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MASTER'S THESIS

RISK MANAGEMENT AND CREDIT RISK MODELING WITHIN EMS FRAMEWORK

Ljubljana, April 2015   PRIMOŽ KUNEJ

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INTRODUCTION

"If you can't manage risk, you can't control it. And if you can't control it you can't manage it. That means you're just gambling and hoping to get lucky."
(Merna & Al-Thani, 2008, p. 1)

Changes are the only constant in business and private lives. Due to the globalization and changing customer demands all forward-thinking companies need to adapt their business strategies more frequently as maybe was the practice in the near past. It is becoming essential that companies need to have a comprehensive risk management strategy setup in order to respond today's market environment.

Managing risk is becoming one of the most important activities in organizations today. Examples of failures such as Enron, Worldcom, Parmalat and many others are serving as a warning that also big systems are very much vulnerable in today's market place and demonstrate the consequences of not managing risk properly (Merna & Al-Thani, 2008, p. 1).

The Cardbury Report is listing criteria for internal control list for directors how to report effectiveness of the company's or organization system and how to identify and evaluate risks and control. Some of the criteria are listed below (Merna & Al-Thani, 2008, p. 2):

- Identification of key business risks in a timely manner
- Consideration of the likelihood of risks crystallizing and the significance of the consequent financial impact on the business
- Establishment of priorities for the allocation of resources available for control and the setting and communication of clear control objectives..

The biggest challenge probably is determining the likelihood of risk. In the standard approach of evaluating risks an individual needs to assess the likelihood of risk occurrence. Future activities impossible to predict but we try to do it to our best knowledge. According to experiences usually the biggest most influential risks with highest financial impact that may jeopardize the existence of a company are usually marked with a very low likelihood. It is questionable if these assessments are done over longer period of time and the same likelihood is applied constantly meaning the risk will never occur. Structural approach toward the risk management conducts suitable response strategies and corrective actions to minimize the effects of risks if they actually occur.

Economic crisis that occured btw. 2007 and 2008 was an event that is actually not uncommon in economy but usually it strikes from nowhere and catches many unprepared. These events usually strike harder than before. The Company I worked for was producing high luxury and higher price level product. The product was for that period of time the most expensive product produced in our country. Company started investing in expanding the production capacities. New infrastructure was built and new debts were raised. The economic situation caused that the price for the oil barrel

dropped significantly for more than 50% and this consequently caused loss of the orders for 50% in one week.

Nobody could predict these events even though fires happen every day and also economic crisis occurs every few decades.

These experiences will motivate me during the writing of this Master's Degree about Risk Management.

Nicholas Taleb is explaining in his book that risk is not possible to measure and same it is not possible to predict the occurrence of the event that may cause harm for the organization. What is possible to is to identify if something is fragile. By doing this an organization will build up awareness of their exposure and will also be able to prepare respond, mitigation strategies to ease up the consequences or even to use the occurrence of the event in their behalf. This is so called the Black Swan problem (Nassim, 2012, p. 4).

Mr. Taleb is introducing in his book a new concept of "Antifragility and fragility" and honestly during my writing I would like to include this concept together with the standard description of risk management.

Big organizations with thousands of employees nowadays try to control the environment to the maximum limits thinking that by doing this they will become better protected and will increase their control of risk. It is becoming a big question to which extend will the organization try to protect itself by generating big systems, processes that in the end tries to exclude the volatility. What does not like the volatility is actually very fragile and much easier to break down. Disorder, stressors, errors this are all everyday occurring events and basically what does not like the volatility actually does not like the time. This is one of the messages from Nassim Taleb, you can try to control as much as you would like but what happened 10 years ago is no assurance that will happen again or it will and it may be ten time worst but only time will show this and this is impossible to predict but knowing this it can help you being better prepared and faster to react (Nassim, 2012, p. 20).

Things come in triples:
Main idea is that we are trying to focus on our fragility we need to know where we are exposed and we should not try to predict and calculate the probability of occurrence of events because for this we should be capable to foresee the future and have supernatural power.

The Triad classifies items in three columns along the designation fragile, robust and antifragile.

Fragility likes peace and quiet and hopes for the best and no changes or volatility will happen. Antifragile is alive and absorbs changes, disorder and also learns from it and grows from it. The robust systems simply don't care much what is going on in the world but the world is changing all the time (Nassim, 2012, p.4).

Danfoss globally is more and more aware of the need to manage risk in the company that employees over 40.000 people. Danfoss's business system is an example of an multinational company with big complexity and a question how to control this mass of information and processes. Danfoss is currently also running a project of becoming certified company according to the automotive TS standard. The TS standard also requires from a company to have risk management strategy, plan.

Scope of my work is set from the category management level of Danfoss company. The category under analysis is called Electronic Manufacturing Services (hereinafter: EMS) and is defined as electronic products designed and developed by (or on behalf of) Danfoss, but manufactured at external suppliers.

The supplier base is global: Scandinavia, Eastern Europe, Americas, China & South-East Asia. The general trend is to increase EMS sourcing in Eastern Europe and Americas. All EMS products are Danfoss specific. Specifications are often difficult to transfer and the switching cost is high (both internal and external).

Danfoss is globally separated into 8 different divisions and each division is producing different types of products but all are buying the EMS products. Different division may be using the same suppliers. Different suppliers differ among each other also how complex EMS parts they can produce whether they are more R&D or industrial production focused.

Due to the high costs (internal and external) to change the supplier and high complexity of EMS parts, category management would like to increase the risk awareness and start with the risk management process. One of the steps in the process will be identifying the risks and then prioritizing the mitigation strategies. Already now it is known that the biggest focus will be on the credit risk.

It is a fact that knowing the risks and managing them is a trend in all forward looking companies that want to stay healthy on the long run. Managing risk is becoming part of the standard process of managing companies and has an impact on competitiveness of the company, better cash flow forecasts, better cost control, higher income of the company and consequently on the market value of the company.

In the Master's work we will try to map identified risk in the EMS category. The risk identification will be done via risk assessment workshop that will be held among EMS category management, EMS key account managers and other relevant and associated colleagues relevant for this category.

Biggest focus will be on analyzing the credit risk and creating a model measuring credit risk / exposure towards individual supplier / key supplier in EMS category.

Currently we are lacking of structural approach in financial analysis when evaluating financial strength of a supplier. Usually credit report available on the internet or purchased from credit rating

agencies show 1 or more year old data and there is no forward looking information of the company development and the information is too static.

With this Master's work I would like to achieve these goals:

- Develop structured approach in financial analysis (relevant for EMS category) with potential spreading the approach also on other categories
- Develop/choose most important financial indicators for the EMS category (big relevance to the identification of soft financial indicators)
- Create a standardized model / tool with key financial indicators showing the development of the company
- To be able to benchmark the suppliers
- Potentially being able to use this date for negotiations with suppliers
- Develop a template that would be filled out from a supplier (on quarterly, half year, year basis?)
- Develop a grading scale to evaluate our EMS suppliers
- Create a traffic light report a one pager for the top management with most relevant information for them
- Identify most relevant risks in the EMS category and level of fragility / antifragility of Danfoss in this category
- To increase understanding of the risk in the EMS category and improve the management of this risk
- Increase knowledge about suppliers in EMS category
- Input for forming strategies and setting directions for the EMS category management
- Create a risk map
- Gain awareness about exposure towards individual supplier
- Develop the model capable of continuous improvements

During the process of obtaining relevant information from suppliers I expect to face resilience. It may be a very sensitive topic to some of the suppliers so I plan to organize an internal meeting with key account holders and category management on how to approach towards suppliers not sending out the wrong message. According to the plan the best way would be to use a uniform approach against all suppliers in scope and then also estimate the responds and time for the feedback as a one indicator on the measurement scale.

This analysis should at the end bring win-win solution and tighten the relationship and cooperation with Danfoss and its suppliers in EMS category. Also according to the TS standards in automotive industry where Danfoss would like to come closer and become certified according to the TS standard, is normal to assess suppliers according to the predefined KPI's. These constant measurements are a standard also internally where each individual employee has a personal agreement with KPI's to follow and to achieve.

1 CORPORATE RISK MANAGEMENT

Risk management is becoming much more than just a term. Companies that are aiming for long-term success see managing risk as a tool that is rooted into top strategy of the company's business to limit losses to increase safety and reliability.

1.1 Concept of Risk

Risk affects every aspect of human life; we live with it every day and learn to manage its influence on our lives. In most cases this is done as an unstructured activity, based on common sense, relevant knowledge, experience and instinct.

Message behind risk management or art of managing risk in an organization is risk identification that is specific to an organization and to define respond strategies to them. Risk identification, planning, assessment and management starts on top levels of management and the process repeats on all lower levels. Managing risk needs to take into consideration how all the management levels are interacted among each other from the corporate, strategic business and project levels. From policy setting to the line of business and project implementations. This also helps different lines and levels to communicate better with each other (Merna & Al-Thani, 2008, p. 2).

Figure 1. Levels within a corporate organisation
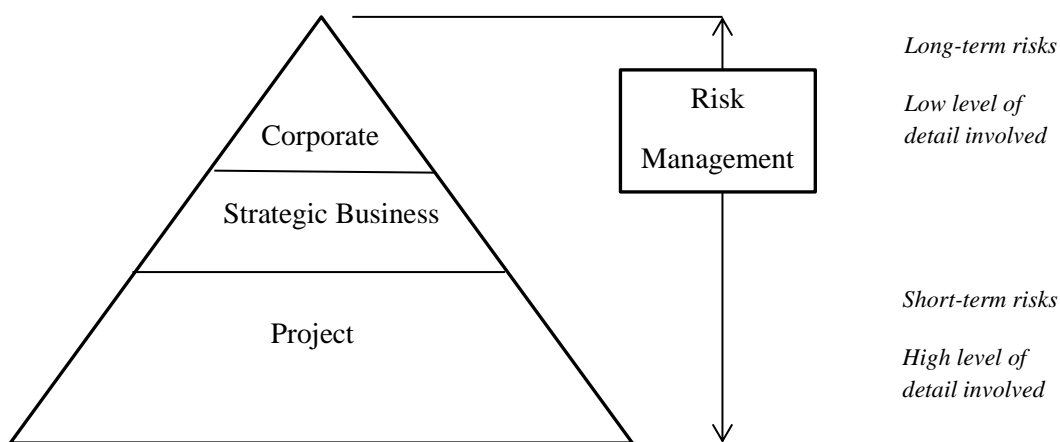
Source: T. Merna & F. Al-Thani, *Corporate Risk Management*, 2008, p. 2.

"Fortune favours the prepared (Louis Pasteur)."
(Merna & Al-Thani, 2008, p. 7)

Investments and their returns are always uncertain and usually all are facing risks Uncertainty is connected with probability that we lower by gathering sufficient information but usually cannot bring it to the level zero and we need to face some risk when taking the final decisions. Probability of an event is connected with its occurrence potential and effect that it may have on the outcome. The cause, effect and description can also be illustrated by (Merna & Al-Thani, 2008, p. 7).

"Crossing the road without looking' will most likely result in injury."

(Merna & Al-Thani, 2008, p. 7)

