SUNK COST FALLACY IN THE DECISION OF NEW PRODUCT PROJECTS

Lappeenranta–Lahti University of Technology LUT

Bachelor's Programme in Industrial Engineering and Management, Bachelor's thesis

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Examiner: Associate professor Kalle Elfvengren

ABSTRACT

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Sunk cost fallacy in the decisions of new product projects

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Sunk cost fallacy costs companies huge amounts of money. If a company would be able to recognize these unnecessary expenses early, it could save lots of time and money gaining an advantage over the competition with the saved capital.

The objective of the thesis is to find out if sunk costs could be anticipated in advance to terminate the project early, before considerable sunk costs. The thesis was done by researching books, articles, and other publications.

Researched topics include the theory of sunk costs and other decision-making biases. These theories were used in analyzing two different case examples to find common factors, especially decision-making biases, within the cases.

What was found were characteristics and biases shared with projects starting to experience sunk costs. A major contributor in the cases was unfit leadership that fell into several biases affecting decision making.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUTin insinööritieteiden tiedekunta

Tuotantotalous

Veeti Vallin

Uponneiden kustannusten harha uuden tuotteen kehittämisen päätöksenteossa

Tuotantotalouden kandidaatintyö

2025

32 sivua, 4 kaaviota ja 7 taulukkoa

Tarkastaja: Tutkijatohtori Kalle Elfvengren

Avainsanat: uponneet kustannukset, uponneiden kustannusten harha, tuotekehitys, päätöksenteon harhat

Uppoutuneiden kustannusten harha voi tuottaa yrityksille turhia kustannuksia mm. tuotekehitysprojekteissa. Harha voi vaikuttaa tuotekehitysprojektiin liittyvään päätöksentekoon negatiivisesti, ja voi johtaa lisääntyviin kustannuksiin ja epäonnistuneisiin projekteihin.

Työn tavoite on tutkia, miten uppoutuneihin kustannusten harhan vaikutukseen voisi varautua etukäteen ja tunnistaa harha päätöksenteossa. Työ tehtiin kirjallisuuskatsauksena tutkien kirjoja, artikkeleita ja muita julkaisuja.

Tutkittuihin aiheisiin kuuluu uppoutuneet kustannukset ja päätöksenteon teoria. Näitä teorioita käytettiin kahden eri case-esimerkin analysointiin yhteisten tekijöiden löytämiseksi, erityisesti päätöksenteon ennakkoluuloja case-esimerkkien päätöksenteossa.

Lopputuloksena löydettiin ominaisuuksia ja päätöksenteon harhoja, jotka esiintyivät tuotekehityksessä, joka on johtanut uponneisiin kustannuksiin. Suuri yhteinen tekijä molemmissa esimerkeissä oli johtajat, jotka kokivat useita ennakkoluuloja päätöksenteossaan projektin edetessä.

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1 Introduction

Businesses face drastic decisions constantly. One such case is where to invest the capital to produce the best result. This decision can make or break a company. As such, the decision should not be based on emotion or anything other than facts and analysis. Still, even large and experienced companies fail to produce good results, sinking further capital into already doomed projects. Sud Aviation's and BAC's 1.43 billion euro Concorde project and Nokia's failure at getting their own operating system to widespread use and success are notable examples of sunk costs affecting new product development. The companies fell into the hole of sunk cost fallacy and continued to pour money into the project hoping the losses could be recouped by succeeding in the project.

According to the Project Management Institute's report "Pulse of the profession 2017" 14% of IT projects fail. Additionally, of the projects that did not fail, 43% went over their allocated budget. The knowledge to avoid these costs would put a company into an advantage over competing companies with the added saved capital. Such it is crucial to notice the signs of a failing project producing nothing more than useless costs as early as possible.

The usual dilemma of sunk costs is the situation where you have already invested 10 million into the building of a new power plant. Due to new advancements in technology a new powerplant from the ground up would cost 5 million, while you would still have to invest 5 million into the current powerplant to get it functional. A completely emotionless and rational being would scrap the current project and build a new powerplant while real humans gravitate towards finishing the ongoing project. While not too grounded in reality this example still brings up the issue of sunk costs and the drastic effect they might have on the processes of a company.

1.1 Objectives and scope

The goal of this thesis is to examine whether sunk costs fallacy could be anticipated. This is further examined by looking into the factors that pushed the decisions forward. Understanding this would give a company the needed knowledge to pull the plug on failing projects early, saving precious capital for more profitable ventures.

The aim is to look at new product development. The presence of product development related failures was high in the researched materials so the cases in this thesis are especially focused on those. On these projects we are focusing on the early decisions in the definition of the project goals, and other reasons during the project, before the launch of the product, that could have affected the outcome. The second aim is to see whether there were decisions based on false pretences and whether some commonalities can be found within the case companies in how they handled the failing new product developments. While sunk cost fallacy can be present in even successful projects, we are focusing on purely failed projects as the prevalence of material on the failures in these projects are far more common. None is writing literature about the sunk costs in building the first iPhone.

This will be examined with two research questions:

I. How to recognize sunk cost fallacy?

II. When to stop investing in the new product project?

1.2 Research methodology

The research methodology used in this thesis is a systematic literature review. Academic books and articles relating to sunk cost and other nearby fields like decision-making theory, psychology, and project management are used. All the sources have been examined critically to determine whether they are trustworthy and as such, usable in this context. The theory structure is supported by two case-examples from literature.

