warranty does not apply: "This warranty does not cover defects in or damage to products which are due to improper installation or maintenance, misuse, neglect or any cause other than ordinary commercial application. The same applies to natural wear and tear, faulty or neglect handling, inappropriate operating resources and/or replacement materials and/or other actions that fall within NedTrain's area of responsibilities and which have led to the defectiveness of the goods". Since "natural wear and tear" is not covered by the warranty, NedTrain defines a quality policy: SVT is required to be ISO 9001 certified. Additionally, quality activities and quality planning need to be done in cooperation with a Supplier Quality Assurance (SQA) engineer from NedTrain. These processes have to be documented and approved by NedTrain. In case NedTrain nevertheless detects a quality non-conformance during the regular supply of goods, SVT will be informed about it and has to take corrective measures and actions. NedTrain can decide to conduct a quality audit. Again, there are no penalties or incentives defined and the consequences are limited to certain procedures. Altogether, the current framework agreement covers mainly the procedures at the supplier and the delivery. Afterwards, the main responsibilities of SVT are limited to information exchange. The component OEM most likely does not feel motivated to engage in performance improvement since there are no agreements about positive or negative consequences. As part of the NS Groep, all contracts made by NedTrain are subject to NS General Purchasing Conditions. However, if the clauses in the framework agreement contradict with clauses in the NS General Purchasing Conditions, the former overrules the latter.

## 5. LITERATURE REVIEW

NedTrain is seeking a relationship with the OEM SVT that goes beyond the delivery of goods, namely they want to reach collaborative performance improvement. This phenomenon of adding intangible performance such as support, knowhow, and specialized services to tangible goods has been explicitly mentioned for the first time in literature by Vandermerwe and Rada (1989). They observed the trend in business that goods and services cannot be clearly distinguished anymore but that corporations engage to a varying extent in both. Based on their naming this trend is called *servitization* (Baines, Lightfoot, Benedettini, & Kay, 2009; Finne & Holmström, 2013). Vandermerwe and Rada (1989, p. 314) specify their observation that: "Modern corporations are increasingly offering fuller market packages or "bundles" of customer-focused combinations of goods, services, support, self-service, and knowledge." Two examples for companies who made a transition from traditional product offerings to such bundles are Alstom Transport and Thales Training & Simulation. Alstom Transport operates in the railway industry and initially offered a.o. signalling and train control systems. Now they offer the product-service system (PSS) 'Total Train-Life Management'© that includes a.o. renovation, parts replacement and service products. Thales Training & Simulation sold flight simulators for commercial and military aircraft and changed its focus to a PSS by selling training services (Davies, 2004). The trigger for the servitization trend are customers: new information technologies shift power and allow them to compare offers and to demand more extensive and customized bundles of goods and services (Vandermerwe & Rada, 1989). Customers benefit from servitization as the value of such bundles is higher than the value of the individual

components (Davies, 2004) and their needs and problems are understood and served more properly (Vandermerwe & Rada, 1989).

In the past, SVT did not only deliver spare parts to NedTrain but also took care of the maintenance of the vacuum toilets. However, four years ago, NedTrain built an in-house facility to do the maintenance itself. This situation highlights one of the disadvantages of servitization: when providing services in addition to products, a manufacturer acts in several markets and encounters different competitors. Among them can be their own suppliers, distributors, and customers (Mathieu, 2001; Vandermerwe & Rada, 1989), like in the given situation: NedTrain and SVT can both deliver the same services. Since NedTrain started to maintain the vacuum toilets itself, the relation with SVT has been limited to the exchange of goods. Next to the reason that there is currently no official agreement about combined bundles of goods and services, there might be another argument that hinders SVT to engage in collaborative performance improvement: additional services might consume a part of its business when the service leads to a longer lifespan of the product and thereby decreases the number of replacement sales (Oliva & Kallenberg, 2003). Therefore, it is unlikely that SVT will develop the need to support NedTrain in reaching its performance goals by itself. Thus, a contract is required that arouses SVT's interest to engage in collaborative performance improvement.

### 5.1 Contract Type

The situation between NedTrain and SVT can be modelled as an agency problem: two cooperating parties have different goals and division of labour. The principal, in this case NedTrain, delegates work to the agent, SVT, who performs the work. The agency problem occurs because the goals of the principal and the agent differ and it is difficult for the principal to measure the behaviour of the agent (Eisenhardt, 1989). For NedTrain, it is difficult to assess e.g. how much effort SVT puts in the improvement of the product's reliability. Agency theory assumes that people and organizations aim at maximizing their own utility and thus the agent might not always act in the best interest of the principal (Jensen & Meckling, 1976). The theory focuses on determining the most efficient contract to govern the relationship between the principal and Eisenhardt (1989) proposes that the agent is more likely to behave in the interests of the principal when the contract between them is outcome based (Eisenhardt, 1989). The technique of using outcome-based contracts is best known under the name *Performance-Based Contracting* (PBC). Ambaw and Telgen (2016, p. 11) define PBC "as a form of contracting where the end results of the contract are expressed in terms of measurable outputs, outcomes, or a combination of these, and contractors are paid only when it is confirmed that the agreed-upon results are achieved, rather than describing the inputs used, the activities to be done, and the means used to achieve the results of the contract". A distinction has to be made between outputs and outcomes: "'Outputs' are defined as the direct results of the service activity or production process itself, whereas 'outcomes' are defined as the value derived by the customer from a given service or product" (Selviaridis & Wynstra, 2015, p. 3507). When applying these definitions to the case, the component vacuum toilet would count as output, while reaching a certain reliability rate of the component can be understood as outcome. A well-known and probably the earliest example for the application of PBC in practice is the case of Rolls Royce: the company is providing aero engine maintenance and its Power-by-the-hour™ business model includes that the payment is based on engine availability measured as hourly aircraft uptime instead of the inputs such as labour and spare parts (Baines et al., 2009;

Cohen, Agrawal, & Agrawal, 2006; Ng, Maull, & Yip, 2009; Selviaridis & Wynstra, 2015).