Figure 2. The concept of Risk

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                    ┌─────────────────────┐
                    │     UNCERTAINTY     │
                    │ Surrounding a Factor or │
                    │        Event        │
                    └─────────────────────┘
          ┌──────────────────┼──────────────────┐
          ▼                  ▼                  ▼
┌──────────────────┐                 ┌──────────────────┐
│      EFFECT      │                 │    PROBABILITY   │
│  Of Factor or Event on │           │  Of Occurrence of the │
│   the Project Outcome  │           │    Factor or Event    │
└──────────────────┘                 └──────────────────┘
          └──────────────────┬──────────────────┘
                             ▼
                    ┌─────────────────────┐
                    │     PROBABILITY     │
                    │    DISTRIBUTION     │
                    │ For the Outcome Values │
                    └─────────────────────┘
```
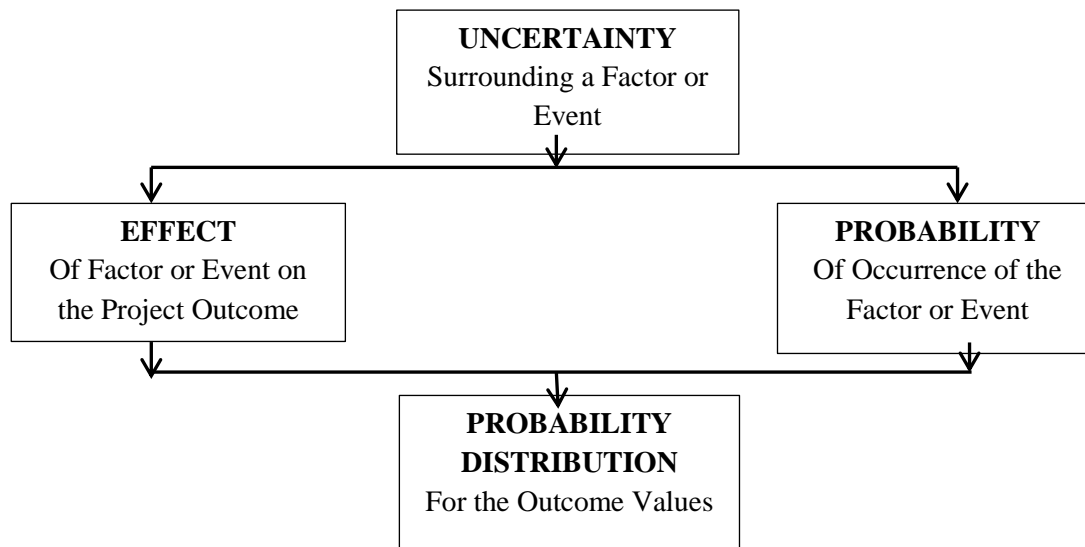
Source: T. Merna & F. Al-Thani, *Corporate Risk Management*, 2008, p. 8.

Figure 2 illustrates the concept of risk in terms of uncertainty, probability, effect and outcome.

Based on the model we can reduce the uncertainty by probability distribution. Probability distribution is calculated from the cause, effect and occurrence over range of possibilities. Authors of the book often expose that uncertainty is interpreted as prophecy and is not based on experiences or valid data however this is a basis for potential risk. (Merna & Al-Thani, 2008, p. 8).

Including the probability of occurrence of the risk or event that we believe is a threat for our business is something I will personally try to avoid when creating a model for managing risk in the EMS category. In my business career I have been conducting quite a few risk assessment workshops or I have been presented the potential risks from project managers. For example we have been assessing probability of an intensive earthquake that may jeopardize the stability of the production hall of our company. Reason for identifying this risk was mainly because we internally knew that our current skeleton construction has not been completed till the end and is on some crucial areas very sensitive for an earthquake of higher amplitude. One of the facts is as well looking historically that Ljubljana had big earthquakes in its present history (the biggest one in 1895 little more than 100 years ago). Anyhow knowing that we are living on a higher threat earthquake area and that we know about the construction deficiency we estimated that probability of the earthquake is 50 years or more so we are not putting much attention into it. I am imagining that if I will be leaving position at my current company when I retire in 40 years again the same risk assessment workshop will occur probably again this risk would be estimated that is not likely to occur in next 50 years meaning consequentially this risk will never occur. Maybe we should start labeling risk with expiry dates when it was identified and what is its life time like the products we buy in a supermarket.

During my writing of this master's degree Balkan has been struck with the biggest natural catastrophic in last 150 years. The flood affected more than 1,6 million people, more than one hundred thousand people were evacuated and had to leave their homes, officially around 50 people died (unofficial number is much higher). Why was nobody capable of predicting this kind of event and why the Balkan nations weren't better prepared for such a catastrophic nature behavior ?

If we would compare how our bodies identify probability and estimate risk we would realize that this is done in a much more sophisticated way than our intellects do. When calculating risk many of the risk managers are looking into the past events and trying to calculate worse case scenarios in order to predict the potential future risk. But usually when saying something is the worst case scenario we get a lection that something even bigger is waiting ahead exceeding the previous worse case. For example we can look at the past earthquakes, tsunamis, Fukushima nuclear reactor or Doctor Alan Greenspam apology "It never happened before". So it is almost impossible to predict and build our assumptions on the worst case scenario from the past as the past is teaching us that in the future even bigger harm is possible (Nassim, 2012, p. 46).

In business environment almost all decisions are grounded with financials or better said by financial returns and how do these returns cover the risk of taking such a decision because almost always there is also a risk of facing the loss if the risk materializes. Similar story is with the investors who are assessing the returns on their investments with the risk they will need to bear if several events that will cause losses occur. Investors demand return on their investment for the price of riskiness of the business they tend to invest in (Merna & Al-Thani, 2008, p. 9).

1.2 Types of Risk

Risk fall in to three categories: known risks, known unknowns, unknown unknowns. Known risks include minor variations in productivity and changes in material costs and occur in construction and manufacturing projects. These are usually covered by contingency sums to cover for additional work or delay, often in the form of a percentage addition to the estimated cost. Known unknowns are the risks whose occurrence is predictable or foreseeable with either their probability of occurrence or likely effect known. A novel example of this is as follows. An automobile breaker's yard in a borough of New York has the following sign on its gate: These premises are protected by teams of Rotweiler and Doberman pincher three nights a week. You guess the nights. Unknown unknowns are often considered as a force majeure events as those events whose probabilities of occurrence and effect cannot be foreseeable by even the most experienced practitioners. An example of the unknown unknowns is common in the pharmaceuticals industry. In the first stage of a drug development process the side effects and their probabilities are unknown although it is known that all drugs have side effects (Merna & Al-Thani, 2008, p. 13).

Typical risks in corporate risk management (Merna & Al-Thani, 2008, pp. 18-33):

- PROJECT RISK: Projects are usually always exposed to several risks such as: not meeting the dead line, exceeding the budget, not achieving the preferred outcome or quality etc.

- GLOBAL RISKS: Major risks in this category are legal, political, environmental and commercial risks and usually these riss are not controllable and it is highly likely they will occur. (Merna and Smith 1996).
- ELEMENTAL RISKS: The four main elemental risks are operational, financial, construction/manufacture and revenue risks (Merna and Smith 1996). These types of risks are usually considered as controllable risks.
- HOLISTIC RISK: In this process an organization identifies and quantifies all threats that may jeopardize its objectives, later also manages those threats within.
- STATIC RISK: An example of this risk is that an organization would lose a market for its product because it would not introduce an upgrade development of the same product in the same market.
- DYNAMIC RISK: When we are risking something that is certain for the gain of something that is uncertain.
- INHERENT RISK: Depends on the business nature and internal organization. For example in the mine there is always a threat of an rock fall.
- CONTINGENT RISK: When a company is affected by some activity or even that is beyond its control and is highly depended from it. For example not getting a supply of goods because a supplier went bankrupt.
- CUSTOMER RISK: Occurs when a company is for example to depended from only only customer and it decides to take the business away.
- FISCAL/REGULATORY RISK: Low control a state decides to rise the tax and this may effect on lower sales.
- PURCHASING RISK: Purchasing risk is a vital part of modern commercial reality but recently the subject has gained prominence in the work of leading academics and management theoreticians.
- REPUTATION/DAMAGE RISK: Usually this is a consequence of another risk. For example if a bank comes to bad reputation the clients may remove its savings and deposits from that bank which may collapse the bank.
- ORGANIZATIONAL RISK: Big organizations can face with communication issues because of poor infrastructure or communication equipment which have huge effects on the business.
- INTERPRETATION RISK: This risk is caused by a misinterpretation due to the leakage in communication btw. management staff and usage of jargon of each individual expertise.
- IT RISK: IT industry is rapidly developing and to keep competitiveness companies need to invest heavy into developing and adopting IT in order to stay successful.
- THE OPEC RISK: OPEC's member's country holds about two-thirds of the world's oil production. OPEC's mission is to ensure stabilization of oil prices but success rate is not always as planned during this control.
- PROCESS RISK: Process risk arises when the fundamental requirements for running a project are established. The management and decision-making process for operating the project, including the communication methods and documentation standards to be adopted, will also be areas of risk.
- HEURISTICS: A threat of a human mistake that may jeopardize the project success is always present.

- DECOMMISSIONING RISK: Many industries have to plan for the end of lifetime costs for their plants, whether dismantling or reconditioning the sites. These characteristics of the project have financial consequences in regard to cost estimating and financing.
- INSTITUTIONAL RISKS: In this bucket are risks connected with the organizational behavior and its structure.
- SUBJECTIVE RISK AND ACCEPTABLE RISK: It is usually subjective to what extend someone feels threated by some risk and also believing into to likelihood of the occurrence. What is acceptable is usually subjective decision for a person or an organization.
- PURE RISKS AND SPECULATIVE RISKS: Pure risks offer only probability of a loss and not profit. Speculative risks on the other hand can offer a profit or loss.
- FUNDAMENTAL RISKS AND PARTICULAR RISKS: Here natural disasters as a fundamental risk can occur and affect whole or significant part of the organization. Organizations have little or no control over this risk maybe only by limiting the effects of these risks.
- IATROGENIC RISKS: When managing one risk this can lead to further risks that may have even greater impact as the initial risk.
- DESTRUCTIVE TECHNOLOGY RISK: Development of new technologies may cause the old technology to become obsolete or uncompetitive. For these reason an organization needs to follow development trends in order not to invest heavily in a technology that may become old the next day after purchase.
- PERCEIVED AND VIRTUAL RISKS: An example of perceived risk are diseases like cholera when special equipment is needed to see the virus and a special training to use the equipment correctly and to understand the results. Virtual risks we talk about when for example scientists cannot agree on their impact (passive smoking, global warming, beauty operations..).
- FORCE MAJEURE: Is a common clause when conducting and signing contracts. This clause frees up both parties of liability for not completing the obligations from the contract in case of an extraordinary event that is beyond the control of each party.

1.3 Risk Management Tools and Techniques

According to the theory currently management of risk is becoming more and more important and in minds of management due to its benefits that may bring to the process. Availability of techniques to support this process has increased significantly.

Because risk management tools and techniques are not core business of this Master's degree I will only list and describe shortly several of them.

- Risk Analysis Techniques

Main categories of risk analysis techniques are:
- Qualitative
- Quantitative

Qualitative methods seek to compare the relative significance of risks facing a project in terms of the effect of their occurrence on the project outcome. Quantitative techniques attempt to determine

absolute value ranges together with probability distributions for the business or project outcome and, consequently, involve more sophisticated analysis, often aided by the use of computers (Merna & Al-Thani, 2008, p. 68).

In determining which of the available analysis techniques is most suitable for application to a particular investment, management should consider:
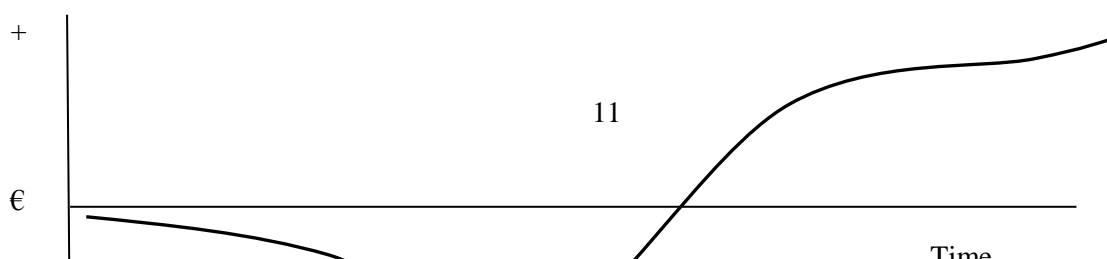- The availability of resources for analysis
- The experience of the analysts with the different techniques
- The size and complexity of the project
- The project phase in which the analysis takes place
- The available information
- The purpose of the analysis

- Qualitative Techniques in Risk Management (Merna & Faisal Al-Thani, 2008, pp. 69-76):

   - BRAINSTORMING: It is used in many different business areas and it also comes n different setups there is no exact rule how many people should interact in it and how exactly the process should be driven. Usually the problem needs to defined and the ideas for finding solutions are generated (Sunday Times 2001).