Sources were found in the materials of the library of LUT University, Finna-service and other internet sources. Most successful search terms were straight forward terms like “sunk cost”, “sunk cost fallacy” and “decision-making fallacies” (see Figure 1). The books found from the library of LUT University were found searching indexes for the same terms around decision-making and sunk cost. Searching material for the cases was mostly done using search terms like the name of the company or the name of the product. In the case of Nokia better material was found searching for general information on Nokia’s failure to hold market share against new rivals during the beginning of 2010s rather than from the actual project’s name.

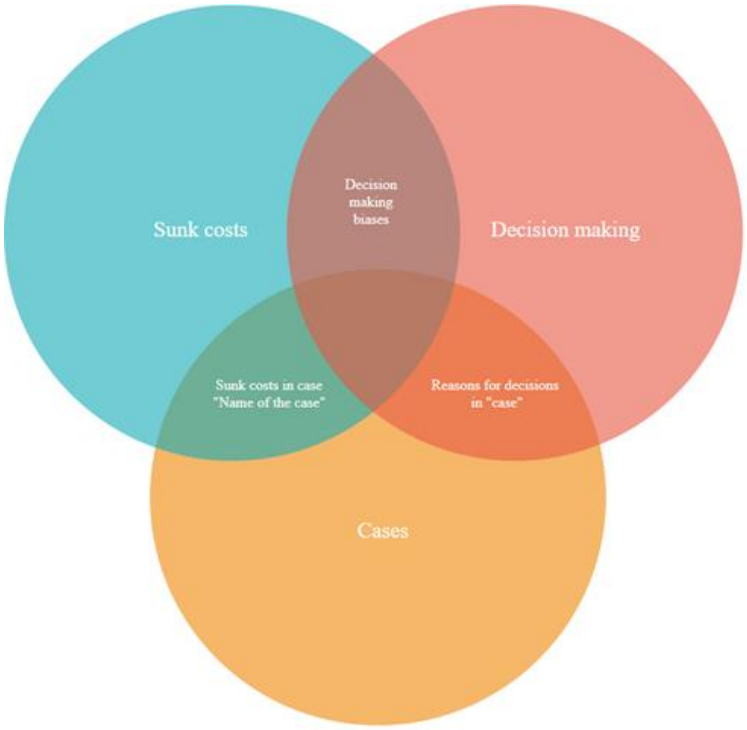

Figure 1. Search terms used in the research

The first part of the thesis (chapters 2–3) will cover the terms, their relation to each other, and the theory behind the sunk costs and decision-making. Chapters 4-7 will go over a few cases of sunk cost fallacy trying to find some common factors within those. The results will be compiled in chapter 8. Figure 2 presents the structure of the thesis as a “input-output chart”.

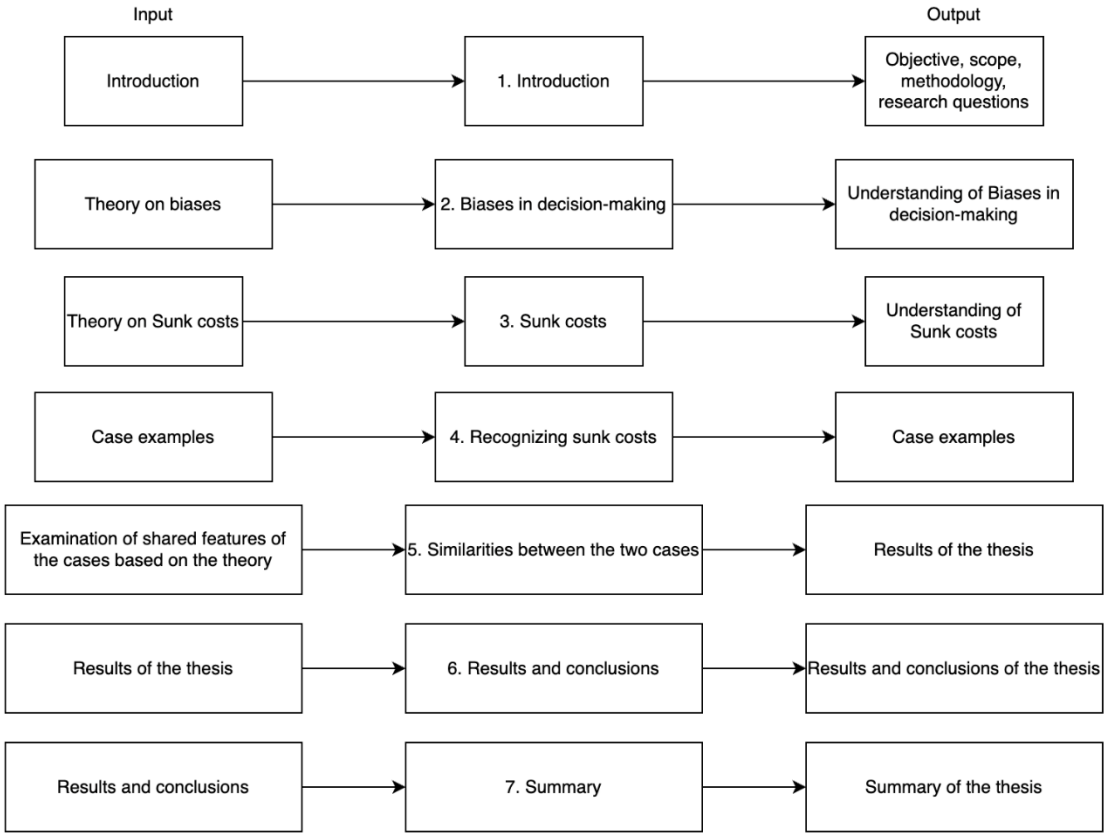

Figure 2. Input-output chart

2 Biases in decision-making

What makes up the decision to continue funding the project past its best before date? To determine where things went wrong the decision-makers' decision factors should be understood. From this knowledge we can also deduce would there be a way to present the question of continuation in a light where an individual making the decision would be more likely to cancel the project when it's needed.