The application of PBC has several advantages for the involved parties. Overcoming the agency problem by aligning the interests of both parties is beneficial for the customer because the risk is transferred to a large extent to the supplier (Gruneberg, Hughes, & Ancell, 2007). Since the payment of the supplier is tied to achieving the desired outcome, the supplier is bearing the risk of not being paid. However, if the supplier performs well, the risk is usually financially compensated (Gruneberg et al., 2007; Tate, Ellram, Bals, Hartmann, & van der Valk, 2010) as well as surpassed by other benefits. Thereby, the supplier is more motivated to reach the customer's goals. PBC gives suppliers the flexibility to decide themselves about the resources and procedures used to deliver the agreed outcome or output (Boykin, 2005; Lawther & Martin, 2005) and motivates them to maximize the utility of inputs and the efficiency of processes (Kleemann & Essig, 2012). Furthermore, PBC increases the trust within the buyer-supplier relationship and trust in turn facilitates information sharing (Ambaw & Telgen, 2016).

While PBC offers these advantages, the implementation is a challenge that can turn into pitfalls when not handled thoroughly. An overview of the pitfalls that are likely to occur is presented in Table 1. The first eight pitfalls are adopted from Behn and Kant (1999). They name two more pitfalls that can occur if the supplier

**Table 1. Pitfalls of PBC.**

1)	Performance contracting may inhibit experimentation
2)	Performance contracting may encourage innovation in cost cutting but not in service delivery
3)	Performance contracting may stifle overachievement
4)	Performance contracting may not provide for start-up costs
5)	Performance contracting may reward promises not performance
6)	Performance contracting uses measures that can distort behaviour
7)	Performance contracting may not be in line with the pillars of public procurement principles
8)	PBC must rely on outputs not outcomes
9)	Contractors need to be trained and experienced in techniques of setting measurable metric standards and performance evaluation
10)	The contractors might not willingly accept the risk of the contract

delivers its performance directly to citizens. Since this is not the case, they are excluded here. Pitfalls 7 and 8 are also mentioned by Ambaw and Telgen (2016) and they add the two additional pitfalls 9 and 10. They also list two more pitfall which only apply when the purchase is subject to the World Procurement guidelines or when an employee from a government institution is making the purchase which is both not the case here. Under PBC, a supplier will try to achieve the specified outcome as fast as possible in order to get his payment. Once the supplier found a way, he might not want to experiment with other, possibly better methods in order to keep the risk low. Reluctance to experiment might hinder the discovery of the most efficient method (1). When the supplier found a way to achieve the specified outcome, he will be mainly motivated to find a way to cut his own costs because this will increase his profit margin (2). It is less likely that he will try to improve the service or product beyond the defined outcome because it does not lead to additional profit (3).

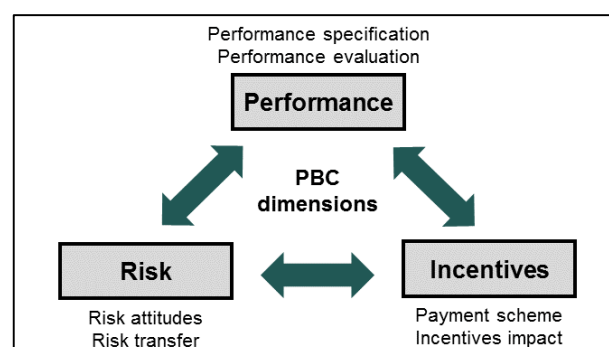
Furthermore, a supplier has to invest capital in order to reach the specified outcome and will only get paid once he achieves results. Many suppliers will not have the access to sources of capital and risk to go bankrupt in case the results are not achieved fast enough (4).

The public procurement law forces state-owned companies to award the tender to the supplier with the best bid. When making a bid, neither the supplier nor the buyer is able to exactly forecast which performance can be reached. Suppliers are stimulated to offer the best performance they realistically hope to achieve in order to win the tender. Thus, there is a tendency to make offers that overpromise the capabilities of the supplier and a supplier might be chosen based on the promises made and not the actual performance capabilities (5). Moreover, when the measurements defined in the contract do not exactly reflect the desired outcome, the supplier's effort will be directed into a different direction than to the real purpose which the buyer wants to achieve (6). Besides, PBC requires a close collaboration between the supplier and the buyer in order to be successful. However, the public procurement laws force state-owned institutions to treat all bidders equally to keep a fair competition. Since new purchases have to be awarded via the tendering process, the buyer cannot promise a supplier an extension of the contract when he performs well under PBC and there is no guarantee that a close collaboration can be maintained over several contract terms (7).

The success of PBC is largely influenced by the measurement of the outcome. Buyers might lack the right technology to measure it or the outcome will only become visible after several years. Since suppliers cannot survive when they are only paid after this time, the buyer will often need to reward the supplier based on the output instead of the outcome (8). Furthermore, the buying company needs to have experts that are trained and experienced in setting measurable metric standards and evaluating the performance. Otherwise, the supplier and his performance cannot be controlled (9). As mentioned earlier, the use of PBC shifts most risk to the supplier who might be reluctant to agree to such a risky contract. This pitfall might lead to the situation that only a small number of suppliers or even one or no supplier tries to win the tender (10). These ten pitfalls of PBC are likely to hinder the successful use, but there are strategies that help to avoid the pitfalls which will be presented in the following section.

## 5.2 Elements of the Contractual Relation

PBC is a contracting approach that contains valuable advantages on the one hand and serious pitfalls on the other hand. Therefore, PBC should be based on a well-grounded concept. For this purpose, Selviaridis and Wynstra (2015) define three key dimensions of PBC: performance, incentives, and risk (Figure 4).



**Figure 4. The dimensions of PBC (adapted from Selviaridis and Wynstra (2015)).**

The dimension 'performance' represents "the processes and practices of specifying, measuring, evaluating and reporting

performance”, while the dimension ‘incentives’ summarizes “the structure of financial and non-financial incentives as well as their impact on supplier behaviour”. Last but not least, the dimension ‘risk’ stands for the “allocation of financial and operational risks” (Selviaridis & Wynstra, 2015, pp. 3508-3509). Related to these dimensions, strategies exist to overcome the ten potential pitfalls of PBC which are going to be explained below.

### 5.2.1 Dimensions of PBC: Performance

PBC requires a definition of the outcome that the buyer wants the supplier to achieve and the specification of performance measurements to control if the outcome is reached. However, the difference between the mission of the buyer and the measurement needs to be noticed: “The mission provides people with a sense of true purpose; the measure[ment] provides them with concrete information on how much they have accomplished.” (Behn & Kant, 1999, p. 479). This difference needs to be recognized and the mission and measurement have to be carefully defined in the contract (A). In addition, it is important to link the outcome measurement to the mission (B1). Behn and Kant (1999) highlight the importance of correct outcome definitions and name three essential characteristics of a sufficient definition: an outcome needs to be measurable, understandable, and attainable (B2). If it cannot be measured, it is impossible to determine if the supplier performed as desired and thus the customer is not able to decide about the payment. Second, if the formulation of the outcome is too complicated, it will likely confuse the supplier. Third, if the specified outcome is regarded as unattainable, the supplier will be demotivated instead of performing in the best way possible to reach it. In addition, the outcome and its measurements should be defined in a way that facilitates benchmarking in order to allow the comparison between different suppliers and the comparison between the performance of a supplier during different months or years (B3).