   - ASSUMPTIONS ANALYSIS: This is an intuitive technique and usually during the project planning assumptions are identified and later also assessed and evaluated by impact that it may have on the project outcome.
   - DEPLHI: This technique tries to predict future outcomes or events by involving a group of experts who are asked to make forecasts individually so it avoids potential group influences in an individual. Later any extreme views are discharged.
   - INTERVIEWS. It is used where information requirements need to be more detailed than a group can provide, or where group work is impractical.
   - HAZARD AND OPERABILITY STUDIES (HAZOP): This is an inductive method close to the brainstorming where a group is examining the elements of a process is defining the intention of each.
   - FAILURE MODES AND EFFECTS CRITICALITY ANALYSIS (FMECA): This technique focus on the hardware involved, with the concentration on potential equipment failures, or on events, with an emphasis on their outputs and the effect of their failure on the system. Every component of the system is considered and each mode of failure identified. The effects of such failure on the overall system are then determined. This technique uses a type of weighted score to identify areas of a project most at risk of failure.
   - CHECKLISTS: It is a deductive technique derived from the risks encountered previously and provide a convenient means for management to rapidly identify possible risks.
   - PROMPT LISTS: This method classifies risks into groups and it may be general or related to a project or industry.
   - RISK REGISTERS: Here it goes for recording risks to a database for later reviews and usage. This data can be captured and saved during the risk management process of identification .
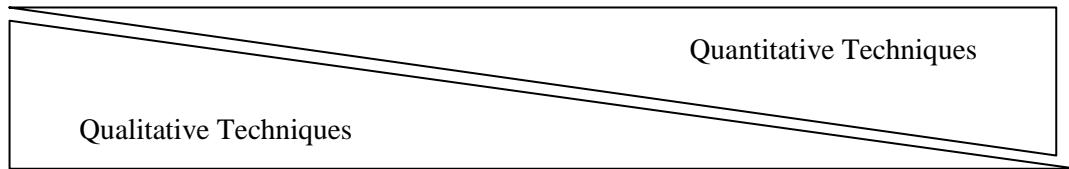
- RISK MAPPING: Here goes for the visualization of the risk in a two dimensional graph usually by affect and occurrence probability.
- PROBABILITY-IMPACT TABLES (P-I): Similar as risk mapping risks are listed by potential impact and probability.
- RISK MATRIX CHART: Usually after the risk management workshops when risk are identified are then listed into a matrix by impact and occurrence probability in order to better separate high impact risks from low impact risks.

Many of such qualitative analysis methods can be used at corporate and SBU levels in the early stage of project definition when little detailed information is available.

- Quantitative Techniques in Risk Management (Merna & Al-Thani, 2008, pp. 76-84):
Quantitative techniques are used mainly when presentation to board of directors is needed for better visualization within time development and budget is required in order to optimize the decision making. Based on this information than board of directors easier take decisions for potential authorizations and budget changes or time prolongations.

  - DECISION TREES: different investment options are presented with more potential scenarios in a graphical way with different probabilities for the decision makers.
  - CONTROLLED INTERVAL AND MEMORY TECHNIQUE: Mathematical means are used in this model with different probabilities and probability distributions for specific risk are presented.
  - MONTE CARLO SIMULATION: A model is designed in order to simulate a real system and its behavior when different inputs occur.
  - SENSITIVITY ANALYSIS: It is determine the effect on a system when one risk variable changes by doing this we then determine the risks that have highest impact on the project.
  - PROBABILITY-IMPACT GRID ANALYSIS: This method is used for risk prioritization at responding to a risk and resource allocation. We will obtain a ranking list of all identified risks. When the impact parameters for a risk (cost, program, performance) have been established, a broad-band rating system may be used to rank the risk based on the probability-impact grid (PIG) method

Figure 3. Typical project cumulative cash flow and the types of risk management techniques

11

Time

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┌─────────────────────────────────────────────────────────────┐
│                                        Quantitative Techniques│
│                                                               │
│   Qualitative Techniques                                      │
└─────────────────────────────────────────────────────────────┘
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Source: T. Merna & F. Al-Thani, *Corporate Risk Management*, 2008, p. 84.

At the start of the project the risk management techniques tend to be more qualitative. As the project moves through its life cycle the risk management techniques tend to become quantitative the more project information and detail there are available.

1.4 Risk Management at Corporate Level

Corporate level is the highest level of the corporation. All the financial and acquisition decisions are made at the corporate level. Second in the hierarchy is the SBU level. These SBU levels are divided into separate strategies business operations. At the bottom of the hierarchy lies the project level. Corporate risk management is there to support corporate strategy for corporate survival, obtaining or increasing the market share, increasing the companies value in financial terms , increase brand reputation ad recognition (Merna & Al-Thani, 2008, p. 186).

Top executives in the corporation are responsible for strategies at corporate level. The degree of responsibility and accountability they face will depend on the degree of autonomy allowed, and the constraints imposed by corporate governance. However, the ultimate responsibility for corporate management/strategy always rests with the corporate board.

 The board's main roles are (Merna & Al-Thani, 2008, p. 189):
- To direct the company
- To appoint the managing director/chief executive
- To delegate the appropriate powers for running the company
- To monitor the performance of the company
- To take corrective action where necessary

For companies in high competitive environments, it is not enough only to protect its assets through a combination of a good housekeeping and derivative buying. Pressure on the margins is to intensive exposure of the vulnerability to volatility is too big so the focus needs to be bigger also in the less tangible world like reputation and expectations in order to sustain investors value – popularity of risk management in the board rooms is rising incredibly.

Financial analysts are more and more focusing on risks and quality how risk management is applied in the company and in the board room. This is telling the analyst how the corporate managers know what are they doing and using the company's capital and how stable are the future profits (Merna & Al-Thani, 2008, p. 197).

A survey of CEOs and risk managers in the UK, Europe and the USA has shown constantly that the main perceived issues today are: corporate governance; extortion, product tampering and terrorism; environmental liability; political risk; regulatory and legal risk; fraud; and a whole host of risks ushered in by modern technologies.

Due to the past events and disasters a strong public opinion that companies and their managers are responsible for their actions that cause failures.

Managing corporate risk is a continuous process in which the main principle in risk management is used as defined. This includes (Merna & Al-Thani, 2008, p. 201):

- Identification of risks/uncertainness
- Analysis of implications
- Response to minimum risk
- Allocation of appropriate contingencies

Knowing the risk that is connected with the corporate strategy is the objective of corporate risk management. It is of vital meaning that the communication through different levels is passed down to the SBUs in a proper way on how risks should be treated.

It is fundamental how the risk structure is incorporated into the corporate strategy. The company should treat the risk as important it does the operations and finance or any other basic corporate function. Risk managing needs to flow through an entire organization's structure.

The worrying fact for senior managers of all types of companies is that the potential for corporate disaster on a large scale is growing at an alarming rate, and, worse still, the specter of corporate Armageddon is growing at a faster rate than the ability of most organizations to cope (Merna & Al-Thani, 2008, p. 208).

1.5 Concept of "Antifragile"

What does it mean something to be antifragile. When something likes volatility, uncertainty, randomness and when it is able to grow from all of it we can call it antifragile. Is something is resilient it can resist shocks but at the end it stays the same, the antifragile gets better. Everything changes during the time (Nassim, 2012, p. 4).

This concept of Antifragility will be in my mind when creating the credit risk model for the specified category. The created model should be real, alive, able to learn and improve in order to use it confidently and supportive when taking strategic decisions.

2 CREDIT DERIVATIVES

2.1 Credit Risk

Credit stands for the idea that a person or a company can use somebody else's money to support their own finances. They may use this money for a shorter or longer period of time and normally for a fee. Modern society has developed around the idea of credit, because it enables people to have or invest in the things they want today, but can't afford to pay for until tomorrow, possibly as a result of the initial investment itself. To a large degree, credit is the oil that greases the cogwheels of the world economy.

According to Moody's KMV default risk is the uncertainty surrounding a firm's ability to service its debts and obligations. It is no way to separate firms between the ones that will default and those that won't. We can try and make a probability model that may calculate us the default rate probability and based on this probability a firm usually needs to pay a premium over the default-free interest rate to compensate the lenders risk. Typical firm has a default probability around 2% in any year. The odds for a firm with AAA rating to default are about 2 in 10.000 per year. A single A rated firm has the odds of 10 in 10.000. The bottom line at rating scale is CCC-rated company with odd of default of 4 in 100 (4%) (Crosbie & Bohn, 2003).

Credit risk is a virus common as cold and it touches anyone who extends a loan. Banks are exposed with loans to individuals and companies. A company is exposed with offering credit lines to its customers. There is always a risk that the credit taker will not return the loan (Chacko, Sjoman, Motohashi & Dessain, 2006, p. 3).

It is mistakenly thinking that only banks are exposed to credit risk because also companies when allowing postponed payment terms for its products or services step in the same line. That is why it is so important to thrust credit worthiness of the partners companies cooperate with.

It is also of high importance that a company looks after its own credit rating. Banks and investors look intensively into credit worthiness and each drop in credit rating can send a strong negative signal leading to increasing risk for lending money to this company and therefore the borrowing costs raise as the lenders demand a higher premium for higher uncertainty and higher risk they need to bear.

From the perspective of this Master's final work credit risk of the supplier will be treated as the fundamental risk in the cooperation between our company as a customer towards its suppliers. We want to believe that companies we work closely together are healthy and are developing in the right direction in order to deliver stable supplies and behave competitive on the market. Also vital to

understand is the exposure towards each supplier and to take strategic long term decisions based on the result of thrust worthiness of present suppliers.

Credit analysts often talk about how much credit exposure a given organization faces. Also known as exposure at default (hereinafter: EAD), credit exposure is a measurement of how much the creditor would lose if the counterparty defaulted on its obligation. Because a small exposure at a low level may not be that damaging to a creditor, this definition helps companies focus on their larger exposures. EAD is often used by regulators of financial institutions, which require credit issuers to measure exposure (Chacko et al., 2006, p. 21).

Most credit risk models are based on two fundamental concepts: default probability and recovery rate. Together these give a good measurement of a debt's quality. Combined as one measurement, they are often referred to as credit spread.

- Default Probability is the likelihood that the counterparty will default on its obligations. Probability of the default can be calculated in several ways traditionally are used historical data, credit agencies reports. Lenders usually also analyze industry dynamic where the company is operating, competitors, marketing plan in order to anticipate how the company would be able to react on changes in environment where they are operating.
- Recovery Rate measures the extent to which the market value of an obligation may be recovered if the counterparty defaults. For example when a company or corporation announces bankruptcy the banks that held loans towards this corporation will be able to recover back some of the debt during the liquidation process.