As evidenced in a study by Arkes (1996) even the wording can affect the decision to stop investing more into a project, where wasteful alternatives are seen as less attractive, even if the monetary reward is the same. In the case of sunk costs, they can be seen as both wasteful and not wasteful depending on the wording from the wasteful 'sell for scrap value' to the not wasteful 'sell the current project materials to a roofer'.

2.1 Biases in decision-making

There are various biases that affect decision-making, which of sunk cost fallacy is just one. To more closely follow the factors of a decision and not let useless biases affect the information used in our decisions, these biases need to be understood (Robbins, 2007 p.162-166). In addition to sunk cost fallacy, other biases can coexist while making a decision. Table 1 presents the biases that came up during the research repeatedly. These biases were selected as they highlight psychological tendencies that particularly make a person susceptible to sunk costs, like resistance to change and fear of failure.

Table 1. Biases in decision-making

Bias	**Description**
Overconfidence	Overconfidence in one's own abilities is usual and can lead to wrong calls in decision-making. This can be especially worrisome in the initial stages of a decision when the person is overconfident in their stance. (Pallier et al., 2002)
Conservatism /sometimes known as anchoring	Conservatism bias is when one relies too much on initial information and fails to change their stance in changing circumstances. This bias is fully visible in the plan continuation bias, in the form of the information that dictates the decisions. (Tversky and Kahneman, 1974)
Confirmation	Confirmation bias is where one seeks out information specifically to confirm your opinions ignoring all the other information. This also means that information according to our views is also accepted more easily while information contradicting that is received more critically. (Robbins, 2007)
Loss aversion / status quo bias	Out of the biases in decision-making the closest one to the topic of this thesis is loss aversion. This is a tendency to avoid losses and thus in effect commit more. Loss aversion can also loosely be understood as status quo bias, where change is resisted. (Kahneman and Tversky, 1991)
Winner's curse	Winner's curse is a bias wherein an auction the winner is the one that overestimated the value of the item most unless everyone drastically undervalues it. This leads to the "winner" committing more resources than would have been reasonable. (Capen, Clapp, and Campbell, 1971)

Shana Lebowitz and Samantha Lee (2015) in their article for Harvard Business Review define some of the biases with a different name, or a slightly differing description overall still fitting the same definitions. For example, anchoring and conservatism are presented as two different biases, where the difference comes from anchoring dealing with a range of options whereas conservatism deals with preexisting reasonings. Where there is some reasoning for this the definition by Robbins for the term covers both definitions in the sense that the affecting force in the decision-making is preexisting knowledge resulting in an unwillingness to consider options outside one's scope (Lebowitz and Lee, 2015).

An important hinderance to decision-making that kept coming up in the other materials but was not covered by Robbins or Lebowitz and Lee is Groupthink. Groupthink happens when a group seeks conformity in decisions. Resulting group pressure leads to a deterioration of mental efficiency, reality testing, and moral judgment resulting in flawed decision-making.

2.2 Human element in decision-making

As nice as it would be that people's decision-making would follow clear criteria, as humans, decisions can be erratic and irrational beyond just specified theoretical decision factors. In Bob Frisch's (2011) article in Harvard Business Review, he describes a set of invisible influencers to a decision. The usual understanding of company structure is that the decisions are done on the top, within the top-level executives and the board of the company. Reality can vary from this hugely, with the CEO taking influence from a few select people from the company or even from the outside. This means the decisions are fully formed when reaching the meeting rooms. This can have a bias effect on the opinions of others in the face of the hierarchical differences between the levels of the companies. The article states that this can also bring with it other problems. Like for example, the senior team has no real power as the decision is already fully formed and the basis for the decision is one of ignorance and inconsideration.

In Table 2 Robbins (2007) presents some guidance on how to fix this and not to let the unjust biases affect decision-making.

Table 2. Robbins' advice (Robbins, 2007)

Robbins' guidance	**Explanation**
Focus on the goals.	Having clear goals should eliminate irrelevant information and help aid the decision process.
Look for information that disproves your current opinion.	By actively looking for information this way, overconfidence is going to be less of a factor in the decisions you make.
Do not attempt to create meaningless cause-and-effect relationships.	Always ask whether the patterns can be explained but also be ready to accept that life has events outside of our control.
Increase your decision alternatives.	Afterall the best decision can only be as good as the set of possible decisions you have.

Van Putten and Zeelenberg (2010) studied the willingness of people to tolerate sunk costs based on action- and state-oriented decision-makers. The research found that state-oriented decision-makers are more likely to continue on a losing course than action-oriented ones. This makes sense considering sunk costs are something where past events affect negatively on current ones. State-oriented people are more likely to look back at the past, while action-oriented ones are faster to jump into the next decision.