When it comes to measuring and evaluating the performance, the terminology has to be treated carefully: a performance measurement is defined as “the process of quantifying the efficiency and effectiveness of action” (Neely, Gregory, & Platts, 1995, p. 80) while a performance measure is “a metric used to quantify the efficiency and/or effectiveness of an action” (Neely et al., 1995, p. 80). The choice of performance measurements is complex and buyers need to be prepared that the first performance contract will not be perfect. PBC is a learning process that requires to change and improve the contract. Buyers need to learn from the experience and apply it for the subsequent contracts (C). Often, the actual usefulness of a measurement only becomes visible after being in place and it is therefore advisable to monitor several performance measurements that exceed the ones set in a contract and, where appropriate, to adjust or exchange them (D) (Behn & Kant, 1999). However, the measurement and monitoring systems require significant investments of time and money (Selviaridis & Wynstra, 2015). Thus even though monitoring several measurements is recommended by the literature, the implementation of extensive systems is most likely not realizable for every company.

When PBC is used, buyers should favour suppliers with a track record. When PBC has already been used for a supplier, the obtained data about his performance and capabilities can be used for new contracts (E). Further, moments of evaluation of the obtained performance measures and consequently the date and method of payment need to be specified in the contract (Ambaw & Telgen, 2016).

### 5.2.2 Dimensions of PBC: Incentives

The literature discusses different payment schemes that rank from paying the supplier a basic payment while adding bonuses or penalties related to the performance measurements till pure

pay-for-performance contracts that tie the full payment to the achievement of defined benchmarks (Collins-Camargo, McBeath, & Ensign, 2011; Selviaridis & Wynstra, 2015). Behn and Kant (1999) recommend that a supplier should not only be paid for the final outcome but also for significant progress. Suppliers need capital to keep their business running and to complete their work. Therefore, milestones should be defined and a portion of the outcome payment should be tied to the achievement of such a milestone (F). Likewise, incentives can be awarded when the provider behaves in a way that is likely to influence its performance positively, such as innovative procedures or high investments in the product or service provision (G) (Ambaw & Telgen, 2016). While agency theory is useful for aligning the different goals of the customer and the supplier, it is mainly focused on the contract design phase. However, measuring and evaluating a supplier’s performance takes place during the contract management phase. A theory that is focused on this phase is management control theory. It makes assumptions about the choice of control type that is used to monitor the contractual compliance and to administer rewards and penalties. The theory differentiates between process monitoring and output monitoring. While the first one focuses on the methods and procedures, the last one aims at monitoring the interim and/or final outputs (Selviaridis & Wynstra, 2015). Conceptually, output monitoring is the appropriate control type for PBC. However, if milestones are supposed to be awarded as suggested by Behn and Kant (1999), the customer has to have at least some knowledge about the supplier’s processes. This means that contrary to the review of Selviaridis and Wynstra (2015), a hybrid method of process and output monitoring should be in place.

The financial consequences that are tied to the evaluation of the performance can have the form of bonus payments when the minimum performance standard is exceeded or negative penalties when the performance is below the standard. (Ambaw & Telgen, 2016). While it is possible to exercise control over the supplier and its performance by financial methods, more innovative and non-financial methods have developed alongside: customers can create e.g. competitive pressure by contracting the second best supplier as backup in addition to the best supplier. If the first-choice supplier underperforms, the backup-contract kicks in and the second best supplier takes over (H). Furthermore, companies can use contracts with a short contract term e.g. a year and add the option to prolong it if both parties are satisfied. Thereby, the provider feels more motivated to reach the agreed outcome in order to get an extension of the contract. For the purchasing company however, it is easier from a juridical perspective not to prolong a contract than terminating it early in case the performance is not sufficient (I) (Telgen, 2009). In general, it is advisable to apply incentives and penalties parallel and symmetric (Ambaw & Telgen, 2016; Fearnley, Bekken, & Norheim, 2004).

### 5.2.3 Dimensions of PBC: Risk

A requirement for successful PBC is that the supplier is willing to take some risk while the buyer is risk-adverse since his payment is tied to some extent to his performance. Most risk is transferred when pure pay-for-performance contracts are applied. As explained, PBC is a learning process for both the buyer and the supplier. Thus, one should start with a simple performance measurement so that the risk for both is low at the beginning. Once the supplier gets used to PBC, the buyer can create targets that stretch the capabilities of the supplier (J). This procedure allows a gentle shift of the risk (Behn & Kant, 1999). Furthermore, the level of riskiness transferred should be reflected in the financial rewards that can be achieved. In extreme situations, it should even be considered to forego penalties in the



**Table 2. Strategies to overcome the pitfalls of PBC.**

No.	Strategy	Source	Avoided Pitfall(s)
A)	Understand the relationship between the mission and the measure.	Behn and Kant (1999)	9
B)	Create contracts that are based on outcomes that are 1) linked to the mission, 2) easy to measure, understand, and reproduce; and 3) facilitate benchmarking.	Behn and Kant (1999)	5, 6, 8
C)	Be prepared to learn, change, improve, and learn some more.	Behn and Kant (1999)	9
D)	Monitor frequently lots of indicators of performance, not just the one(s) specified in the contract.	Behn and Kant (1999)	6
E)	Favour suppliers with a track record.	Behn and Kant (1999)	5
F)	Pay suppliers not just for the final outcome but also for significant, well defined progress.	Behn and Kant (1999)	1, 4, 10
G)	Reward quality innovations and the risk of high investments	Ambaw and Telgen (2016)	1, 2, 10
H)	Use back-up contracts with second best supplier.	Telgen (2009)	3, 5
I)	Use short contract terms and the option prolong the contract in case of sufficient performance.	Telgen (2009)	3, 7
J)	Start simple and ratchet up.	Behn and Kant (1999)	9, 10
K)	Adjust rewards to level of riskiness.	Selviaridis and Wynstra (2015)	10
L)	Take influence of force majeure into account when assessing the performance.	Fearnley et al. (2004)	10
M)	Handle caps of financial rewards carefully.	Fearnley et al. (2004)	3
N)	Work collaboratively – not adversarially – with contractors.	Behn and Kant (1999)	5