Combining the default probability and recovery rate with the credit exposure of a given debt, companies can calculate the expected loss of any given obligation, using the following formula:

$$Expected\ loss = Default\ Probability * Credit\ Exposure * (1 - Recovery\ Rate) \qquad (1)$$

- Credit Spread is an important concept for investors in credit. Credit spread incorporates both the default probability and recovery rate concepts, and becomes a quick way for investor to put a price for its money. The higher the spread the riskier the investment.

EVALUATING DEFAULT PROBABILITY: CREDIT RATING AGENCIES

Evaluating default probability is a particularly important task for professionals in the credit industry. The task is easy to understand (assess the capability of counterparty to pay back debt) but hard to carry out. Many banks, investment managers, and financial companies employ their own credit analysts to evaluate the probability of default. However, the same service can be purchased from professional rating agencies. These agencies evaluate financial strength of companies, assign

them ratings, and rate the debt they issue. Different rating agencies use different rating systems. The ratings serve as a reference, helping investors to match their strategies and risk preferences with investment opportunities. For instance, the highest Moody's rating is Aaa and the lowest is C. The lowest investment grade rating is Baa, and anything below Baa is deemed as speculative grade.

Table 1. Credit rating system for S&P and Moody's

S&P	Moody's	Description
AAA	Aaa	Best credit quality-Extremely reliable with regard to financial obligations
AA	Aa	Very good credit quality-Very reliable
A	A	More susceptible to economic conditions-Still good credit quality
BBB	Baa	Lowest rating in investment grade
BB	Ba	Caution is necessary-Best sub-investment credit quality
B	B	Vulnerable to changes in economic conditions-Currently showing the ability to meet its financial obligations
CCC	Caa	Currently vulnerable to nonpayment-Dependent on favorable economic conditions
CC	Ca	Highly vulnerable to payment default
C	C	Close to or already bankrupt-Payment on the obligation currently continued
D	/	Payment default on some financial obligation has actually occurred

Source: G. Chacko et al., *Credit derivatives - a primer on Credit Risk, Modeling, and Instruments*, 2006, p. 27.

Credit rating agencies continuously improve and update their models but for their ratings offer no guarantees.

Rating agencies normally look at balance sheet information, which gives a smoothed-out accounting version of the organization's financial health, or economic status, at a given point in time. Ratings based on such a snapshot sometimes lag behind new events. Using up-to-date economic and financial statements that change as new information arrives would lead to greater accuracy. Many large financial institutions and market players employ this alternative method in their internal rating departments.

2.2 Typical Credit Derivatives

As an alternative to commercial risk mechanisms (guarantees, letters of credit, or other insurance products), during past decades different financial mechanisms were developed in order to transfer the credit risk from lender to some other party. These credit risk instruments are so called or referred to as credit derivatives. (Credit derivatives gain or derive their value from underlying credit instrument, such as bond or loan. Idea is that the risk is passed to another party who receives a fee for taking this risk on his shoulders (Chacko et al., 2006, p. 44).

Credit risk instruments enable financial institutions and companies to transfer credit risk to a third party and thus reduce their exposure to the risk of an obligor's default.

Credit derivatives are bilateral contracts that legally transfer credit risk from one to another party. Party that is transferring risk to another party wants to protect itself against credit risk will need to pay a fee to the protection seller (the party who is buying the risk). If the credit event occurs, the credit derivative contract provides for the settlement of any payment obligation.

There are numerous credit instruments in the market. I will briefly present only some of the most common ones.

2.2.1   Total Return Swap

The owner of an asset transfers the total return of and specific asset to another party in exchange for a fee. The buyer does not want to own the asset, and the seller uses this instrument to pass on the returns and the buyer pays in exchange a fee and in case the actual returns turn up to be lower as forecasted , the buyer will need to compensate the seller. Benefit for the seller is that he keeps the portfolio of assets and he limits his exposure in the business environment for the expected returns on those assets. Typical sellers in total return swaps are banks, and typical buyers are hedge funds (Chacko et al., 2006, p. 48)

Figure 4. Total return swap
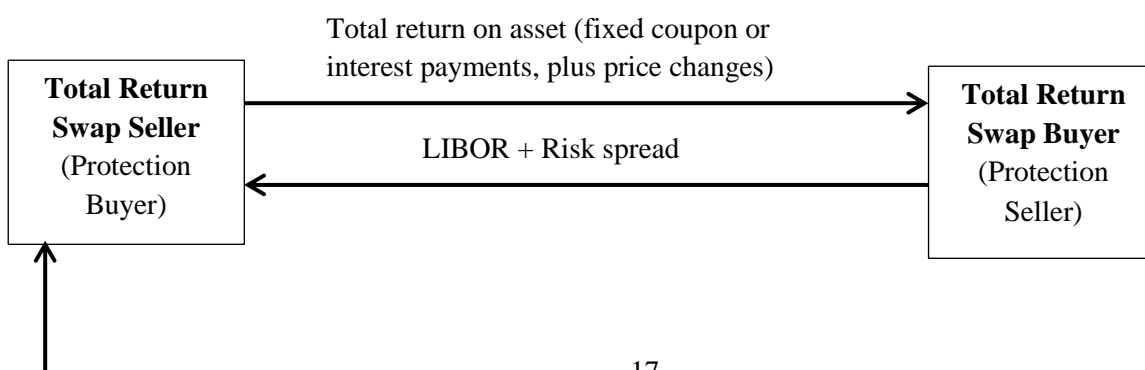
```
┌─────────────────┐
│ Underlying asset │
│ with credit      │
│ exposure         │
└─────────────────┘
```

Source: G. Chacko et al., *Credit derivatives- a primer on Credit Risk, Modeling, and Instruments*, 2006, p. 47.

2.2.2 Credit Default Swaps (hereinafter: CDS)

It is a two party agreement where one party pays a periodic fee to protect itself against predefined credit default event occurrence. If this credit default event does not occur the other party doesn't need to make any payments. The first party is only buying the protection against the default and the other party is selling the protection. CDSs are providing credit default protection for occurrence of very specific events that need to be named in the contract and it covers the protection only if this particular event from the contract occurs (Chacko et al., 2006, p. 49).

Figure 5. Credit default swap
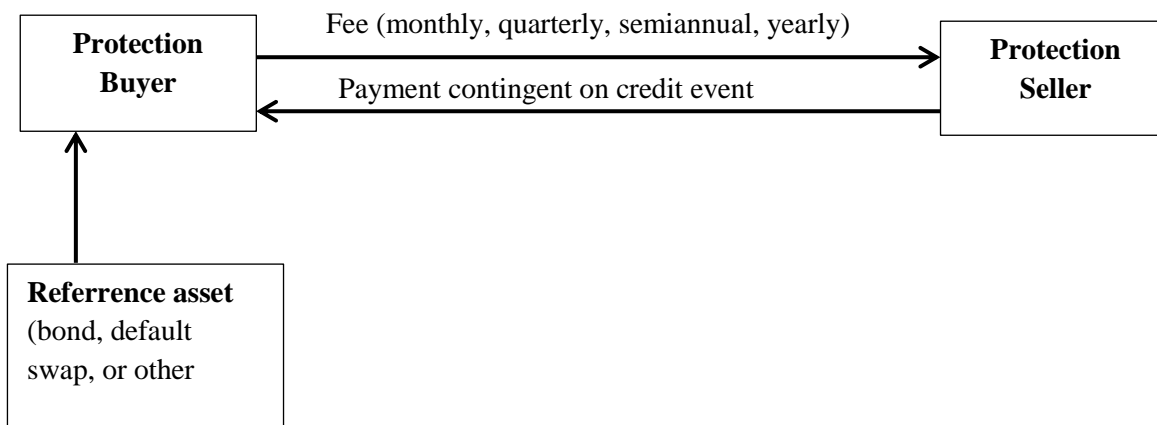
Source: G. Chacko et al., *Credit derivatives- a primer on Credit Risk, Modeling, and Instruments*, 2006, p. 49.

2.2.3 Credit Linked Notes (hereinafter: CLN)

A CLN is a combination of a standard debt (bond) and a credit derivative (CDS). It is a financial security and this security is linked to the performance of a reference debt. Investor in the CLN expects a higher yield for the exposure to a specific credit default event occurrence. Issuer of the CLN needs to pay higher interest rate so it can attract the investors and in exchange it receives the protection from the investor if a specific predefined credit event occurs. CLNs often include special companies (SPVs, SPCs, SPEs) or legal entities for financial transactions. Usually these entities are registered in offshore tax havens. One of the reasons is that assets are protected and cannot be

affected in case the originator goes bankrupt or has to default on its debt. These legal entities are issuing the CLNs. The process starts so that this legal entity signs CDS with the originator who pays a fee for it. This fee is then passed on to the investor under the CLN terms. Reasons to issue the CLN are similar to the reasons for issuing the CDS. The originator buyer of the protection wants to protect himself and split off the risk that is unessential to core operations. The protection seller benefits from it so he doesn't need to directly purchase the assets (Chacko et al., 2006, p. 50).
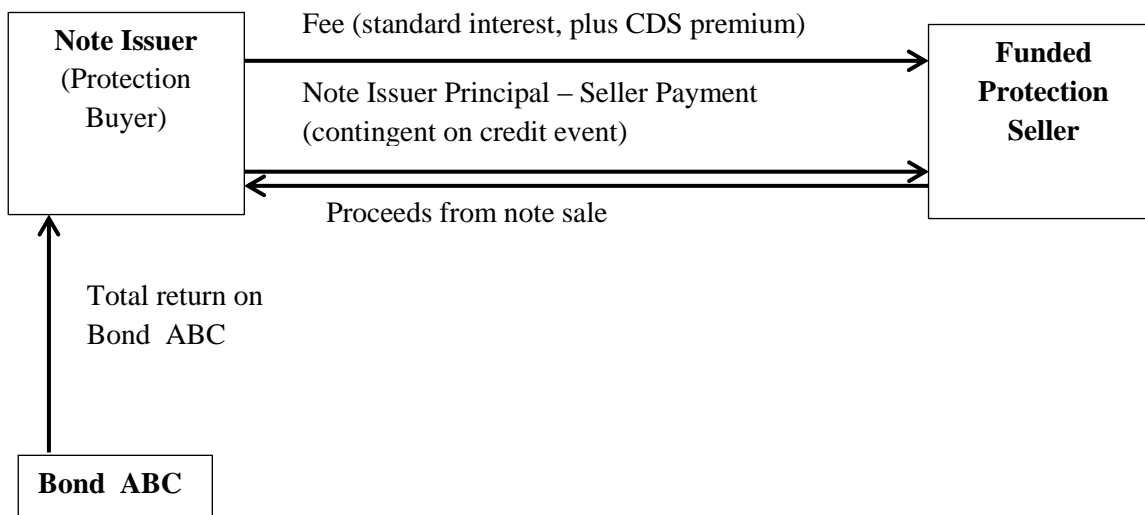
Figure 6. Credit linked note with embedded credit default swap

Source: G. Chacko et al., *Credit derivatives- a primer on Credit Risk, Modeling, and Instruments*, 2006, p. 50.

2.2.4   Credit Spread Option

Credit spread options (hereinafter: CSOs) are hedging an investment instruments that protect against changes in credit spreads. A CSO can be based on changes in credit spread between two different credit instruments, or between a credit instrument and risk-free benchmark, such as LIBOR or U.S. Treasury Bonds. CSOs give the protection buyer the right to sell (put) or buy (call) a reference credit at a specific spread at a certain date. In exchange, the protection buyer has to pay a premium fee. The payoff is then determined by where the actual spot spread is at the maturity date (over or under the spread of the reference credit). A call-CSO pays out if the underlying spread is over the strike spread (the opposite is true for a put-CSO) (Chacko et al., 2006, p. 52).

Figure 7. Credit spread option (Put)
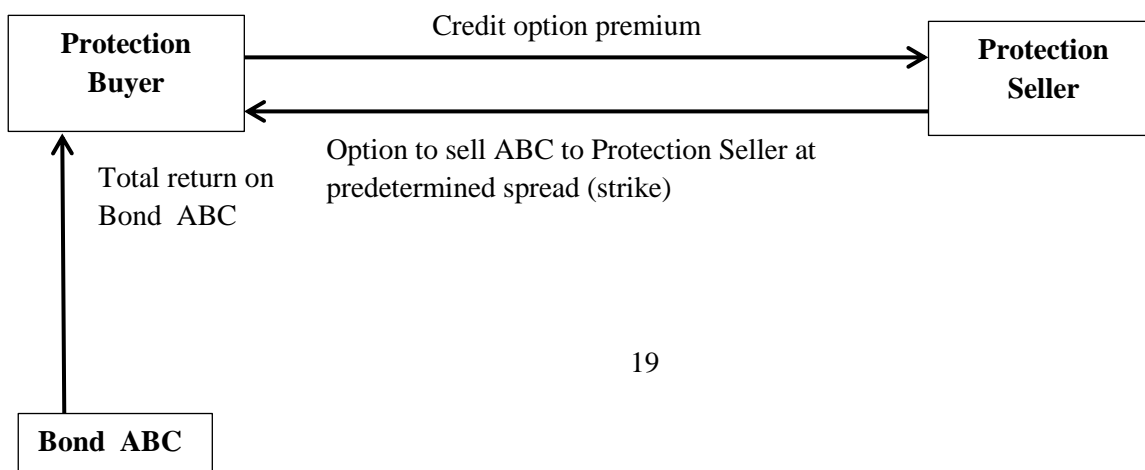
- Credit Derivatives Market

Trading in credit derivatives began in early 1990s in New York and London. By 1996, the global market size was estimated roughly between $100 billion and $200 billion. By 2003, it had grown to $3,5 trillion. Estimating the size of the market is difficult, because credit derivatives are not traded on public exchanges but on private negotiation basis in the so-called over-the-counter (OTC) market. The actual market might therefore very well be larger, because seller and buyers have a natural inclination not to reveal their trading information.

Today market size is estimated to around $3 trillion per day.

2.3 Modeling Credit Risk

Credit risk models can help us estimate a default probability. These models are mainly used when trading with credit derivatives on the credit derivatives market or in banks for monitoring the overall credit risk of the loans portfolio and for the approving/denying individual loan applications. For the purposes of this master piece I will try to create a credit risk model for better estimation of the financial health of suppliers in the EMS category in order to minimize the credit risk or to increase exposure awareness toward individual supplier in the category.

The role of any credit risk model is easy to describe: It takes as input the conditions of the general economy and those of the specific firm in question, and generates as output a credit measurement such as credit spread, credit score, or credit rating. A good credit risk model should take into account also the status of a firm's individual projects-which is information that the firm naturally does not release to an outsider. Credit risk model is still nothing more than an interpretation and it should be a function of the default probability for the debt and the recovery rate in case of default.

Figure 8. The basis of credit risk model
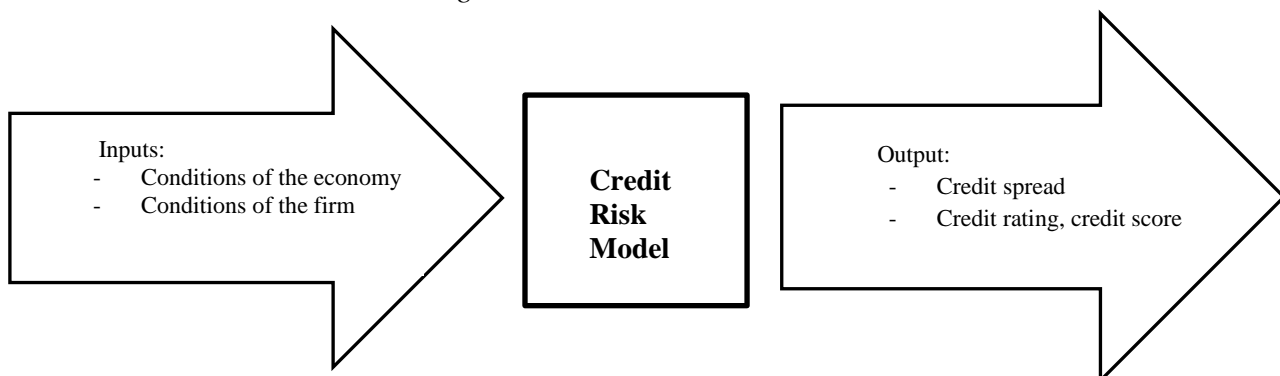
Inputs:
- Conditions of the economy
- Conditions of the firm

Credit Risk Model

Output:
- Credit spread
- Credit rating, credit score

CLASSES OF RISK MODELS (Chacko et al., 2006, p. 65):

- Structural
- Empirical
- Reduced form

Structural models all share common approach of replicating the firm and its economic structure. The basic idea is that a company defaults on its debt if the value of that company's assets falls below a certain default value. As the company's stock equity decreases, the model predicts that default is more likely.

Empirical models approach the situation differently: They assume that it is too difficult to model the company and its environment accurately. Instead, they look at companies that have defaulted, evaluating their financial data to arrive at specific point. The score given to defaulted companies is then being compared to that of nondefaulted firms-closer the score less creditworthy the firm assumes to be.

Reduced form models try neither to create a model nor arrive at a score. Rather than look inside the firm, these models attempt to model the likelihood of default by assuming that default simply is tied to an external signal such as statistical or econometric value. This value becomes the deciding factor of default, rather than a model of the firm or a score attributed to it. These models build on the assumption that default occurs as a random event.

Due to the clear direction from our category management director I will focus in this master piece examining only structural model approach more in details.

2.3.1 Structural Credit Risk Models

The structural approach to credit risk models says that a firm defaults when the market value of its assets is less than the obligations or debt has to pay. (Structural models are therefore sometimes also referred to as asset value models.) These models look at a company's balance sheet and its capital structure to assess its creditworthiness. However, one of the inherent problems with this approach is that the value of a company's assets is hard to observe. The annual report only provides an adjusted accounting version of the company's real assets. However, the market value of a company's stock equity is normally observable, as its debt.

High percentage of equity lowers the danger of insolvency. High percentage of equity is a sign of higher independency from debt lenders, therefore the company has a lower cost of financing and less cash outflows (Koletnik, 2006, p. 264.) High percentage of equity in financing is not always preferable for a company, because this can also point to an irrational financing of assets with more expensive financing sources. In professional literature we can find procedures of setting the optimal structure of capital (Berk, Lončarski & Zajc, 2006, p. 164).

The structural approach states that the fundamental source of uncertainty when it comes to a company's credit risk is its market value. The balance sheet of the company is therefore a natural starting point when we want to assess market value (Chacko et al., 2006, p. 67).

In simple words the natural assumption behind the structural approach is: When you owe people more money than you have or that you would have if you sold off what you own, you are bankrupt.