3 Sunk costs

Sunk costs, sometimes referred to as retrospective costs, are according to Gregory Mankiw in his book "Principles of Economics" (2004) a cost that has already been committed and thus cannot be recovered. As such sunk costs are an inescapable part of operating a business and they should be completely disregarded in decision-making. A company's fixed costs can also be counted into sunk costs in the short term since it can be assumed that these costs are unrecoverable in the short term. Therefore, any fixed costs should not be taken into account when deciding whether to keep the business open for business on a given day. In the long term such as in the decision of closing the business for good these costs matter again. In this case, these fixed costs are no longer costs that have already been committed, but costs that can be saved in the future (Mankiw, 2004 p. 296-298).

John Cullis and Philip Jones in the book "Microeconomics, A journey through life's decisions" (2009) define sunk costs a little differently. A sunk cost is defined as "Expenditure on durable specific factor input that has no obvious alternative use, and, therefore, little resale value".

While the definitions given by these economists are going after the same idea they're worded slightly differently. While Cullis and Jones focus more on the product side of the sunk cost, they still have the same idea of an expenditure that cannot be resold to recoup the investment. This makes Mankiw's (2004) definition more usable in all situations without causing confusion on for example the resale value of a more typical sunk cost like product development or investment into marketing. Therefore, in this thesis, I will follow the definition set by Mankiw (2004) in examining sunk costs.

An example of the sunk costs, where sunk costs should be treated as bygones, is offered in the same Mankiw's (2004) book. You buy a 7€ movie ticket which you lose before seeing the movie. Therefore, you would have to buy a new 7€ movie ticket to see the movie, making your total investment to be 14€. But if you value seeing the movie over the ticket price you should buy a new ticket and not let the sunk cost of 7€ not affect your decision.

3.1 Sunk cost fallacy

Sunk cost fallacy is a fallacy where individuals continue a behaviour or endeavour because of previously invested resources (Arkes and Blumer, 1985). This results in a situation where the individual overcommits resources since the previously invested resources are held in a higher value. A study conducted by Kahneman and Tversky (1985) measured people's willingness to go through slight trouble for a reward. In the questionnaire, the respondents were asked to consider whether they would go 100 kilometres away to a concert. One of the group's respondents were given a 40 € concert ticket while the other had spent 40 € for the same ticket. The study found that people who had invested money in the experience were more likely to answer that they would attend the concert.

In their study Tversky and Kahneman (1981) put this effect well into words: "a sunk cost effect arises when a decision is referred to an existing account in which the current balance is negative". This leads to the question of what if the balance is positive instead? Unrealized losses and gains are not weighed in the same way. Kahneman and Tversky (1979) formulated Prospect Theory which the implications of are shown in the value function (Figure 3). The gains and losses are evaluated nonlinearly meaning that losses are weighted more in decision-making than gains.

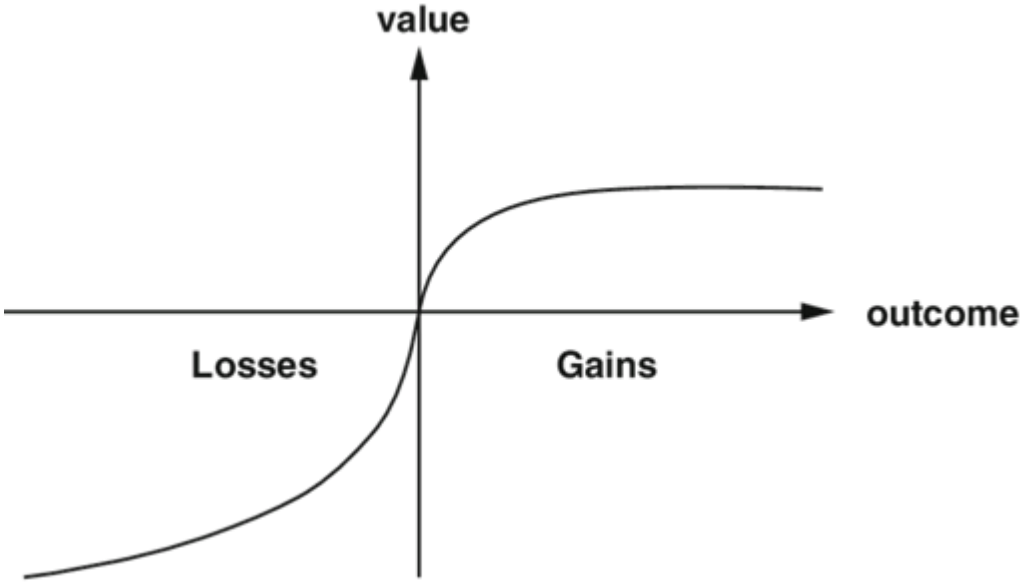

Figure 3. Value Function (Kahneman and Tversky, 1979)

In both ends of the graph the value assigned to further losses or gains does not increase. This means that as sunk resources increase, the willingness to invest further resources becomes easier as the losses (or gains) get greater.

3.2 Sunk costs vs. opportunity cost in new product development

An opportunity cost is what you have to give up to get that item (Mankiw, 2004 p. 6). This creates a slight difference between opportunity costs and sunk costs. Similar in a lot of ways both types of costs can be thought of as something you give up when making decisions. Whereas sunk cost is thought of as something that cannot be recovered and is lost in all cases, opportunity cost is a cost that is not in itself a loss. For example, investing in Project A over Project B while Project B would have produced 1 000 € more profit, is the opportunity cost of investing in Project A over Project B. As such both projects produced a profit, but the investment would have produced better results in Project B. Differencing between sunk costs and opportunity costs can be hard or even impossible in the early stages of the project.

Will Kenton (2019) describes opportunity cost as "representing the benefits an individual, investor or business misses out on when choosing one alternative over another". There is no real difference between these two views of opportunity costs. Both definitions describe the relationship of not losing but missing out on something.