payment scheme when suppliers might otherwise not be willing to take the risk (K) (Selviaridis & Wynstra, 2015). In addition, the customer should take external factors such as economic trends, price fluctuations of material, and demographic factors into account when assessing the performance of the supplier (L). If an insufficient performance is subject to force majeure, he should not be blamed for it (Fearnley et al., 2004). Moreover, companies can make the decision to set caps for the sum of the bonus and penalty payments. The caps have the effect that if the supplier performs much better or much worse than expected, the penalty or respectively the reward cannot increase without limits but stops at a specified level (Fearnley et al., 2004; Grinblatt & Titman, 1989). Thereby, the customer can control potential expenses and the supplier its losses. These caps have to be chosen carefully though (M), since they might otherwise demotivate the provider to reach the outmost best performance possible (Fearnley et al., 2004). Under PBC, the supplier and the buyer should work collaboratively. The supplier has great expertise when it comes to his product or service and can help the buyer a.o. to improve specifications, set the right expectations concerning the desired performance, and engage in innovation in quality and costs (N) (Behn & Kant, 1999).

#### 5.2.4 Summary of the Strategies

A summary of the strategies linked to the pitfalls that they help to avoid can be found in Table 2. The strategies were discussed during the interviews in order to recheck their feasibility and to discover additional strategies. Taken all together, the feasible strategies form the basis of the proposed solution.

### 5.3 Influence of the System-Integrator

The topic “triad” stems initially from sociology: Simmel (1950) described a.o. relationships between three people (Bastl, Johnson, & Choi, 2013; Choi & Wu, 2009b; Wuyts, Rindfleisch, & Citrin, 2015), but Caplow (1956) argues that the assertions made about three-person groups can be generalized for large organized groups. It is argued that triads should be studied because dyads do not take into account that firms are embedded in networks and by focusing on dyads it is not possible to explain

the behaviour and relationships of firms (Choi & Wu, 2009c). Critics argued that a triad is neither able to reflect the whole network (Dubois, 2009), but researchers need to set borders for their studies and a triad is appropriate since it is the smallest where links can be observed (Choi & Wu, 2009b). In the existing studies, the observed trend of servitization becomes visible: one third of the applicable papers found that use “triad” as key term focuses on service triads, analysing the implication when services are outsourced to an external provider. The research papers that concentrate on manufacturers focus mainly on buyer-supplier-supplier triads and co-opetition, cooperation or competition between the two suppliers (Wu, Choi, & Rungtusanatham, 2010; Wynstra, Spring, & Schoenherr, 2015).

Van der Valk and van Iwaarden (2011) shed light on subcontractor – buyer – end customer triads where the end customer requests a service from the buying company that outsources the service provision to the subcontractor. This triad can be compared with NedTrain’s supply chain: during warranty phase 1 and 2 (Figure 2a & b, page 3), NedTrain (the end customer) orders from the train manufacturer or system OEM (the buyer) who receives the spare parts from the component OEM SVT (the subcontractor). By applying agency theory, Van der Valk and van Iwaarden (2011) made propositions about the contractual arrangements and monitoring activities in place between the three parties. The subcontractor can be seen as an agent who has two principals: the buyer and the end customer. The two principals have their own goals which might be different. Since there is no direct contract between the subcontractor and the end customer or in the current case between SVT and NedTrain during the warranty phases, the subcontractor will try to reach the objectives that are defined by the buying company or the system-integrator since this performance will be compensated. Therefore, the end customer needs to make sure during the contract management phase that its objectives are fulfilled by monitoring the agent’s activities. While monitoring helps the principal to control the agent, the agent might feel controlled and might show reluctance (Van der Valk & van Iwaarden, 2011). Thus, it is argued that the contract types within the triad and the monitoring activities need to be

aligned. Further, Van der Valk and van Iwaarden (2011, p. 200) propose that relational governance could overrule contractual governance in triads: if there was a misalignment, it could be overcome by a social contract which is defined as “a micro-level agreement that is purposely designed within an individual exchange relationship”. Such social contracts could be “agreements about objectives and behavioural standards as a foundation for their ongoing interactions”. However, the proposition made by van der Valk and van Iwaarden were tested only in two case settings and need to be further evaluated in empirical research.

## 6. INTERVIEWS

NedTrain’s procurement department is structured in four teams and there is a functional differentiation between them: *Procurement Projects* plans the modernization after 20 years and is also responsible for setting up the spare parts agreements. Afterwards, the *Spare Parts & Equipment* team takes over and cares for the contract management. Thus, the contract manager of SVT is working within this team and operates as a tactical buyer. The *Planning & Purchase* team is responsible for all operative tasks related to ordering. Last but not least, the *Strategic Supplier & Category* team deals with strategic suppliers and takes an overarching role. In total, seven formal recorded interviews were held as well as several informal talks with four additional employees. The function of the interviewees related to the contract types can be seen in Figure 5. The two interviewees from SVT were a Sales Manager and the Head of the After Sales Service Department.

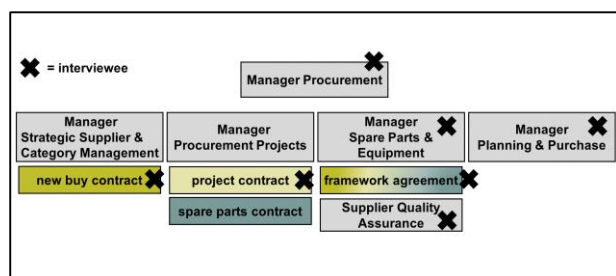


Figure 5. Functions of the interviewees at NedTrain.

## 6.1 Internal Processes at NedTrain

### 6.1.1 Corrective Maintenance

As explained earlier, malfunctions of the toilet system have a crucial influence on the operations and require corrective maintenance at one of NedTrain’s maintenance shops that are spread over different locations in the Netherlands. A mechanic will control the toilet system at the maintenance shop visually. If this is sufficient to detect the cause of the failure, e.g. clogging and is able to solve it at the location, the mechanic will rectify it immediately. However, if the mechanic diagnoses that the cause for the failure must be within the component vacuum toilet, he will take out the whole component and replace it with a new one. He enters the observation of the cause into a system. However, the observations are not specific because they are based on the visual control and are neither analysable: not much attention has been paid to the failure registration and most of them were registered within the category ‘other’.