If we use industry jargon: Equity has to drop to zero before debt is hit. Thus, equity holders are the cushion that softens the blow for debt holders from a drop in asset value. Investors naturally see equity as a much riskier investment than debt, which explains the old investment rule-of-thumb that stock is riskier than bonds.

Table 2. Risky debt

A				B				C			
Asset	200	Debt	70	Asset	150	Debt	70	Asset	100	Debt	70
		Equity	130			Equity	80			Equity	30
	200		200		150		150		100		100

D				E				F			
Asset	70	Debt	70	Asset	50	Debt	70	Asset	0	Debt	0
		Equity	0			Equity	0			Equity	0
	70		70		50		70		0		0

Source: G. Chacko et al., *Credit derivatives- a primer on Credit Risk, Modeling, and Instruments*, 2006, p.76.

Company owners invest capital same time with the starting assets in form of cash, equipment or rights at company's foundation. Later on the capital is being increased with new additional investments or by net income, in special cases also by transitional revaluation of individual assets. Capital decreases by paybacks to the owners or by a loss. Capital expresses ownership's financing of the company and it is a company's obligation towards the owners. This is also an obligation towards assets that we cannot treat as debt. Usually for running business operations also debt is used that enables to finance assets. According to financial concept of capital, according to Slovenian Accounting Standards (SRS), capital represents the buying power of the owners that needs to be maintained by company's operations or increased (Slovenski računovodski standardi, 2014).

Capital is the most important item on the balance sheet. It is the residual of assets when all debt is deducted. Capital is the liability towards owners of the company as well towards other financing companies, that is due for payment if company stops to operate or the decision for decapitalization of the company is taken because of lowering companies operations. Looking from the financial concept capital is separated generally in two types the owners capital so named equity and owed capital so named as debt (Slovenski računovodski standardi, 2014).

According to Moody's KMV there are three main elements that determine the default probability of a firm (Izzi, Oricchio & Vitale, 2012, p. 244).

- Value of Assets: The market value of assets is showing the present value of the future cash flows and it gives us the information about the industry and company's prospects for the future.
- Asset Risk: Value of the firm's assets is always a risk and it goes for an estimate connected with uncertainty. Asset risk is measuring the risk of the firm's assets and estimates the risk in the industry.
- Leverage: A measurement of a firm's market assets value versus the book value of liabilities.

Figure 9. Evolution of the asset value and book liabilities of Winstar Communications
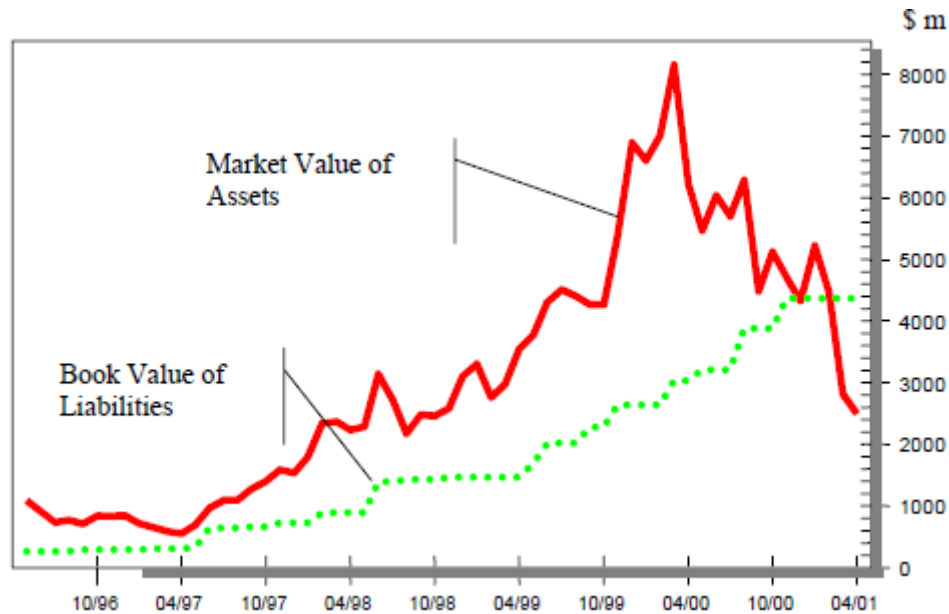
Source: L. Izzi et al., *Basel III Credit Rating Systems : An Applied Guide to Qantitative and Qualitative Models,* 2012, p. 244

One of the issues we face many times is that both assets and liabilities can be broken down into thousands of subcategories, making their true value very hard to observe in the real world. The balance sheet that is printed out in a company's annual report is an accounting statement, and as such it only gives a very polished snapshot of the company's financial situation. Many time estimates would have to be used for calculating values. This explains one the main drawbacks of the structural approach to credit risk modeling.

Some of the structural models that exist:

- Merton model says the company defaults if its assets fall below its outstanding debt at the time of servicing or refinancing the debt. This is the first credit risk model.
- The Black and Cox model state that default occurs when firm's assets value falls below certain threshold value, which does not have to equal the debt value, and that default can occur at any time, not just at the expiration of the debt. It is an extension to the Merton model by setting the barrier function.

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- Longstaff and Schwartz model is an extension to the Black and Cox model. Still Longstaff and Schwartz model uses much more parameters, and depending on the choice of parameters, the probability of default coming out can be higher or lower than the Black and Cox model. This model instead of using constant interest rate, allows for a time-varying interest rate. It uses high-level mathematical approach.

All models come with their own set of simplifying assumptions that simply the real world and take you away, in a manner of speaking, from reality.

Merton's model explains equity as nothing other than a call option on the assets of a firm. According to this concept, you have the right, but not the obligation, to sell the stock of the company; exercising this right allows you to cash out on your option. Because option models set out to price an option, and because we view equity as a call option on assets, we can use option-pricing models to find the value of equity, we can then simply calculate debt value as the difference between assets and equity (Chacko et al., 2006, p. 78).

Using the credit risk models is to evaluate the default probability. The models are calculating the credit spread and higher the spread is bigger the default probability. One of the parameters that affects the default probability is also the debt maturity, longer it is higher the default probability, because higher the compensation that an investor will seek for investing in that particular debt. Default probability also increases with the asset volatility, meaning the value of the company fluctuates more and more overtime, the likelihood that the asset value will fall below the debt value at maturity increases. Simply put with higher volatility, there is a chance for the asset value to reach zero, and for the company to lose all value. One of the statements is also that if asset values increases, the probability of default decreases-that is, as the asset value increases, the chances of the asset being below the principal amount of debt at any time in the future is by definition lower. Probability of default is therefore lower.

Fundamental assumption in Merton's approach is that default can only occur if the value of the assets is below the value of the debt at the time the debt expires. Merton assumes the whole debt consists of one bond issue, and that default happens when that bond issue matures. In Merton model there are no interest payments, there is only one payment, which happens at maturity when the full principal value is paid back. If the company misses this payment, it defaults.

Structural approach proposes that firms never default by surprise, and that their default probability can be modeled from looking at the structural values of the company-primarily its balance sheet-the two other approaches (empirical and reduced form models) assume that there is no reliable method of predicting when default will happen. In their view, there is no relationship between firm's asset value and default. Instead, defaults "just happen"; they are unpredictable events that either can be estimated based on historical data or the sake of modeling can be tied to some external signal (Chacko et al., 2006, p. 119).

2.3.2 Empirical models of default or credit scoring models

The defining characteristic of the empirical model is that it identifies the possibility of default with a quantitative score. A credit scoring model compares companies that defaulted in the past with the companies that didn't. For comparisment I is using financial statements as balance sheet, income statement, financial ratios for measuring profitability, liquidity, solvency. The results are also compared among competitors and Industry as a whole. When joining all the different values it can also evaluate or score a firm individually (Chacko et al., 2006, p. 123).

Z-SCORE MODEL is the first scoring model introduced by Edward I. Altman in 1968. Altman has used historical data and a group of companies. He has separated the companies into defaulting and nondefaulting group. Later he started to calculate certain financial indicators focused on profitability, leverage, liquidity, solvency and activity. He was able to calculate also the correlation coefficients later from the outcome based on the weight each indicator had on the defaulting result. It needs to be pointed out that all the data was based on historical results.

$$Z = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 \qquad (2)$$

- Z = Overall score
- β_1 through β_5 = Coefficients
- x_1 = Working capital / total assets
- x_2 = Retained earnings / totalassets
- x_3 = Earnings before interest and taxes / total assets
- x_4 = Market value equity / book value of total liabilities
- x_5 = Sales / total asstes

x_1, **Working Capital / Total Asset(WC/TA)** – This is the indication of company's liquidity compared with companies value. This ratio reflects both liquidity and size features, and is preferred to other liquidity ratios such as quick ratio and current ratio.

x_2, **Retained Earnings/Total Assets (RE/TA)** – The indicator is showing how the company is reinvesting its earnings over its life. Usually high ratio means that the company is less likely to default. This ratio is preferring the companies that are on the market for a longer period as they might have cumulated more retained earnings and maybe that is why this ratio could neglect younger companies. Anyhow Altman's opinion is that: Young companies are more likely to default or go into bankruptcy than older companies.

x_3, **Earnings Before Interest and Taxes / Total Assets (EBIT/TA)** – Profitability or productivity of the company against its assets is being measured by this indicator the variable measures firm's productivity and profitability against its assets. It is essential that the company capable to produce as much profit as possible with given assets in order to stay on the market long term and this indicator is usually one of the most viewed and of highest importance.

x_4, **Market Value of Equity / Book Value of Total Liabilities (MVE/TL)** –   This is a measurement of how the company is solvent. We are comparing the equity market value with total liabilities and a rule is that when this value drops below 1 the company becomes insolvent.

x_5, **Sales / Total Assets (S/TA)** – We are measuring activity of the company and also it tells us how capable the company is to generate sales with the assets. It is always good to compare also with competitors for better evaluation and this is a general rule.

The values for the ratios come directly from off the financial statements. Coefficients B are calculated as a regression function where the dependable variable is the default score and independent variable are five financial ratios. The regression generates numerical values for the coefficients B1 through B5. We should use average values between the current fiscal year and last fiscal year so the ratio captures the financial performance of the entire year.

Altman found out that the high value for the Z-score, given his data, was 2,99. A company with a Z-score higher than 2,99 could be considered unlikely to default. Similarly he found the low value for his group to be 1,81. Companies with score lower than 1,81 would be considered to have a high probability of default. However companies with a value between 1,81 and 2,99 were difficult to categorize. Altman therefore placed these firms in what he referred to as a grey zone.

$$Z = 1.2\,x_1 + 1.4\,x_2 + 3.3\,x_3 + 0.6\,x_4 + 1.0\,x_5 \qquad\qquad (3)$$

Limitation of the Z-score model is that it allows evaluating only publicly traded companies. Altman therefore developed a revised Z-score model, which modified the fourth financial ratio so that it could use the book value of the firm's equity instead of market value. The revision led to a change in the coefficients before each variable.

$$Z' = 0.717x_1 + 0.847\,x_2 + 3.107\,x_3 + 0.420\,x_4 + 0.998\,x_5 \qquad\qquad (4)$$

Z-score model was revised further because Altman observed that the financial ratios differed significantly between industries. One of the simplest variations of the model meant simply removing the last variable X5 and made it applicable to all nonmanufacturing companies.

$$Z'' = 6.56\,x_1 + 3.26\,x_2 + 6.72\,x_3 + 1.05\,x_4 \qquad\qquad (5)$$

2.3.3 Reduced form modeling

The assumption under this approach is that there is no correlation between firm's value and default. A default is completely unpredictable as a result of a sudden loss in a company's market value. The approach still asks for a signal to indicate that default has occurred-and the reduced form models therefore simply assign an external signal to serve this purpose. When this exogenous variable-which normally is a statistical or econometric number-hits a certain value, we simply assume the company has defaulted. (Chacko et al., 2006, p. 123).

Every so often, new information about a company becomes available; stock price might change or new business events unfold. These new pieces of information affect the likelihood that the company will default.

Using a signal builds on the approach's assumption that default arrives suddenly and unexpectedly for no reason; it is a random event.