Both of these biases can be strengthened by plan continuation bias. Plan continuation bias is a cognitive bias to continue on the decided course even within changing conditions (Squair, 2011). This can result in disastrous catastrophes when stubborn deciders are not updating their strategy based on the current circumstances, falling deeper into the sunk cost fallacy. According to NASA's (2004) research into flight accidents, there seems to also be a stronger bias towards the end of a given action to continue as decided. This would mean in the business world that if the new product development is nearing its perceived end point, justifying the cancellation of the project will become even harder. This finding aligns with that of the value function when the expense of the new product development is linear. Towards the end the sunk costs are higher, so the bias to stay on course will be more likely. Thus, understanding plan continuation bias is an important part of understanding sunk costs and reasons behind causing them.

3.3 Implications of sunk cost in new product development

In the context of new product development sunk cost fallacy can lead to reluctance to abandon a project despite mounting evidence that it should be cancelled. Because costs generally

accrue evenly throughout the project earlier cancellation will save the company a lot of resources that can be redistributed to better projects. (Schmidt and Calantone, 2002). In general, the sooner the project can be cancelled the better. As Kahneman and Tversky (1979) pointed out, the increasing sunk costs will also make it harder to cancel the project.

Failing to cancel the projects means that these failed projects will take a lot of resources from the company restricting the ability of other projects to succeed. Inefficient allocation of resources will weaken the innovation happening at the company as past projects with existing sunk costs will vacuum resources from more promising projects without existing burden. This will have a long-term impact on the competitiveness of the company. Furthermore, if managers are too strict about not incurring any sunk costs, the true potential of possibly great projects will not become clear before the project is discontinued (Keil, Mann and Rai, 2000).

Company structures can also inadvertently reinforce a culture of embracing sunk costs despite evidence against the project. For example, milestone-based funding incentivises promote ignoring project cancellation criteria to reach the next funding milestone, project leaders or champions are incentivized to push the project through no matter what and set key performance indicators might not promote adaptability overstaying on course. Over time these kinds of measures root acceptance of unnecessary sunk costs as a core principle of the company culture (Shepherd, Patzelt and Wolfe, 2011).

3.4 Sunk costs in innovative solutions

Innovation is by its nature uncertain and there are a lot of unknowns in the process of bringing an innovative solution to market. As established earlier sunk costs are inevitable and the only avoidable sunk costs are the unnecessary ones. Innovation decisions should rely on future returns, not past investments. But what to do when the returns are uncertain?

Teece (1986) presents a framework for examining who wins in innovation. While the framework is limited to innovations that have a proven market, it is still a useful framework to examine from the view of sunk costs. The framework argues that each innovation will gather imitators, who copy the innovation and companies with related capabilities who are better positioned to take advantage of the innovation. This is called the innovation risk: the innovator is not necessarily the one most benefiting from the innovation. Teece argued that a company should focus their efforts on innovations protected by intellectual property law or

innovations which the company has strong related capabilities for. For minimizing unnecessary sunk costs this is the right strategy as maximizing the share of value the company gets from the innovation increases the commercial potential of the innovation while increasing the likelihood of recoupment of investment. A company's failure in making sure one of these criteria is fulfilled leads to a higher chance of unsuccessful innovation which might lead to throwing more money into a failed venture because of past investment.

4 Recognizing sunk costs

Examples in this thesis will be from publicly traded companies, meaning their ultimate end goal is to generate profits for the shareholders. As such our criteria for a project with reasonable sunk costs would be if it generated a reasonable profit. If no reasonable profit was formed most likely the project failed meaning there might be a possibility that it could have been ended sooner, if proper actions would have taken place, saving the company's resources. Also examining researched reasons for project failures can also lead us towards possible reasonings for projects going over their budget.

In order to recognize tipping points in projects, we will look at two cases in product development to see if they have common factors that could be attributed to the forming of sunk costs. These cases were selected for the following reasons.

Concorde: Sunk cost fallacy is also known unofficially as Concorde fallacy as the British French supersonic airplane is infamous for the huge expenses the project caused. The end of the project resulted in a plane that was flown on a loss for various years until they were finally grounded after public perception sunk following an accident caused by a design flaw.

Nokia: Failure to innovate on the software side during a changing phone market caused a loss to competitors from a dominating position, which led ultimately to the selling of mobile phone business functions to Microsoft.

4.1 Case Concorde

Concorde was a joint project of SUD Aviation and British Aircraft Corporation. It was a new type of plane able to sustain highspeed flight over long distances, transporting passengers in comfort.

The first flight by a Concorde plane was performed in 1976 with the last one being in 2003. In 2000 a catastrophic failure resulted in 8 of the 14 planes being grounded. This factor with the effects 9/11 had on the aviation industry caused the last Concorde flight to be in 2003. Deemed as a financially unviable form of transportation all the planes were grounded and made inoperable, only existing for museum usage. (Rowbotham, 2016).

Concorde was mainly used by top executives and A-list celebrities. Still, this was not enough and the effective market for supersonic flight over the Atlantic was limited. What also limited Concorde's usage was the competing options. A flight with Boeing's 737 in the first class was more affordable due to the higher capacity and cheaper operating costs of the plane. Boeing also offered a more comfortable option as the Concorde was cramped and the seats were not movable, due to weight savings. This left the winning parts of a seat on a Concorde to be the time it took to cross the Atlantic. Priced at over twice the price and resulting in only a time saving of a few hours this was simply not worth it for majority of people.