The faulty system is sent to NedTrain’s largest repair shop. Upon arrival there, the vacuum toilet will be brought to a special cleaning station where it gets disassembled in its individual parts and cleaned in citric acid. Afterwards, certain parts will be sorted out and replaced with a standardized spare parts kit. After reassembling the vacuum toilet, it will be tested and if it functions properly, kept in stock in order to replace the next vacuum toilet

with a malfunction at a maintenance shop. This means, that no incoming control takes place. Even if only a small part within the vacuum toilet is the cause for the fault, all other parts that are in the spare parts kit will be replaced. The result is on the one hand that the costs for spare parts are much higher than necessary and on the other hand that there is no track record of the specific failure, e.g. if a small part degrades faster than expected. According to the interviewees, it is not possible to make incoming tests due to safety and health regulations. However, SVT is doing such tests at its own facility. The interviewees were not sure if this is due to different regulations in the country where the supplier is based or if SVT found a solution to make the procedure safe enough for the employees. Every component that is repaired at the large maintenance shop receives a QR code in order to save its maintenance history, but there is no registration that tracks which system is built into which train. If a train is brought to a maintenance shop for a planned maintenance that includes a revision of the vacuum toilet, a full spare parts kit will be used. Since the track records of the component and the train are not connected, it might be the case that the toilet will be revised again even though maintenance took place two months earlier to fix a malfunction. Therefore, NedTrain is not able to measure the desired outcomes reliability, maintainability and LCC of the component since more spare parts are used than it might actually be necessary.

### 6.1.2 Contracting

During the interviews it became clear that an internal reorganization of NedTrain’s procurement department which took place less than a year ago caused vagueness about the division of tasks between the four teams, e.g. the scope of the contract manager’s tasks is not clear for all buyers in the other teams. Further, not all contracts have been filed in the digital system and standard procedures such as filing information, e.g. communication or risk matrices, are not embedded in the responsibilities but dependent on the effort and thoroughness of the contract manager. However, they are highly required to coordinate the smooth cooperation of different tasks and employees.

## 6.2 Relation between SVT and NedTrain

SVT has been a supplier for NedTrain for several years and the system is currently built in three of its train series; the total fleet includes eight different train series. The value of the spare parts that NedTrain is buying from SVT is rather low and accounts for less than one percent of SVT’s turnover. Previously, the contact between NedTrain and SVT was limited to negotiations about the terms of the contract and the delivery of spare parts. Both companies decided that they prefer to work more collaboratively by organizing e.g. personal meetings, plant visits, and information sharing. Lately, a new contract manager has been appointed for SVT who is supposed to renew the framework agreement between the two companies. Overall, NedTrain is satisfied with the relation with SVT, but during the interviews, three problems turned out to be in place between NedTrain and SVT: first, in the past it happened more than once that SVT changed parts of the vacuum toilet without communicating these changes to NedTrain. When NedTrain used the given order number, it suddenly received a different part than mentioned in the documentation. The result were ambiguities about the differences at the work place, if new instructions were needed, and how to proceed with the leftovers of the old version of the part that NedTrain still had in stock. These ambiguities caused delay in the maintenance. Second, the engineers criticized that SVT only offers spare parts within large kits and it is often not possible for NedTrain to order individual smaller parts, e.g. when it appeared during testing the cleaned and maintained toilet that

such a small part was not working properly. In some of these situations, it was eventually possible to order the single component after talking several times to different people which required unnecessary time and effort. SVT on the other hand criticized a communication issue: the component OEM gets contacted by several NedTrain employees from different departments and it is not clear which tasks these different persons have. This problem can be linked to the internally observed issue that often a communication matrix is missing.

Literature suggests that suppliers might be reluctant to offer product-related services because they might consume the spare parts sales. According to the interviewees, the business model of most OEMs indeed relies on the sale of spare parts, also known as the razors-blades-myth: an item is sold at a relatively low price in order to increase the sales of complementary goods (Picker, 2011). However, according to the statements of the interviewees from SVT, the component OEM makes one quarter of its turnover by selling spare parts and three quarters by selling complete new components. In addition, NedTrain has a low purchasing volume. Based on these facts, it can be assumed that cannibalism of the business is not an important issue in the relation with NedTrain.

### 6.3 Strategies

During the interviews it appeared that it is not possible for NedTrain to put all fourteen strategies that were suggested by literature into practice. NedTrain's procedures for the detection of the cause of a vacuum toilet's malfunction are not sufficient to measure e.g. the components reliability. The unspecific failure registration based on visual control and the missing incoming control hinder the measurement of the desired outcome concerning the RAMSHE aspects. Further, the use of standardized spare part kits has a distorting effect on the LCC calculation since more spare parts might be used than necessary. Thus, NedTrain is currently not able to measure the performance and is not able to implement strategy B. Even if NedTrain would be able to measure e.g. if the LCC that the supplier names are correct, it is according to the interviewees from SVT very difficult for a maintenance company like NedTrain to prove that all maintenance that is prescribed in the documentation has been

executed correctly. Thus, if the buyer wants to hold the supplier responsible for early degradation of the product, the supplier will most likely be able to successfully contest it.

As Selviaridis and Wynstra (2015) criticized, it is rather expensive to monitor several performance indicators. Since NedTrain at the moment only uses indicators that are focused on logistics, the introduction of different performance indicators for e.g. quality and the related monitoring systems will require a relatively large investment. Thus, it might not be possible to follow strategy D. Strategy J, "start simple and ratchet up", might be more appropriate at the beginning. Also, strategy E "Favour suppliers with a track record" is currently not feasible since there is no clear record that could be compared.

Telgen (2009) suggests the use of back-up contracts or short contract terms (strategies H and I) in order to motivate the supplier. However, NedTrain would face high switching costs when changing the supplier during the spare parts phase because all components within a system are highly interdependent. As an industry analysis based on Porter's Five Forces model (Porter, 2008) shows, there are just a few alternate suppliers and the industry is rather static due to high entry barriers so that it is unlikely that new suppliers will enter the market soon (see Figure 6). Only if there would be an extremely large price difference between the suppliers, strategies H and I could be considered.