Table 3. AUC (power metric) for various default predictors

	AUC	Name
1	84.39%	Merton European Option
2	83.94%	Merton American Option
3	81.64%	Market Cap/Liabilities
4	81.42%	Merton w/ Dividend
5	81.07%	Shumway
6	79.24%	Altman's Z-score (5 variable)
7	77.84%	Volatility
8	77.56%	Net Income Minus Ex Items/Assets
9	77.05%	Income Before Ex Items/Assets
10	74.68%	Cash Flow/Assets
11	74.41%	Mkt Cap
12	74.37%	Debt/Assets
13	74.26%	(Liabilities-pref stock)/Assets
14	73.50%	Liabilities/Assets
15	73.50%	Book Equity/Liabilities
16	73.30%	Retained Earnings/Assets
17	72.57%	(Liab - Cash)/Assets
18	72.41%	Altman's Z-score (4 variable)

Source: E.G. Falkenstein, *DefProb: A Corporate Probability of Default Model*, 2008

3 FINANCIAL ANALYSIS

Analyzing by using the accounting indicators is one of the main tools of assessing the financial situation and how successful the company is, because of two main characteristics. It narrows huge amount of data from accounting statements to a few main parameters and assures comparability of accounting statements of different size companies. Key question of a good financial analysis is which indicators to select. Selection depends also on the user's purpose of the analysis. Using too many indicators decreases one of the main advantages of such analysis that is in concentrated information about the company. Analysis of the accounting statements is important especially for the external observers (Slapničar, 2006, p. 1).

The fundamental value of any financial asset-a stock, a bond, a physical asset such as a machine, and even an entire corporation- is the present value of its future cash flows. The fundamental value may differ from the current market price if the market's expectations of future cash flows are based on faulty information. This can happen, for example, when management releases misleading or fraudulent earnings reports and accounting statements (Brigham & Daves, 2004, p. 5).

$$Value\ of\ any\ financial\ asset = \sum_{t=1}^{n}\frac{CF_t}{(1+r)^t} \qquad (6)$$

A fundamental assumption underlines the theory of financial management: Management has one basic goal which is to create value for stockholders. Stockholders own the firm-it legally belongs to them. That ownership position gives stockholders the right to elect directors, who then hire the executives who actually run the company.

In our market-based financial system, investors establish stock prices by buying and selling shares. Through this process, management receives feedback about its performance-in effect, the stock price is used to grade management and is the basis for determining compensation. However, the system is dependent on a free flow of accurate information. If reliable, accurate information is available to all market participants, then we are said to have market transparency. But on the financial markets many times we can face with fraudulent data like in cases of Enron, World Com, Merrill Lynch. Honest and ethical behavior on the part of corporate management is crucial to firm's long-term success-and to the success of our economic system.

3.1 Basics of the CAPM

Basic investors mentality is that they require a premium for bearing the risk of not getting the investment back. Also investors are usually looking at the profitability of their complete investing portfolio and they don't look only into individual investments in their portfolio. Still they are interested into how risky individual investment (stock) is and this can be measured by using the Capital Asset Pricing Model (CAPM).

Developers of the CAPM model were in 1990 awarded with Nobel Prize, Professors Harry Markowitz and William F. Sharpe. The basic concepts of the CAPM were developed specifically for common stocks. However it has become common practice to extend CAPM concepts to capital budgeting and to speak of firms having "portfolios of tangible assets and projects" (Brigham & Daves, 2004, p. 47).

Conclusion of the CAPM is this: The relevant risk of an individual stock is its contribution to the risk of a well-diversified portfolio. Individually held stock is according to the CAPM message much riskier than the same stock in a well-diversified portfolio. The risk that stays after the diversification is so called market risk and is inherent, it is measured by the degree a stock tends to move up or down with the market.

The CAPM is an ex ante model, which means that all of the variables represent before-the-fact, expected values. Investors are using so called beta coefficients that reflect expected volatility of a given stock's return versus the market return. Beta's are generally calculated from the data in the past period and then assumptions about the stock's volatility will stay the same in the future are generated.

The relevant risk of an individual stock, which is called its beta coefficient, is defined under the CAPM as the amount of risk that the stock contributes to the market portfolio.

- COST OF CAPITAL

When we are choosing the ideal mixture of equity and debt in a firm the cost of capital is the vital factor. Companies can use many different types of capital to finance itself.
Three most frequently used types of capital:

- Debt
- Common stock
- Preferred stock

All capital components have one feature in common: Funds provided by an investors expect to receive back a return for bearing the risk of lending. Different capital components differ also in risk and rates of return and that is why they also have a different cost. The required rate of return of each capital component is called its component cost, and the cost of capital used to analyze capital budgeting decisions should be a weighted average of the various components' costs. We call this weight average cost of capital or WACC (Brigham & Daves, 2004, p. 297).

- Cost of debt

When estimating the cost of debt one of the first steps is to determine the rate of return debt holders require or "rd". A financial manager will probably not be able to calculate at the start what is the ideal amount of debt to be used in a period. Decisions like this depend on assets that need to be financed, expected returns, current capital market conditions. In financial management the WACC is used primarily to make investments decisions, and these decisions hinge on projects' expected future returns versus the cost of new, or marginal, capital. The required rate of return to debt holders "r_d" is not equal to the company's cost of debt because, since interest payments are deductible, the government in effect pays part of the total cost. As a result, the cost of debt to the firm is less than the rate of return required by debtholders. The after-tax cost of debt, r_d (1-T), is used to calculate the weighted average cost of capital where T is the firm's marginal tax rate (Brigham & Daves, 2004, p. 298).

- Cost of preferred stock

Special thing with preferred stocks is that they are not tax deductible. Preferred stocks also have the advantage when dividends are considered to be paid out to common stock holders. That is the reason why a company has an interest to pay out the preferred dividends. One of the reasons is also if a company doesn't pay out dividends then it may have a hard time to raise additional funds in the capital market and in some cases preferred stock holders can take control over the firm. The component cost of preferred stock used to calculate the weighted average cost of capital, r_{ps}, is the

preferred dividend, D_{ps}, divided by the net issuing price, P_n, which is the price the firm receives after deducting flotation costs (Brigham & Daves, 2004, p. 300).

$$\text{Component cost of preferred stock} = r_{ps} = \frac{D_{ps}}{P_n} \qquad (7)$$

Equation (7) shows component cost of preferred stock.

- Cost of common stock

Common equity can be raised in two ways: (1) directly, by issuing new shares, and (2) indirectly, by retaining earnings. When a company is issuing new shares rate of return needs to satisfy the new investors or new stockholders. Still the company needs to earn more than r_s on new external equity and need to consider commissions and fees, so called flotation costs. New capital can be raised also indirectly by retained earnings but also this has a cost. If some of its earnings are retained, then stockholders will incur an opportunity cost-the earnings could have been paid out as dividends (or used to repurchase stock), in which case stockholders could then have reinvested the money in other investments. Thus, the firm should earn on its reinvested earnings, at least as much as its stockholders earn on alternative investments of equivalent risk. To produce reasonably good cost of equity estimation three methods typically are used: (1) the Capital Asset Pricing Model (CAPM), (2) the discounted cash flow (DCF) method, and (3) the bond-yield-plus-risk-premium approach. Usually when estimating the cost of equity all three methods are used as they are not mutually exclusive and we need to know that all of them are subject to errors when used in practice. (Brigham & Daves, 2004, p.301).

$$required\ rate\ of\ return\ on\ the\ stock = r_s = r_{RF} + (RP_M)\,\beta_i \qquad (8)$$

- r_{RF} – risk free rate
- RP_M – risk premium on the market
- β_i – beta coefficient of the particular stock

Equation (8) shows CAPM equation to estimate required rate of return on the stock in question.

$$WACC = W_d r_d\,(1 - T) + W_{ps} r_{ps} + W_{ce} r_s \qquad (9)$$

- W_d – percent of debt
- W_{ps} – percent of preferred stock
- W_{ce} – percent of common equity

Equation (9) shows weighted average cost of capital.

How can higher proportion of debt affect the WACC and/or FCF:

- Debt increases the cost of Stock, r_s. Debtholders have priority claim compared to shareholders who can expect some residual cash only when the debtholders have been paid.
- Debt reduces the taxes a company pays
- The risk of bankruptcy increases the cost of debt, r_d. If the debt increases also the risk of bankruptcy goes up and therefore also debtholders will require higher return, which increases the pre-tax cost of debt, r_d.
- Bankruptcy risk affects negatively the free cash flow. It is often that also the customers are following the financial reports and less stable firm are fast under the radar and usually bad information travels much faster. Therefore the customer may walk away when risk of bankruptcy increases to protect their own business. Bad financial reports usually heavily influence the employees inside the company and they start to worry and search for new jobs meaning that this also has a negative effect on companies' productivity.
- Issuing equity usually can send a negative signal to the market meaning that the company needs additional funds to finance its operations. This often affects the stock price to fall.

3.2 Accounting for Financial Management

One of the most important reports a corporation needs to issue for its stockholders is the annual report. Usually in the annual report a verbal section is meant for the chairman to present and describe operating results during the past year and to introduce new developments and prospects for the future. Inside the report there are also the four basic financial statements:

- Balance sheet
- Income statement
- Statement of changes of equity
- Cash flow statement

Financial statements present the accounting view of the company's operations and they report what has actually happened to company's assets, earnings over the past year. In the verbal section we can read the explanation why have some things turned out to be as they are and the financial statements show what actually happened (Brigham & Daves, 2004, p. 192).

Balance sheet is showing the financial position of the company on the exact day usually the last day in the year. The left side of the balance sheet lists assets in order of "liquidity," or the length of time it typically takes to convert them to cash. The right side lists liabilities and equity, which are claims against the assets, in the order in which they must be paid.
Income statement shows the financial performance of the company during a particular period. Income statements can be prepared at any time also depends on the company's policy.

Statement of changes of equity is a financial statement that presents a summary of the changes in equity account over the reporting period. It reconciles the opening balances of equity accounts with their closing balances. There are two types of changes in shareholder's equity. Changes that originate from transactions with shareholders such as issue of new shares, payment of dividends,

etc. and changes that result from changes in total comprehensive income, such as net income for the period, revaluation of fixed assets, changes in fair value of available for sale investments, etc.

Statement of cash flow it shows the cash position of the company and all the changes in cash during the year. A company may have a net income but lower cash amount end of the year as at the beginning. Net income can be used on different ways not only as cash on the bank account it can be used for dividends, inventories, pay of account receivables, lowering debt, investments in new assets, buying back common stocks. The statement separates activities into three categories, plus a summary section:

- Operating activities, which includes net income, depreciation, changes in current assets and liabilities other than cash, short-term investments, and short-term debt.