The first mistake was not recognizing what are the priorities of the customer segment. The fast flight is a nice gimmick but, in the end, it did not add enough extra value to move customers from the more traditional alternatives over. Especially when the trade-offs were so clear. The other reason for the continued funding and thus overfunding of the project Concorde was far more complex than that. The cooperation contract for the Concorde was signed between the British and the French governments. As also the majority owners of the respective airlines the governments had a huge incentive to see the project pull through. The question on the funding and success of the Concorde became a political question. Soviet Union's efforts to develop its own supersonic airliner must have also had an impact on the decisions made by the governments. In 1964 (United Kingdom National Archives, 1964) briefing notes for the prime minister view cutting the funding of the Concorde development as a "rational choice" but not "practical politics".

As such Britain sought to withdraw from the agreement but could not build their case. Ultimately planes would have needed to be sold at 18 million euros on a production of 100 to recoup "modestly" (Kaminski-Morrow, 2019). In the end, the final orders ended up at 20 planes for 25 million euros apiece. This resulted in a loss from the projected revenue for the modest recoup by 1.3 billion.

In the case of Concorde, there are huge escalations of commitment. Once the government's money was already deeply invested into the project and the project became reliant on it, it was not in the best interest of the deciding people to cut the funding. It was wrong to move the decision from the hands of the experts to the hands of the politicians running the government. Experts were heard, but as the situation in 1964's briefing note showed the opinions were largely ignored. The marks show an inability to face their own mistakes causing further and further sunk costs, with the planes running for public image for years. Was this just to

sweep the failure of the project under the rug showing the public that all the money paid off, while the project ended up as the poster child for sunk costs?

The deciders also lacked a real stake in the decisions, or the stake was aimed at the wrong place. The trade-off in the funding of the project was in the beginning clear. Use the money for this or for something else all in the interest of the general public. Further on the trade-off changed into a trade-off between public perception about the ability of the government or keeping the project afloat. Incentives were also in the wrong places when taking down the project would have most likely led to negative perception from the public. The best course of action would have been to from the beginning move more deciding power to the people who understood the project completely. This could have led to a more favourable table for the politicians to cancel the project as it would have already been "unofficially" cancelled and would have just needed permission from the government to stop the funding. Following this the stakes would have been stacked so that the decisions the deciders make would have aligned more with traditional marginal cost vs -benefit situation, causing better decisions in this project.

The situation from the eyes of the taxpayer could be described as a sunk cost fallacy as well. In the article "Casualties of war and sunk costs: Implications for attitude change and persuasion" Schott et al. (2011) found that war casualties raise support for the war as the public sees these as an investment that must be won back, ignoring these are obvious sunk costs, lives that cannot be recovered. Obviously, the case of Concorde is not as serious as lives lost during war times, but this can still give us a picture of the public not understanding sunk costs. Therefore, the taxpayer's money that was used to fund this venture would not have been seen as a sunk cost by the public. Hence decision to cut funding would have been seen completely as wasted money.

4.2 Case Nokia

In the early 2010s, after Nokia started to lose market share to new entrants in the smartphone market, Nokia stuck to its old operating software trying to make it compete with the newer systems of the rivals. This caused Nokia to plummet in market share and was sold later to Microsoft just ten years after the creation of the most popular phone ever.

Nokia's phones at the time of the Apple iPhone's launch were working on the operating software Symbian. Due to pressure to release new models frequently, the development team

never had time to modernize the software, rather just bolting new features on top of it. This caused the quality of the phones to decline over time as more advanced features were required and provided by competitors. By 2010 Nokia released the N8 which was a total flop with numerous setbacks due to software limitations. A new CEO was appointed to Nokia who came to the conclusion that it would be better to buy software from Microsoft (Vuori and Huy, 2015, p.28).

According to the research by Vuori and Huy (2015), the main reasons for Nokia's failure in keeping its share in the smartphone market can be attributed to three reasons. Their technology, company culture, and lack of vision:

- The technology was inferior to competitor's offerings causing performance also to be inferior
- Top executives were afraid of not hitting their quarterly targets and losing investors if they would admit that the technology was inferior
- Creating new software that could rival rivals was years too late.

Nokia didn't admit early enough that it is not worth it to pour more money anymore into Symbian and start from a clean slate to create modern software. The top management shut down every wish from the production units to improve Symbian until it was unfixable. The situation was not helped with all of the top engineers not having an engineering background.

Several biases in the decision-making of mainly the top management can be noted. Most notably huge levels of conservatism. Conservatism in the organization ran so rampantly the middle management was afraid of bringing up differing opinions on the state of the current software. Even top management was living in a state of fear with a comment raising up from the research: "I couldn't say [publicly] that Symbian was no good and that we had to replace it with MeeGo as soon as possible, because I was afraid of the [negative effect on] Symbian sales" (Vuori and Huy, 2015). Escalation of commitment was present in retrofitting and tacking on new features to the already clunky Symbian.

Groupthink was also present in the fear-driven environment of Nokia. As mentioned previously the feeling of fear to conform to the ideas of top management was present. This resulted in no one confronting the ideas leading to widespread groupthink.

5 Similarities between the two cases

Despite the projects happening almost half a decade apart similarities can be found. Both organizations kept putting more resources into a project despite (silent) opposition from subordinates who were more aware of the limitations of the current approaches. Let's examine the role of the projects in product portfolio matrix and revisit the biases present in the decisions surrounding the continuation of the corresponding projects.