Except for the five named strategies, NedTrain can apply the strategies suggested by literature at least to some extent and can thereby overcome most of the pitfalls. Nevertheless, pitfall 6, 7, and 8 remain without solutions (see Appendix A, page 17 for an overview of all pitfalls and strategies). One of the interviewees from NedTrain suggested an alternative strategy that helps to solve pitfall 7 ("Performance may not be in line with the pillars of public procurement"): the data about the performance of the OEMs should be collected in a system that is accessible for all OEMs that are suppliers of NedTrain. Thereby, the suppliers can review their own performance and NedTrain can use the data when selecting an OEM for one of its projects. Since the suppliers have access to the data, the selection process remains transparent and the considerations are openly shared and thus, the

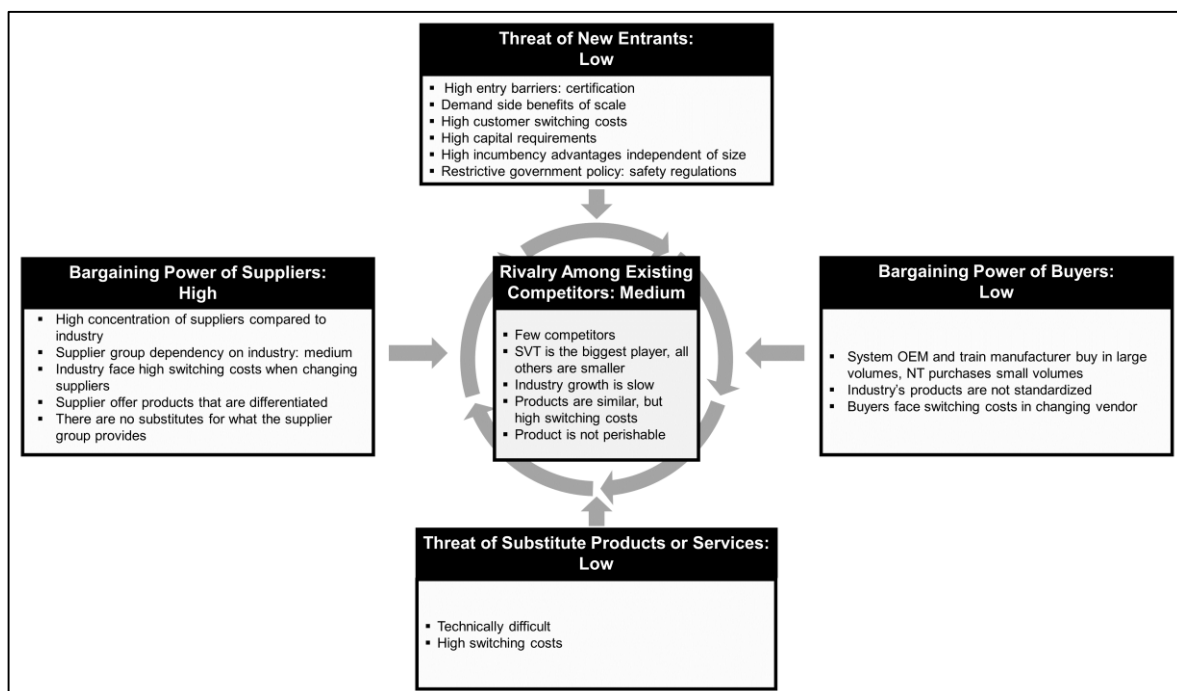


Figure 6. Industry analysis: Porter's Five Forces (adapted from Porter (2008)).

requirements of the European law on public procurement are fulfilled. The interviewee from SQA confirmed that it is one of their goals to build and implement such a system during the next months and years. Specifications for a system that is going to connect all existing ones have been written down and will be implemented as soon as they are approved by the management. However, it will take a while until the system is sufficiently implemented to be used for the named purpose. Therefore, it is not a solution that can be relied on right away.

Since the measurement of the outcome is not possible, it is likely that in case NedTrain starts using PBC, the measurement has to rely on the output and thus it is also not possible to introduce a pure pay-for-performance contract. However, contract types that tie all payment to the performance shift most risk to the supplier and since the power in the industry is on the side of the suppliers during the spare parts phase, a supplier will also most likely not accept the risk that comes with such a contract. Therefore, it might be more likely that the supplier agrees to a contract that guarantees a basic payment for the spare parts but additional rewards for (not) achieving a defined output or outcome. Furthermore, if this output or outcome is linked to the mission, it can still help to overcome pitfall 6 even though not all characteristics of an ideal outcome definition are fulfilled.

#### **6.4 Incentives and Penalties**

The current framework agreement between NedTrain and SVT includes a penalty payment for late delivery. While this is a standard procedure, other bonus-malus rules are not common in the market. One interviewee from NedTrain reported that the psychological effect of financial penalties is more serious than the actual sum that has to be paid. When working with penalty payments, it is most convenient to agree on a lump sum in the contract instead of charging the costs that incurred due to a malfunction because it is difficult and time-consuming to calculate the costs. On the contrary, it is also challenging to define bonus payments for milestones on the way to product improvement since it is often not clear which benefits the improvement will eventually deliver. Again, it is important to pay attention to an appropriate outcome definition and to link the milestones to it.

When it comes to non-financial incentives, the promise for future business with NedTrain has already been ruled out due to the public procurement law. However, NedTrain can reward SVT with a recommendation to other potential buyers. Due to the static market and few potential suppliers, it is easy to keep an overview over the existing suppliers which makes a good reputation crucial. One competitor of SVT has almost been driven out of the market because it got a bad reputation and nobody wanted to buy its products. It is also a possibility for NedTrain to threaten with a negative recommendation in case of insufficient performance. However, this is not a weapon that can be used as a daily motivation but is rather the last resort. Furthermore, interviewees from NedTrain named the exchange of in-service knowledge about the product, collaborative innovation development, and allowing SVT to use NedTrain's maintenance facilities in case needed as possibilities to reward SVT for reaching performance targets. While these incentives can be used as motivation in the long-term, standardized financial consequences can serve more easily as short-term motivation for reaching concrete targets.

#### **6.5 Monitoring**

One method for process monitoring is doing quality audits at the supplier which is expensive and time-consuming. However, when a supplier is certified, frequent audits will be done by the institution that awards the certificate in order to control if the

supplier still deserves the certification. SVT is currently not only holding the mandatory ISO 9001 certification but also the International Railway Industry Standard (IRIS). Thus, NedTrain should motivate SVT to keep its certification since it is a good control mechanism. Besides, it is difficult for NedTrain to monitor how much SVT invests in performance improvement such as product development. One third of SVT's engineers is working in R&D which indicates that product development is an essential part of SVT's work. In order to be able to monitor it to at least some extent, NedTrain could engage in joint product development and deliver inputs such as in-service knowledge.