- Investing activities, which includes investments in or sales of fixed assets
- Financing activities, which include raising cash by selling short-term investments or by issuing short-term debt, long-term debt, or stock. Also, because both dividends paid and cash used to buy back outstanding stock or bonds reduce the company's cash, such transactions are included here.

It is not uncommon or possible for a company to report a positive net income a day before it announces bankruptcy but in such cases usually cash flows from operations begin to deteriorate earlier and such event could be noted by an eye of analyst. If we would like to analyze a company in a short time or we face time pressure then first thing to look at would be a trend in net cash flow provided from operating activities a negative number or a negative trend sends out immediately a strong signal that something might be wrong in the company.

3.3 Analysis of Financial Statements

When management wants increase or maximize value of the firm, it needs to use firm's strengths and improve the firm's weaknesses. Usually financial analysis of the financial statements is done in comparisment with other companies in the industry and historical financial development od the company and its financial results and financial indicators. Doing such analysis improvement potential can be recognized and actions from management taken (Brigham & Daves, 2004, p. 230). With financial ratios we can evaluate the financial statements. I will list the financial ratios into five categories and briefly present some of the ratios individually. Categories of financial ratios:

- Liquidity ratios
- Asset management ratios
- Debt management ratios
- Profitability ratios
- Market value ratios

    - Liquidity Ratios

Liquid assets are the ones that can be quickly converted into cash at market price. The ratio is telling us how the company is capable to cover or pay off its debts as they come due over the next year or similar.

Two representative liquidity ratios are:

- Current ratio
- Quick, or Acid test, ratio

$$Current\ ratio = \frac{C0,urrent\ assets}{Current\ liabilities} \tag{10}$$

$$Quick, or\ acid\ test, ratio\ ratio = \frac{Current\ assets - Inventories}{Current\ liabilities} \tag{11}$$

- Asset Management Ratios

With this ratio we measure how effectively the firm is managing its assets

Some representative asset management ratios:

- Inventory turnover ratio
- Days sales outstanding
- Fixed assets turnover ratio
- Total assets turnover ratio

$$Inventory\ turnover\ ratio = \frac{Sales}{Inventories} \tag{12}$$

$$DSO = Days\ sales\ outstanding = \frac{Receivables}{Average\ sales\ per\ day} = \frac{Receivables}{Annual\ sales/365} \tag{13}$$

$$Fixed\ assts\ turnover\ ratio = \frac{Sales}{Net\ fixed\ assets} \tag{14}$$

$$Total\ assets\ turnover\ ratio = \frac{Sales}{Total\ assets} \tag{15}$$

- Deb Management Ratios

These ratios are analyzing how the firm is being financed or what kind of leverage it has, there are three important implications: (1) By increasing debt it is true that stakeholders maintain their control (2) If the firm earns more on investments financed with borrowed funds than it pays interest, then its shareholders' returns are magnified, or "leveraged," but their risks are also magnified. (3)

Creditors look to the equity, or owner supplied funds, to provide a margin of safety, so the higher proportion of funding supplied by stockholders, the less risk creditors face.

Some representative Debt management ratios:

- Debt ratio
- Times-interest-earned (TIE) ratio
- EBITDA coverage ratio

$$Debt\ ratio = \frac{Total\ liabilities}{Total\ assets} \tag{16}$$

$$Times - interest - earned\ (TIE)ratio = \frac{EBIT}{Interest\ charges} \tag{17}$$

$$EBITDA\ coverage\ ratio = \frac{EBITDA + Lease\ payments}{Interest + Principal\ payments + Lease\ payments} \tag{18}$$

- Profitability Ratios

Profitability ratios are showing the result of different policies and decisions, they also summarize the effects of other ratios in liquidity, operations, managing assets and debt.
Some representative profitability ratios:

- Profit margin on sales
- Basic earning power (BEP)
- Return on total assets (ROA)
- Return on common equity (ROE)

$$Pofit\ margin\ on\ sales = \frac{Net\ income\ available\ to\ common\ stockholders}{Sales} \tag{19}$$

$$Basic\ earning\ power\ ratio\ (BEP) = \frac{EBIT}{Total\ assets} \tag{20}$$

$$Return\ on\ total\ assets = ROA = \frac{Net\ income\ available\ to\ common\ stockholders}{Total\ assets} \tag{21}$$

$$Return\ on\ comon\ equity = ROE = \frac{Net\ income\ available\ to\ common\ stockholders}{Common\ equity} \tag{22}$$

- Market Value Ratios

This ratios indicate outside view and perception of the company's performance and future prospects. from investors standpoint.

Some representative market value ratios:

- Price/Earnings (P/E) ratio
- Price/Cash flow ratio
- Market/Book (M/B) ratio

$$Price\ earnings\ ratio = \frac{Price\ per\ share}{Earnings\ per\ share} \qquad (23)$$

$$price\ cash\ flow\ ratio = \frac{Price\ per\ share}{Cash\ flow\ per\ share} \qquad (24)$$

$$Book\ value\ per\ share = \frac{Common\ equity}{Shares\ outstanding} \qquad (25)$$

$$Market\ book\ ratio = \frac{Market\ price\ per\ share}{Book\ value\ per\ share} \qquad (26)$$

3.4 The Du Pont

This approach was constructed by managers to better assess the company's performance. The model is building bottom up and different expenses are summed in order to obtain total cost which is than subtracted from sales to calculate the net income (Brigham & Daves, 2004, p. 247)

Figure 10. Modified Du Pont chart for imaginary company
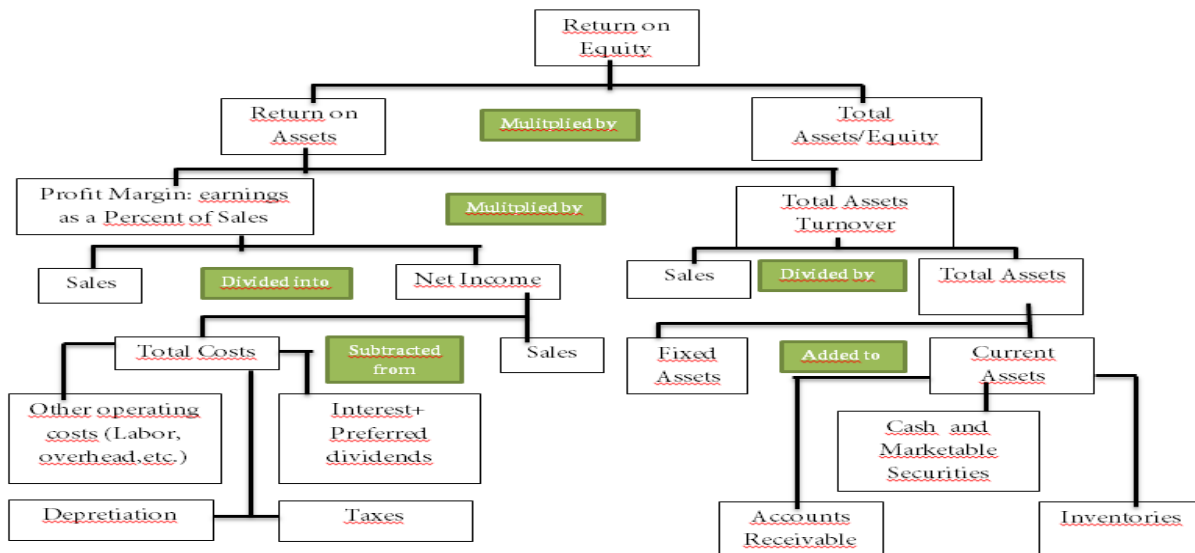
Source: E.F. Brigham & F.R. Daves, *Intermediate Financial Management*, 2004, p. 247.

The profit margin times the total assets turnover is called the Du Pont equation, and it gives the rate of return on assets (ROA).

$$ROA = Profit\ margin \times Total\ assets\ turnover = \frac{Net\ income}{Sales} \times \frac{Sales}{Total\ Assets} \qquad (27)$$

Equation (27) is showing the Du Pont equation for ROA.

If the company has no debt than ROA and ROE are the same. Usually companies are using debt in their financing and for the common stockholders it is important that the ROE is greater than ROA.

$$Equity\ multiplier = \frac{Total\ assets}{Common\ equity} \qquad (28)$$

Firms that use a large amount of debt financing (a lot of leverage) will necessarily have a high equity multiplier. A company's return on equity (ROE) depends on its ROA and its use of leverage.

$$ROE = ROA \times Equity\ multiplier = \frac{Net\ income}{Total\ Assets} \times \frac{Total\ assets}{Common\ equity} \qquad (29)$$

If we combine Equations we can create the extended Du Pont equation that is showing how the profit margin, the assets turnover ratio, and the equity multiplier combine to determine the ROE (Brigham & Daves, 2004, p. 249).

$$ROE = (Profit\ margin) \times (Total\ assets\ turnover) \times (Equity\ multiplier) = \frac{Net\ income}{Sales} \times$$
$$\frac{Sales}{Total\ assets} \times \frac{Total\ assets}{Common\ equity} \qquad (30)$$

Equation (30) is showing the Du Pont equation for ROE.

3.5 Economic Value Added (EVA)

EVA is focusing to measure the effectiveness of managing the company in the past year. EVA will show a positive number if ROIC will be higher as WACC (Brigham & Daves, 2004, p. 208).

$$EVA = Net\ operating\ profit\ after\ taxes\ (NOPAT)$$
$$- After\ tax\ dollar\ cost\ of\ capital\ used\ to\ support\ operations$$
$$= EBIT\ (1 - Corporate\ tax\ rate) - (Operating\ capital)(WACC)$$
$$= (Operating\ capital)(ROIC - WACC)$$

$$(26)$$

4   EMS CATEGORY – BUILDING A MODEL

4.1 Introduction of the EMS category

EMS stands for Electronic Manufacturing Services and the term is used for companies that manufacture, test, design, distribute services for electronic components for original equipment manufacturers (OEMs). This industry took of approx. in 1970 as before it was more common to

produce and assemble these components in house. Large scale production and analysts showed the benefits to outsource this production to the EMS manufacturers. EMS manufacturers offered flexibility and eased up the human resource issues especially for smaller companies   (Electronics manufacturing services, n.d.)

EMS industry is usually divided into Tiers by their revenue:

- Tier 1: >$800m/1 Billion
- Tier 2: <$250/300m to $1B
- Tier 3: <$250m
- Tier 4: <$4m

There is also additional distinction inside the EMS companies into High Mix low Volume (HMLV) and High Volume Low Mix (HVLM) companies. In higher tier we will most likely found HVLM and in lower tiers HMLV companies. In the EMS Industry we have a few really big companies and thousands of smaller ones. EMS Companies especially in 1990s started to move their productions from high cost regions low cost areas this was typical especially for the high tier companies where they could use the high scale and optimize their costs and profits.

According to the NVR (New Venture Research) the worldwide electronics manufacturing services will grow 7,7% compounded between 2013 and 2018 and should reach $639 billion in 2018 (*Global Electronics Manufacturing and Services – Electronics Publications,* 2014).

Table 4. Growth of the EMS market according to NVR July 2014

Year	2012	2013	2014	2015	2016	2017	2018
Value in $ B	419	440	490	510	570	600	639
% change		4,9	10,2	4,1	11,8	5,3	6,5

Source: *Global Electronics Manufacturing and Services – Electronics Publications*, 2014

The company, where I am currently employed, defined the EMS as electronic products designed and developed by (or behalf of) our company but manufactured at external suppliers. All EMS products are specific and often difficult to transfer and the switching cost is high (both internal and external). The supplier base is global: Scandinavia, Eastern Europe, Americas,   China & South-East Asia. The general trend is to increase EMS sourcing in cost competitive countries.
 The company's spend inside the EMS category totals to approximately 100 million €. The 80% of total spend is distributed among few suppliers. The company cooperates with approximately 40 different suppliers. The current suppliers are supplying approximately 1400 different electronic parts that vary according to their complexity (HVLM & LVHM).

Figure 11. Internal EMS spend distribution per manufacturing divisions
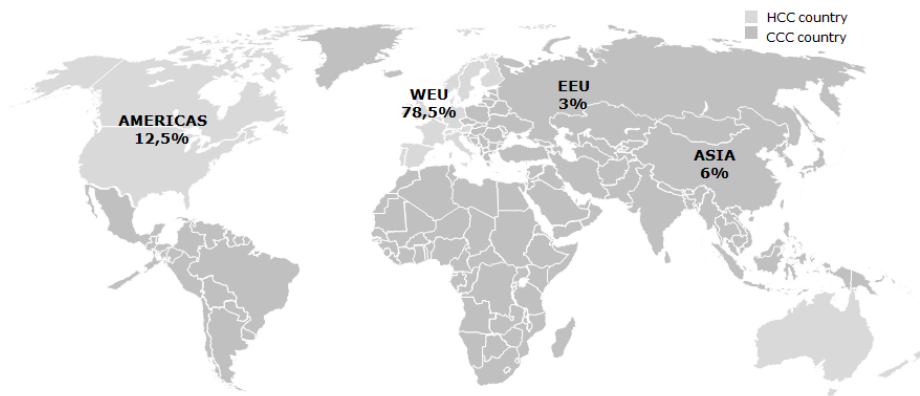
Purpose of creating the credit risk model for the supplier involved in the EMS category will be only one of the instruments that will help to support long term development decisions for the category management.

Based on our internal conversation the global category management would like to have an analysis of the industry in order to see which direction it is developing and by which pace. The EMS industry is according to NVR research $440 billion business in 2013. In the industry there are present a few big players and thousands of smaller size companies. Idea is to try and obtain the financial figures from the big players and analyze their performance. Joining the numbers together from these companies could then be treated as a general industry figure and later individual companies could be also measured or compared towards this trend.

4.2 Risk Assessment Workshop

Some of the challenges/risks the category management has identified for the EMS category:

- Requirement of technical cost-down (design-to-cost) on products for sustained price reductions
- Constrain to switch supplier (NRE cost, Resource, PPAP, Change Mgmt. etc.)
- Single sourcing on most products
- EMS suppliers dedicated for each region
- Current size of business of our company with the largest suppliers

Due to the identified risks at the corporate level the management focused on the credit risk rating of the suppliers that are currently part of the EMS category. Category management would like to increase the level of control inside the EMS category and create foundation for next long term decisions that will affect further development of business in the category.

4.3 EMS Industry Financial Analysis

To do the financial analysis of the EMS category I will focus on the top 50 companies in the industry. On the internet you can find a link that is showing and presenting the top 50 players in this category. The financial analysis will be done based on the annual reports – Balance sheet, Income statement and cash flow statement to be more explicit. I will be focusing to obtain these documents for the last 5 years. If a company is publicly listed these reports shouldn't be hard to reach,

difficulties are expected in case of privately owned companies where publication of these documents is not obligation.

Table 5. Top 50 companies in EMS industry

Rank	Name of the company
1	Hon Hai
2	Pegatron
3	Flextronics
4	Jabil Circuit
5	Celestica
6	Sanmina-SCI
7	New Kinpo Group
8	Shenzhen Kaifa Technology
9	Benchmark Electronics
10	Plexus
11	Universal Scientific Industrial Co., Ltd. (USI)
12	Venture
13	Elcoteq
14	SIIX
15	Zollner Elektronik
16	Beyonics Technology
17	Sumitronics
18	UMC Electronics Co., Ltd.
19	Orient Semiconductor Electronics
20	Kimball Electronics Group
21	AsteelFlash Group
22	Fabrinet
23	Nam Tai Electronics
24	Wong's Electronics
25	3CEMS Group
26	Creation Technologies
27	VIDEOTON Holding
28	Enics

Source: Marketing Market Insider - *MMI Top 50 for 2013*, 2014.

29	Integrated Micro-Electronics, Inc.