5.1 Product Portfolio

Product portfolio matrix or BCG matrix (see Figure 4) is a tool to estimate the potential of the company's products (Henderson, 1970). A company needs a sufficient number of products that could turn into cash cows funding new product development.

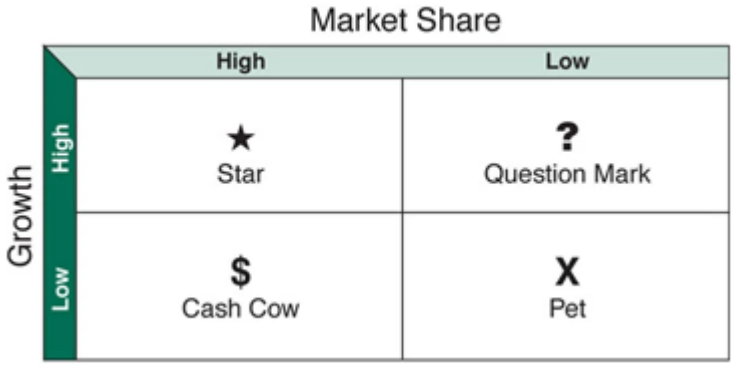

Figure 4. Product portfolio/BCG matrix (Henderson, 1970)

Both of these products started their life in the question mark, with high initial growth, but quickly lowered to the pet category, where they produced no funds and required investments to keep the projects running. Henderson argues the profits from the cash cow should be invested in turning question marks to stars. From there, stars will with time turn into cash cows.

SUD aviation had its plane star model, but it was discontinued to focus effort on the development of the Concorde (Dougal, 1963). Shortly after the Concorde project, SUD aviation was passed around through mergers to be part of the current Airbus.

Nokia was in search of past levels of success but did not jump ship to Android, like all the other competitors, because of the top management's belief their product was closer to hitting the cash cow status than it was. Simultaneously the product was bleeding users and vital ecosystem support from app developers.

5.2 Common factors

These two cases represent two situations of new product development. Factors in their failure can be widely contributed under one single theme. What unified all the cases was unfit leadership in decision-making. In Concorde, this was seen as a decision to keep continuing the project despite feedback not to, and in Nokia's case in the conservatism bias of the top executives shutting down ideas of lower-level employees.

Table 3. Case overview

Case	**Project failure contributors**	**Biases (apart from Sunk cost fallacy)**
Concorde	Failure to pull funding from the project Teams and funders opposing views	Conservatism Overconfidence Loss aversion
Nokia	Leaders not listening to lower management Not admitting current software is inferior and should be replaced	Conservatism Loss aversion Groupthink

A study into eight different project failures reached the same conclusion, most often projects fail because of conservatism or anchoring bias. These were followed by sunk cost fallacy and illusion of control. (Shore, 2008, p.8)

Study into "the early warning signs of IT project failure" raises people-related risks like lack of top management support and weak project managers as the top reasons for project failure alongside lack of documentation and no change management. (Kappelman et al., 2006) The top reasons go hand in hand with the observations from the case examples.

Behrens and Ernst present methods to lower the amount of loss aversion by having stop points before the stages of the new product development. In the study the stop points also held outside consultation, visual aids or a mixed approach of both in them. With a mixed approach the commitment to a failing project was the lowest. (Behrens & Ernst, 2014)

Following Robbins's guidance on avoiding biases, and Behrens' and Ernst's suggestions on stop points, we can see how changing the circumstances could have looked like in the cases.

1. Focus on the goals

Table 4. Goals

Case	**Refined goals**
Concorde	Have goals outside of building a supersonic airplane (e.g. financial viability)
Nokia	Define goals for the current software

Having clear goals should eliminate irrelevant information and help aid the decision process. These new goals would have brought Concorde room for still fitting better inside the upper end market, while sacrificing some of the capabilities for extended supersonic flight. Nokia could have seen already earlier how the current software was not living up to the goals other manufacturers' operating systems achieved. Outside consultation and visual aids would have highlighted the lack of a feasible way to reach the end goal and lack of progress.

2. Look for information that disproves your current opinion

Table 5. Background research

Case	**Disproving information**
Concorde	Research the market preferences to find out if there is a need and how big compromises can be made on comfort
Nokia	Look into the actual numbers of the software with lower management

By actively looking for information this way, overconfidence is going to be less of a factor in the decisions you make. Further market research would have shown every company the inferiority of their product and how it could be improved to meet market demands better. By

latest outside consultation would have brought up the lacking market research for the products and provided different views on the future potential of the products.

3. Increase your decision alternatives

Table 6. Decision alternatives

Case	**Decision alternatives**
Concorde	Define goals outside creating a supersonic airplane
Nokia	Consider making completely new software as a possibility, or change to Android like the competitors

Afterall the best decision can only be as good as the set of possible decisions you have. The project could have pivoted in the middle of development towards better possibilities for success in the market. Following consultation advice would have steered the projects toward more feasible and profitable options in the middle of the development.

In total all the projects could have benefitted from greater focus on the prework, laying a valuable foundation with wide enough goals to not fall into plan continuation bias, and minimizing the effect of other biases followingly:

Conservatism: Extensive research outside one's comfort zone would bring hard data on the insufficient measures in the current situation.

Confirmation bias: The research would lay the foundation for everyone's knowledge of the project.

Loss aversion: Goals would be clear and going over them would be more noticeable.

Sunk cost fallacy: The potential of the product is clearly determined, if not met the project would be ended.