Moreover, NedTrain has to engage in output monitoring and should e.g. monitor if SVT is delivering all the information that is asked for in the contract. It is important to define specifically which information is required, e.g. the language of the documentation, and to arrange clear communication lines between both companies. Several interviewees suggested that the contract manager should be responsible for organizing and steering the contact between both companies. The new contract manager already started to make a communication matrix. This matrix should be communicated throughout all teams within the purchasing department in order to be able to clearly monitor the communication.

#### **6.6 Influence of the System-Integrator**

Buying a new train is not an off-the-shelf purchase. The railway industry has a long history and evolved before the globalization started. Most countries developed their own railway network and thus there are differences in track width, the platform height at the stations, laws and regulations, and most important voltage used. Therefore, trains cannot be standardized such as cars or airplanes but have to be designed and produced according to national requirements. The long-term goal of the industry is a European standard that eliminates the differences between the national railway networks. Train manufacturers usually produce the essential parts of a train such as the car body and the traction power system themselves while acquiring all other systems from system OEMs. As already mentioned, NS is obligated to buy new trains through a tendering process that follows the EU law on public procurement. The tender includes all specifications that the new train needs to fulfil. The law prescribes that "technical specifications should be drafted in such a way as to avoid artificially narrowing down competition through requirements that favour a specific economic operator by mirroring key characteristics of the supplies, services or works habitually offered by that economic operator" ("Directive 2014/25/EU of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal service sectors"). Thus, NS has little influence on the train manufacturer's choice of the system OEMs. NedTrain, however, has to work with the system OEMs and their component OEMs for up to twenty years.

NS defines RAMSHE and LCC requirements for the complete train and assumes that the train manufacturer will transfer these requirements to all systems in the train. Conversely, the interviewees from SVT reported that the train manufacturer as well as the system OEM select component OEMs almost solely based on the lowest price offer. The aim of the train manufacturer is to push down the purchase value of the train in order to win the public tender and to maximize its own margin. In addition, the toilet system is not a crucial component for the train manufacturer compared to e.g. the brake system or the traction power system and thus he will likely not spend much effort on the selection.

During the warranty phase of the train, all spare parts are ordered from the train manufacturer. When the two years have passed, NedTrain contacts SVT directly for spare parts. Interviewees

from NedTrain said that it is often difficult to make this transition when there was no contact with the component OEM before.

## 7. DISCUSSION AND CONCLUSION

### 7.1 Contract Type

The sub-question a) addresses which contract type most likely promotes performance improvement. The scientific literature argues that outcome-based contracts are most helpful to tie supplier's performance to the buyer's goals, but also names several pitfalls that can come with PBC. The case situation shows that internal processes, product characteristics, the industry structure, and restrictions of the public procurement law determine if a company can follow the strategies for a successful implementation of PBC. Neither NedTrain nor the component OEM SVT are used to this type of contracting. During the interviews it became clear that the internal processes and systems of NedTrain do not allow to measure the maximization of the RAMSHE aspects and the minimization of LCC costs. Therefore, pure pay-for-performance contracts are not feasible given the current situation. Furthermore, often it is not possible to measure the outcome, but one has to rely on the output and the measurement might not exactly reflect the desired outcome which distorts the behaviour of the supplier. Due to the challenges of PBC, it is a learning process and buyer and supplier have to work collaboratively on it. While NedTrain has to develop its internal capabilities to measure the performance, the learning process can be started in a pilot project with SVT. Within the framework agreement, concrete consequences can be tied to the product-related performance such as the information flow. When buyer and supplier experience success and NedTrain's systems evolved, step-by-step more performance indicators can be measured and the achievement of desired outcome or output targets can be rewarded or non-achievement can be punished.

### 7.2 Elements of the Contract

Following Selviaridis and Wynstra (2015), a performance-based contract is built on a conceptual model that includes the aspects performance, incentives, and risk. Within the contract, the performance needs to be specified and thus, the new framework agreement should be more concrete, e.g. the language of the documentation should be specified and instead of using terms like 'periodically', time intervals should be named. Further, the statements made at the beginning of the current contract that are supposed to transfer responsibility to SVT for supporting the goals of NedTrain have to be incorporated into the contract terms and further specified. In addition, monitoring processes have to be implemented which can take the form of audits related to the certification and regular control of the information exchange by the contract manager.

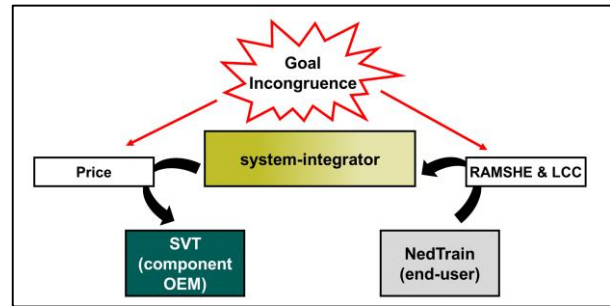
Moreover, consequences should be tied to the responsibilities of the supplier that come into force when the actions are not fulfilled and also when the supplier performs well. Incentives that can be awarded are the exchange of in-service knowledge, collaborative innovation development, recommendation in the market, and bonus payments. Negative consequences can take the form of a bad reputation in the market and financial penalties.

The incentives and penalties used need to be in proportion to the shift of risk. Since the power in the market is on the side of the suppliers during the spare parts phase, risk should be shifted for actions that have great impact for NedTrain but require either only a small effort from SVT or are even profitable for them. Among these actions are communicating sufficient information about the products and collaborative innovation development. When it comes to actions that involve more effort and risk for SVT such as selling individual spare parts instead of spare part

kits, the incentives need to be sufficiently attractive to make it worthwhile for SVT.

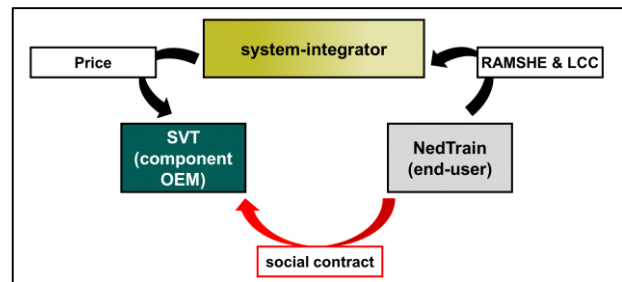
### 7.3 Influence of the System-Integrator

The analysis of the triad between the component OEM SVT, NedTrain, and the system-integrator showed that the contractual relation and NedTrain's attempt to reach performance improvement are clearly influenced by the system integrator. It appears that there is a goal misalignment between the system-integrator and NedTrain. While the former focuses solely on the minimization of the price, NedTrain aims for the maximization of RAMSHE and the minimization of LCC (see Figure 7a).