All the companies had a different approach to the product portfolio. In the case of Concorde, more prominent stars were discontinued in hopes of hitting a bigger cash cow. Nokia did not admit failure in time, and when the older cash cows became outdated the current innovation did not pay off in the form of a new market leader.

Both companies were innovating something new. Using Teece's framework on innovation risk how would the situation have looked different?

Table 7. Teece's framework (Teece, 1986)

	Concorde	**Nokia**
IP protection	Too expensive to replicate	Not protected, Android succeeded in making similar but a better product
Related capabilities	The participating airlines could not make the economics work	Strong hardware capabilities but failed to integrate software capabilities into the organization

Concorde did not focus on IP protection as the entry barriers to building airplanes are very high so competition in this area of airplanes wasn't a big focus. In related capabilities, they failed to have airlines that could appropriately use the innovation to their advantage. The related capabilities were not present.

In the case of Nokia, the operating system market was not protected at all allowing new entrants to flood in. Simultaneously not only Nokia lost related capabilities of outside developers creating applications for the ecosystem to rivals, but Nokia's own software team couldn't be fully utilized to the degree that hardware was either.

6 Results and conclusions

Sunk costs are costs that cannot be recovered. In product development, these costs can pile up to heights where no profit will be made from the product. Biases are a part of decision-making when a human element is included. The effect of these biases on the decision process within a project should be minimized to avoid wrong decisions and unnecessary expenses contributing to sunk costs.

In this thesis several ways to reduce the effects of bad decisions, and to avoid them all together were introduced in the form of Robbins' guidance on avoiding biases to Behrens' and Ernst's stop points. In the studying of the cases, it became apparent unfavorable decisions, like those coming out of improper leadership, lead to sunk costs often. Hence it would be effective in reducing the number of bad decisions that can be made in the project. These simple measures, when implemented, could open new ways to look at the new product project, and bring clarity to the current situation, whether the situation is good or bad. Following decisions could be made from an unbiased standpoint reducing the effect biases have. This in turn would prevent falling into the trap of sunk costs, leading to better new product developments, that would be terminated early enough, or continued appropriately. Further issues in the preparations for the projects were also found.

Further market research would have benefitted all the cases. This market research would have produced valuable insight into the actual needs of the desired market segment, making it easier to align the goals of the product for better return on investment. In both the cases hugely successful alternatives to these products were created around the same time, that identified their place in the market correctly and capitalized on it.

Studying the place of the product in the product portfolio and following clear market trends instead of trying to create your own could have paid off. Further research into the product portfolio would have shown the product's place in the company's portfolio, placing more emphasis on the qualities the product should have. Outside consultation and stop points would have stopped the projects, if and in these cases when, this preparation for the new product development was not done properly. Using Teece's framework could've shown areas to improve before the end of the innovation process. Most importantly these factors

would have showcased the amount of sunk cost fallacy present in the projects, possibly making the decision to end the projects easier.

I. How to recognize sunk costs?

In a sense, all companies and projects acquire sunk costs. Therefore, sunk costs are not inherently bad or avoidable. When the biases in decision-making start taking too much hold, the project might quickly get out of hand and acquire unnecessary sunk costs that will be completely for nothing. Sunk cost fallacy seems to be joined by one or several other biases in decision-making. Therefore, recognizing biases in the project and intervening early enough can save unnecessary expenditures and wasted time working on a failing project. In the cases of this thesis a lack of preparation was also a factor in the failure of the products. The apparent lack of planning could have also caused the projects to be more vulnerable to bad decisions leading to sunk costs. Otherwise in positions where incapable leadership is present, sunk costs can be expected in the wrong decisions, that go to waste

II. When to stop investing in the new product project?

If the project does not fit the needs of the company or market research fails, the new product should be stopped before going further with the project. If during the project signs of failure start to appear, it would be best to start to reconsider the project from all the possible options to minimize exposure to possibilities for sunk cost. These signs can include biases in decision-making and incapable leaders bringing these biases into decision-making. Also, stop points, and outside consultation will bring new light into the project. Improper incentives or conflicts of interest should also be investigated and responsibility for the project redistributed appropriately.

7 Summary

Sunk cost fallacy is a decision-making bias where one continues on the current track due to previously invested resources that cannot be recovered anymore. In a perfectly rational environment this wouldn't happen, but factors in decision-making by humans leave room for error. This leads to biased decisions by every single individual in the project. These biased decisions can have a bad influence on the project at hand. The leader or the biggest decision-maker is in a position where these biases should be avoided. Failure to avoid these biases can result in further sunk cost fallacy along with other biases hindering the project's success.

In the researched cases sunk cost fallacy was most often paired with conservatism, the belief that in the changing circumstances the initial plan should still be followed. This makes sense regarding the sunk cost fallacy's nature of trying to recover what is already lost. Also, as an attribute of sunk cost fallacy is a certain degree of plan continuation bias. Other such biases present were overconfidence and loss aversion.

All the projects would have benefitted greatly from further market research. This information would have brought much needed insight into what can and should be cut from the final project. Therefore, also the goals could have been defined with actual data and insight from the market research. This would have led Concorde to cater better to the upper end category it tried to attract and Nokia to admit its short fallings in the software department. Studies into how the product fits the product portfolio would have also helped the companies to focus on the more viable or the already established options.

Recognizing the biases affecting decisions in the product development phase can result in noticing improper decisions affected by these biases. Decisions stemming from improper conclusions can expose the project to further sunk costs. If these kinds of decisions start to show up in the project, their effect should be evaluated, and the project's future renegotiated.

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