**Figure 7a. Goal incongruence between the system-integrator and NedTrain.**

When modelling the situation as an agency problem, SVT faces two principals. The system-integrator is the principal when it comes to the sale of new components while NedTrain becomes the principle during the spare parts phase. Since new business generates three fourth of SVT's turnover compared to one third from spare parts, SVT is likely mainly motivated to decrease the price of its components which can have a negative effect on the RAMSHE aspects and the LCC. While the system-integrator can freely choose the systems and components with the lowest price, it is almost impossible for NedTrain to switch to a different supplier once the component is built into a system in the train. Thus, NedTrain has to make sure that its own goals are transferred to the component OEM already when a new train is planned, designed, and built. Literature suggests that NedTrain could make a social contract with the component OEM already during the warranty phase to make sure that the effect of the goal incongruence is minimized (Figure 7b). Such a social contract



**Figure 7b. A social contract solves goal incongruence.**

does not need to be a legally binding document but should include "agreements about objectives and behavioral standards as a foundation for their ongoing interactions" (Van der Valk & van Iwaarden, 2011, p. 200). In addition, these agreements will allow a better transition from the warranty phase to the spare parts phase.

When NedTrain wants to reach collaborative performance improvement, the named contract type and elements of the contractual relation should be chosen and social agreements



should be made in order to minimize the influence of the system-integrator. Clearly, the investment of time and effort is required when the contractual relation shall promote inter-organizational performance improvement. It is a learning process that requires the effort of both companies but once successful experience is made with performance-based contracts, this contract type can be used for other suppliers in order to improve the overall performance.

## 8. IMPLICATIONS AND LIMITATIONS

### 8.1 Recommendations for Practice

NedTrain should engage in two processes: first, a pilot project should be done together with SVT in order to gain experience with the use of incentives and penalties and to get used to rewarding performance. Second, performance measurement systems need to be built and implemented and it should be clarified if it is possible to build a testing station for an incoming control of the faulty toilets. For these two processes a concrete action plan should be made. NedTrain is advised to complete the action research cycle by performing the consecutive three steps action taking, evaluating, and specifying learning.

### 8.2 Suggestions for Future Research

Agency theory has been proven as an appropriate model for the problem. However, it falls short on the actual contract design and the contract management phase. While PBC seems to be a fitting approach for a solution, it idealizes the scope of action of the buying company. Research on PBC frequently took place in the health care sector. However, further research in the manufacturing industry is required due to industry specific

limitations. Practitioners need more advice on the right level of PBC so this should be addressed in business studies.

## 8.3 Limitations

There are some limitations to this research and the most significant is the short time frame which has the consequence that only the first two steps of the action research cycle were performed. Now, the action plan needs to be put in practice by NedTrain. Further, it was not possible to verify SVT's statements about the goal incongruence between the different principals NedTrain and the system-integrators. In addition, most of the given information comes from NedTrain. Therefore, the research outcome might be influenced by the subjective perspective of NedTrain's employees. Moreover, this research has been done within one case company which limits the generalizability of the results. On the other hand, it increases the practical usefulness which is preferred to solve the given practical problem. Last, there is the possibility that an interviewer bias occurred. Even though preventive actions have been taken, the results should be verified in additional talks by other researchers or practitioners to make sure that any potential effects of this bias are eliminated.

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## 11. APPENDIX A

Pitfall	Strategy	Feasibility of Strategy	Alternative
1) Performance contracting may inhibit experimentation	F) Pay suppliers not just for the final outcome but also for significant, well defined progress. G) Reward quality innovations and the risk of high investments	F) G)	
2) Performance contracting may encourage innovation in cost cutting but not in service delivery	G) Reward quality innovations and the risk of high investments	G)	
3) Performance contracting may stifle overachievement	H) Use back-up contracts with second best supplier. I) Use short contract terms and the option prolong the contract in case of sufficient performance. M) Handle caps of financial rewards carefully.	H)  High switching costs, technical dependency, not many alternatives I)  High switching costs, technical dependency, not many alternatives M)	
4) Performance contracting may not provide for start-up costs	F) Pay suppliers not just for the final outcome but also for significant, well defined progress.	F)	
5) Performance contracting may reward promises not performance	B) Create contracts that are based on outcomes that are 1) linked to the mission, 2) easy to measure, understand, and reproduce; and 3) facilitate benchmarking. E) Favour suppliers with a track record. H) Use back-up contracts with second best supplier. N) Work collaboratively – not adversarially – with contractors.	B)2  No correct measurement systems E)  No record at all H)  High switching costs, technical dependency, not many alternatives N)	
6) Performance contracting uses measures that can distort behaviour	B) Create contracts that are based on outcomes that are 1) linked to the mission, 2) easy to measure, understand, and reproduce; and 3) facilitate benchmarking. D) Monitor frequently lots of indicators of performance, not just the one(s) specified in the contract	B2  No correct measurement systems D)  Expensive, not possible yet	Tie rewards to product-related performance that is linked to the mission
7) Performance contracting may not be in line with the pillars of public procurement principles	I) Use short contract terms and the option prolong the contract in case of sufficient performance.	I)  High switching costs, technical dependency, not many alternatives	Transparent supplier rating system
8) PBC must rely on outputs not outcomes	B) Create contracts that are based on outcomes that are 1) linked to the mission, 2) easy to measure, understand, and reproduce; and 3) facilitate benchmarking.	B2)  No correct measurement systems	basic payment for the spare parts but additional rewards
9) Contractors need to be trained and experienced in techniques of setting measurable metric standards and performance evaluation	A) Understand the relationship between the mission and the measure. C) Be prepared to learn, change, improve, and learn some more. J) Start simple and ratchet up.	A) C) J)	
10) The contractors might not willingly accept the risk of the contract	F) Pay suppliers not just for the final outcome but also for significant, well defined progress. G) Reward quality innovations and the risk of high investments J) Start simple and ratchet up. K) Adjust rewards to level of riskiness. L) Take influence of force majeure into account when assessing the performance.	F) G) J) K) L)	