30	VTech Communications Ltd
31	Alco Electronics
32	Topscom Technology
33	Neways Electronics International
34	WKK Technology Ltd.
35	LaBarge
36	éolane
37	OnCore Manufacturing Services
38	PartnerTech
39	Scanfil EMS
40	Hana Microelectronics
41	V.S. Industry
42	Surface Mount Technology (Holdings) Limited.
43	SRI Radio Systems
44	Kitron
45	CTS Electronics Manufacturing Solutions
46	EPIQ
47	Selcom Elettronica
48	SMTC - Markham, Ontario, Canada
49	SVI
50	EPIC Technologies

Source: Marketing Market Insider - *MMI Top 50 for 2013*, 2014.

4.4 Selecting Financial KPI's for the Analysis

Before starting with the data mining searching for the annual reports and financial statements I need to define which data will be the most relevant for my financial analysis.

Selected financial coefficients for the analysis will be measuring the company's performances:

- Financial ratio
- Liquidity
- Ability to operate
- Profitability
- Cash flow
- Leverage

Separately I will be calculating the ROA and ROE using the Du Pont formula.

*Figure 12*. Key financial figures and data for the analysis
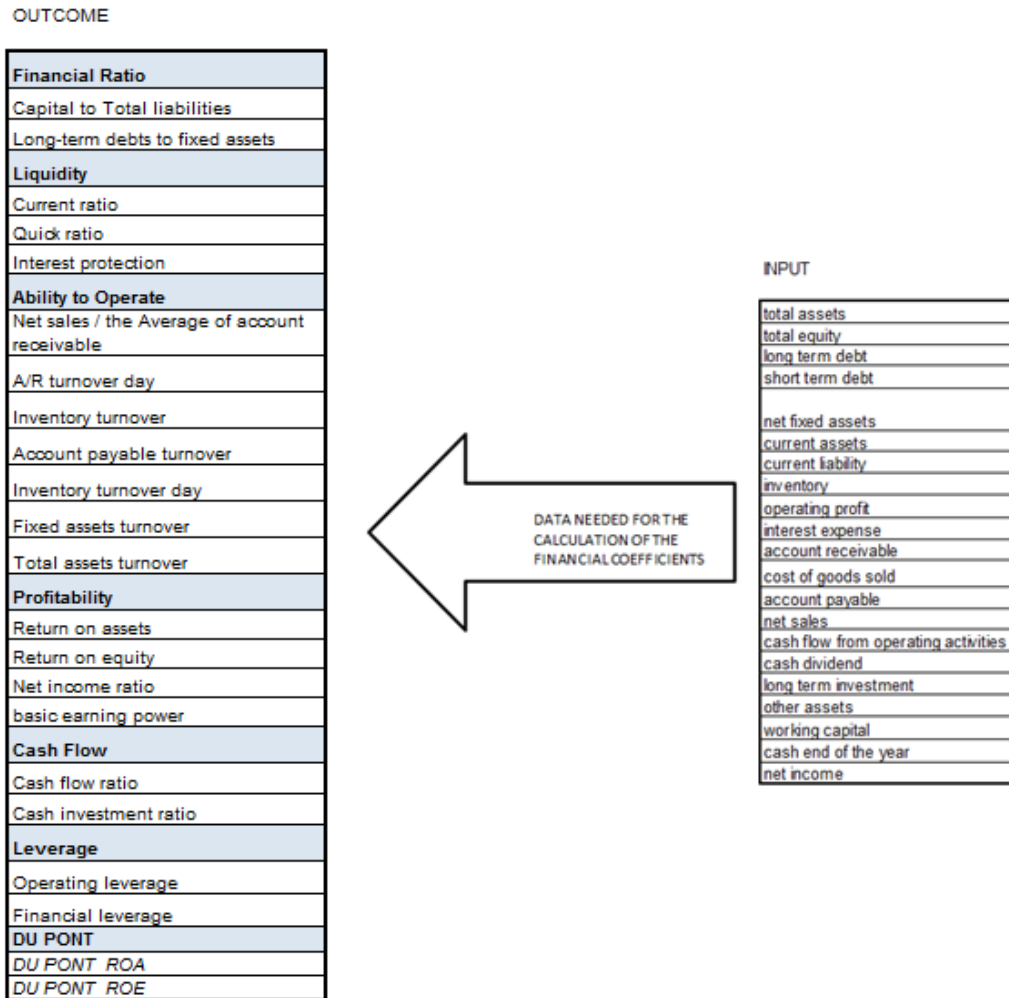
4.5 Results of Data Mining

Out of top 50 suppliers in the EMS industry I managed to obtain annual reports for 25 companies. In most cases it goes for publicly listed companies and on most occasions the annual reports were available for the past five years.

Total revenues from these 25 companies in year 2013 amounted $222,2 billion. According to the NVR research the total EMS industry revenues in 2013 were $440 billion. By analyzing selected 25 companies we are actually touching 50% of the total Industry revenues. My hypothesis is that by analyzing these 25 companies and 50% of total revenues in the Industry is according to my statement big enough sample so the financial analysis could be treated as the financial indicator of the current trend in the EMS Industry and its development in the period between 2009 – 2013.

Figure 13. Analyzed companies vs total revenue in EMS industry
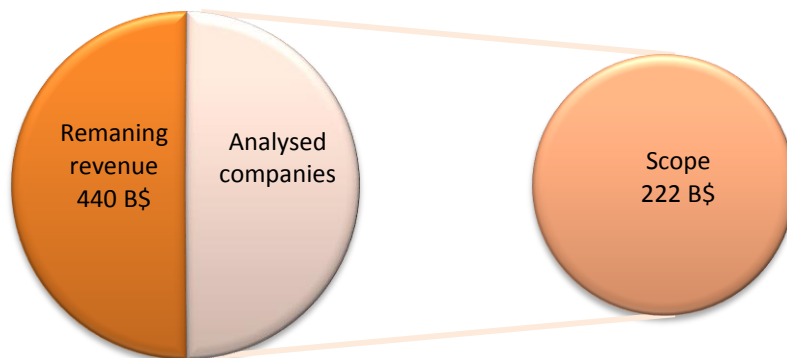
The biggest company in the business is from Taiwan called HON HAI. Because this company in their revenues and assets approximately 4 times exceeds the second biggest company Pegatron, will be excluded from the comparable financial analysis used for individual companies.

*Figure 14*. Pie chart analyzed companies per values of assets (in %)
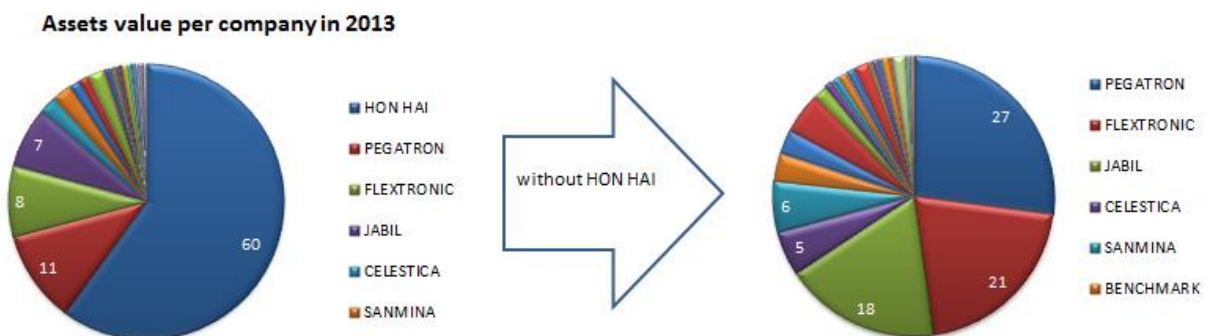
4.6 EMS Industry Financial Analysis of period 2009 – 2013 without   company HON HAI

Due to our internal know-how and intellectual property I will not expose all the results from this analysis. From the same reason also the presented analysis will not be as detailed as it could be.

Figure 15. Results from analysis

43

Continued

44
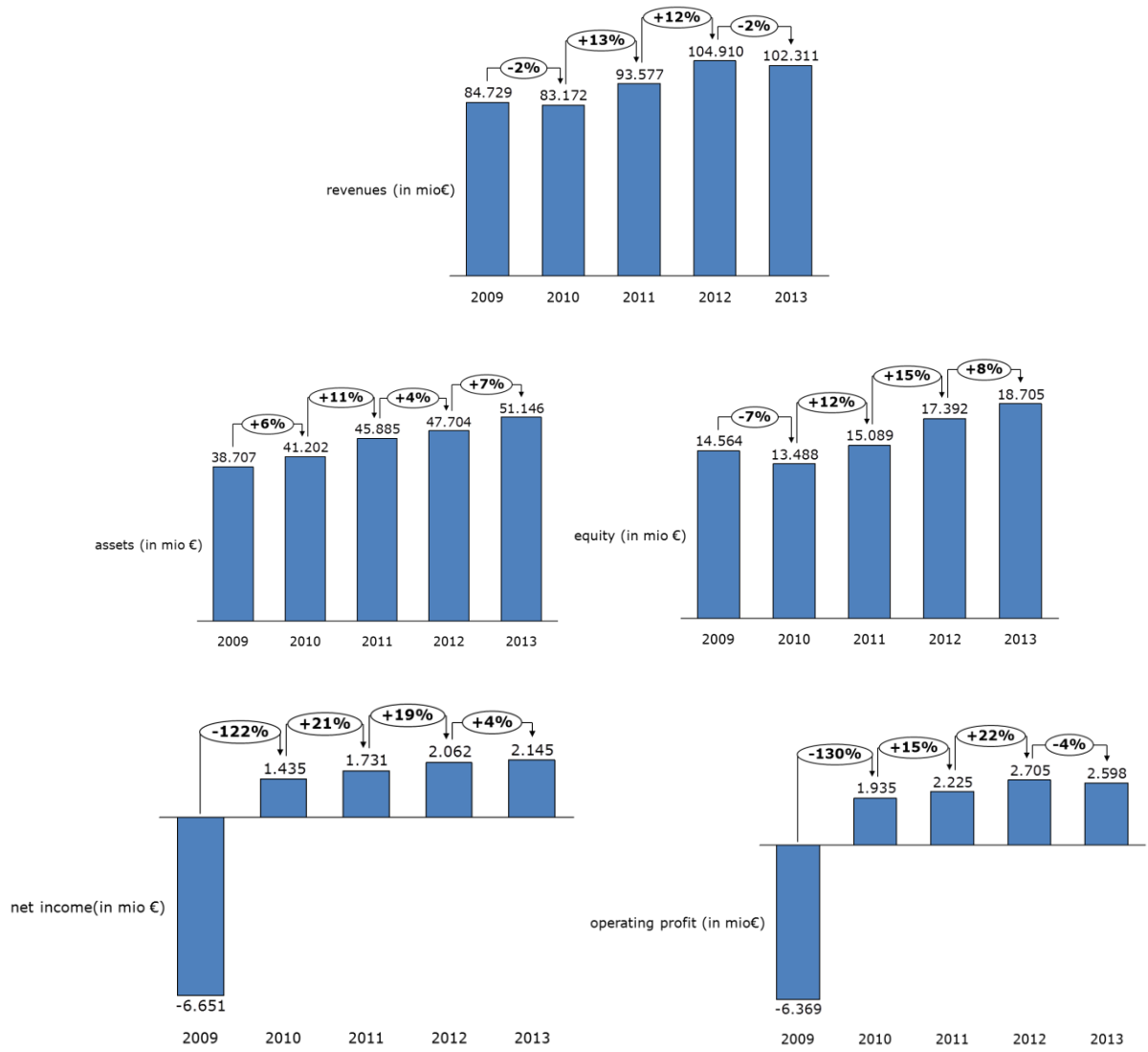
Continues

Continued

In US $
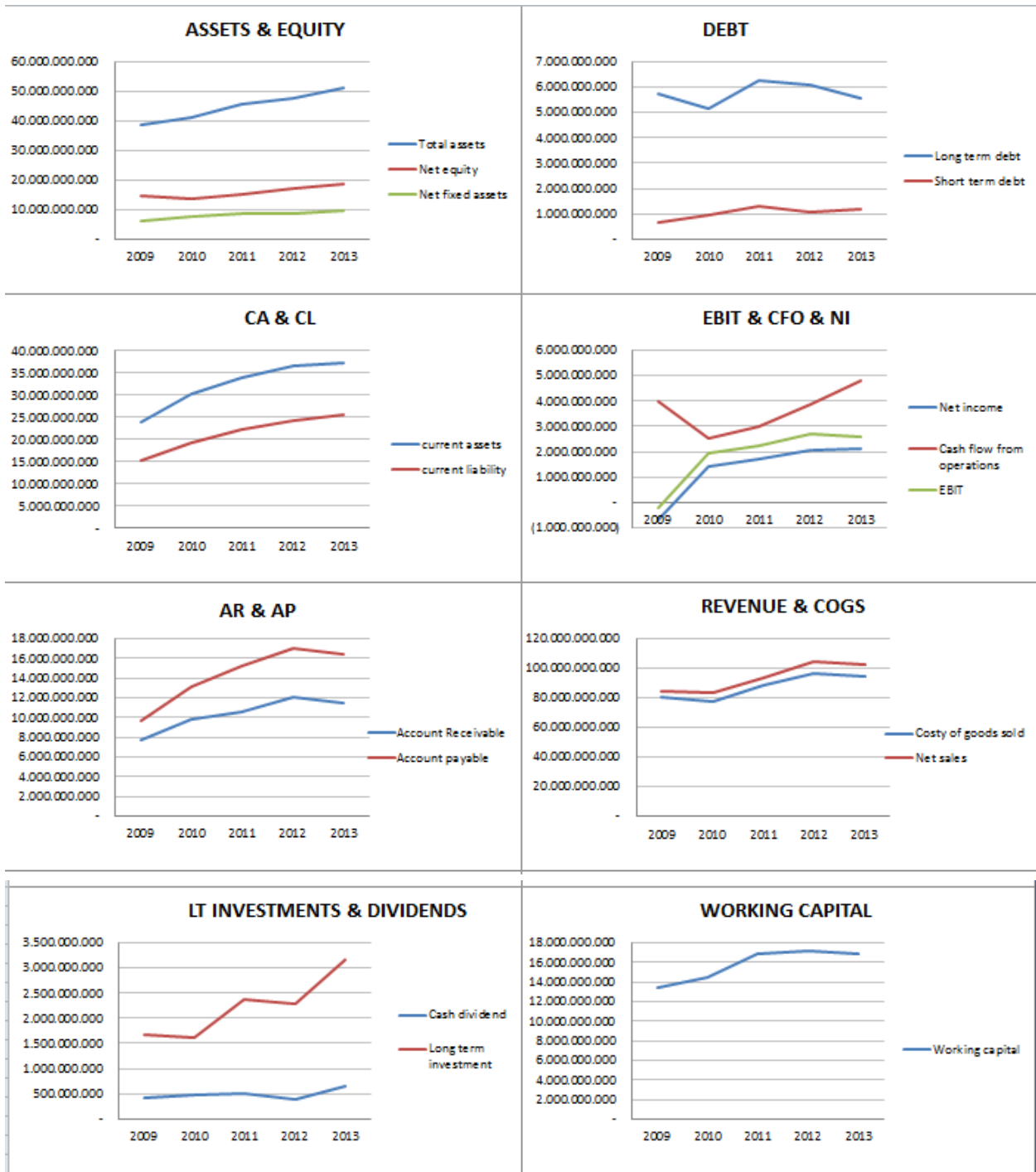
For financial analysis of accounting statements exists several methods and technics, but most commonly used approach is analysis of absolute data together with financial ratios. Analysis with financial ratios where we are comparing values of ratios of individual company with the same ratios of similar companies in the industry. This approach is called industry comparisment analysis. This analysis anyhow is not without traps. Comparisment with the industry can lead us to misleading assumptions because of big difference in the economic environment (Mramor, 1993, p. 65).

- Analysis of Assets

Assets represent the wealth of the company. Based on the speed of their turnover we separate them into fixed and tangible assets.

Value of total assets for the industry has been increasing every year with average of 7% per year. This value also confirms the NVR research and forecast of forecasted 5,9% growth per year of the industry in the future until 2018.

Figure 16. Total Assets value development
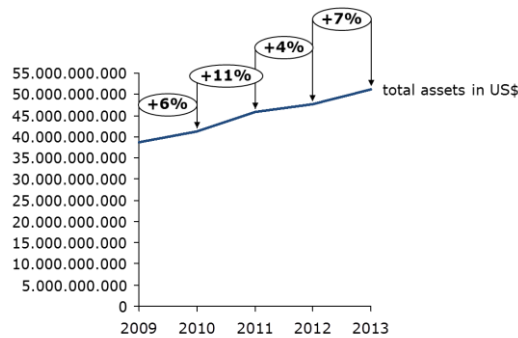
- Analysis of Liabilities

This analysis is telling us how a business system is being financed. We divide Liabilities into long-term and short-term liabilities. Some of the long-term liabilities are equity and long term debt. Some of short-term liabilities are accounts payable and short term debt. Equity is the most important figure in the balance sheet and it means the remaining of all resources after deduction of debt. Equity represents the liability towards the owners of the company.

In five year average companies inside the analysis were financed with 35% of owner's equity. Long-term debt was representing in average 12,9% of total liabilities with a dropping trend since year 2009 when this percentage was 14,8% comparing with the 10,9% in year 2013. Short-term debt was in average 2,3%comparing with total liabilities and it is showing an increasing trend since 2009. Account payable represented in average 31,5% of total liabilities and are showing a very increasing trend since 2009.

Figure 17. AP vs Total liabilities development
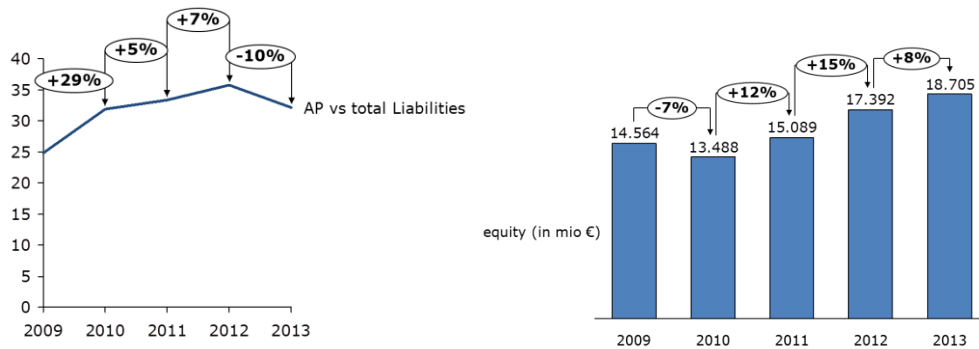
- Analysis of Revenues

Income statement books revenues immediately the invoice has been issued for the customer. This mean the invoice still hasn't been paid. When revenues are higher than the costs caused during the business process the company is achieving profit. In this case the company may decide to increase its assets with retained earnings and change the capital structure or lower its debts.

Revenues in the industry have been rising in average for 5,25% per year during the analyzed period. Still we can note negative growth from year 2009 to 2010 and the same event happened from year 2012 to 2013. The NVR research is forecasting 5,9% growth until the year 2018.

Figure 18. Revenues value development
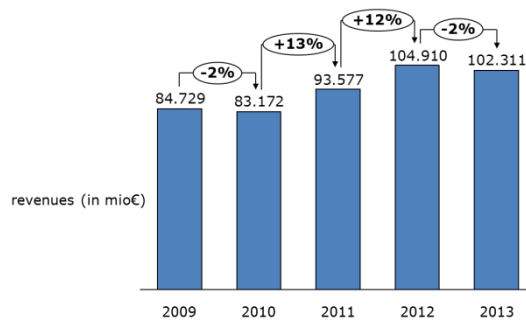
- Analysis of Financial Coefficients

Financial ratios can contribute preventing or help early to detect problems in capital structure or potential insolvency of the company. I have been using six categories of financial ratios and calculated their values for the industry. Interpretation of the results would be more appropriate when we would be comparing individual company's ratios with the Industrial ratios. For this reason I will conduct a traffic light report by pondering the results from the industry. Traffic light report can be than used for the individual financial comparisment.

4.7 Financial Traffic Light Report

Traffic light report is showing in yellow the Industry average btw. 2010 - 2013. The green column is 5% above the average and the column red is 5% below the average. Traffic light setup is currently made according to my personal belief and knowledge and further optimizations are expected to be done. Purpose of the traffic light is to setup the range according to the industrial performance for individual company's financial assessment and for faster and easier visualization and interpretation of the results.

Table 6. Traffic light report

TRAFFIC LIGHT			
FINANCIAL COEFFICIENTS	green	yellow	red
Equity to Total liabilities			
Long-term financing			
FA vs TA			
Return on assets			
Return on equity			
Net income ratio			
Basic earning power			
DU PONT ROA			
DU PONT ROE			
Current ratio			
Quick ratio			
Interest protection			
Operating leverage			
Financial leverage			
Cash flow ratio			
Cash investment ratio			
Net sales vs account receivable			
Inventory turnover			
Account payable turnover			
Fixed assets turnover			
Total assets turnover			
A/R turnover day			
Inventory turnover day			

4.8 Soft indicators

Always when analyzing financial it is good to use common sense and not only to rely on accounting numbers. That is why we can improve financial interpretations by using some of the qualitative soft indicators to back up our analysis and improve business decisions in company evaluations and forecasting further developments (Brigham & Daves, 2004, p. 253).

Some of the suggested soft indicators:

- structure of the ownership of the company
- percentage of the observed business at suppliers turnover and the other way around
- % revenues tied to key customer
- % of company's revenues tied to key product
- To what extent does the company rely on single supplier
- % of the company's business is generated overseas
- does the company invest in R&D

- number of employees per year

4.9 Financial Analysis Tool

When the process of data mining began searching for the annual reports and obtaining the relevant numbers from the financial statements an idea for developing a financial tool that could do some automatic calculations and visualizations occurred. This tool would ease up the analysis and improve strategic decision taking.

In this moment the tool is already developed and it appears to be very useful. One of its advantages is also that it is very user friendly and easy to understand.

Brief presentation of the tool:
First page "Explanation and Instructions"

Table 7. Explanation and Instructions table

FINANCIAL COEFICIENTS		
Financial Ratio	**Equation**	
Capital to Total liabilities = Equity / Total liabilities	$\frac{2}{1} \times 100$	Capital to liabilities ratio explains how the company is being financed. Here we are interested specialy how much equity is in total structure of all sources of financing. More equity means less chance for insolvency. Optimal capital structure is hard to assess because of different interest of the owners of the equity and debt lenders.
Long-term financing in total liabilities = (equity + Long-term debts) / total assets	$\frac{2+3}{1}$	Long-term financing in total liabilities is showing the percentage of long term financial sources of assets. Bigger percentage of long-term financial sources is lowering the possibility of short term insolvency, but these financial sources are more expensive than short-term financial sources. This indicator is part od decision making when deciding the ratio between short-term and long-term financing of the company.
Fixed assets vs total assets	$\frac{5}{1}$	This ratio is showing the percentage of fixed assets in the total assets. Fixed assets have much lower turnover than tangible assets. Therefore fixed assets are the least liquid. With this ratio we get the feeling how many assets are needed to create profit in the industry or individual company. High values in this ratio could also represent bigger risk when the revenues are declining.
Liquidity		
Current ratio = Current Assets / Current liability	$\frac{6}{7}$	Current ratio has the similar purpose as quick ratio but has a bigger weight as it includes also inventories. Its value should be approximatelly 2 but still it showed that also this is not a guarantee that the company is solvent.
Quick ratio = (Current assets - Inventory) / Current liability	$\frac{6-8}{7}$	Quick ratio is conservative indicator of companies solvency because it assumes the inventory cannot be cashed in. The biggest added value of quick ratio is the factthat is showing influence of the inventory level and changes in the inventories levels to financial balance of the company. Its value should be above 1 but it well depends on the industry we are analyzing.
Interest protection = EBIT / Interest expense	$\frac{9}{10}$	Interest protection is telling us how the EBIT covers the interests
Ability to Operate		
AR turnover =Net sales vs account receivable	$\frac{14}{11}$	AR turnover is showing how the accounts receivables are turning in one year.
A/R turnover day = 365 / account receivable turnover	365/	Arturnover day is showing
Inventory turnover = Cost of Goods Sold / the average of inventory	$\frac{12}{8}$	Inventory turnover is showing how many times per year the inventories are turned. Higher the value of this ratio the better inventory management in the company.
Account payable turnover = Cost of goods sold / the average of account payable	$\frac{12}{13}$	Account payanle turnover is a short-term liquidity measure used to quantify the rate at which a company pays off its suppliers. Accounts payable turnover ratio is calculated by taking the total purchases made from suppliers and dividing it by the average accounts payable amount during the same period.
Inventory turnover day = 365 / Inventory turnover	365/	Inventory turnover day is telling us how much time the companies money is tied in inventories.
Fixed assets turnover = Net sales / Fixed Assets	$\frac{14}{5}$	Fixed asset turnover is a financial ratio of net sales to fixed assets. The fixed-asset turnover ratio measures a company's ability to generate net sales from fixed-asset investments - specifically property, plant and equipment (PP&E) - net of depreciation. A higher fixed-asset turnover ratio shows that the company has been more effective in using the investment in fixed assets to generate revenues.
Total assets turnover = Net sales / Total assets	$\frac{14}{1}$	Total asset turnover is showing how much revenues company generates with their assets. This ratio is good to compare between different companies so you can see how many assets company needs to make revenues compared with the competition. Production technology, percentage of fixed assets, type of products etc.. are effecting the most this ratio. This ratio very much affects the profitability of the assets and equity.
Profitability		
Return on assets = Net income / Total assets	$\frac{22}{1}$	Return on assets are telling us how much net income the company is making with existing assets.
Return on equity = Net income / equity	$\frac{22}{2}$	Return on equity is the key indicator of how successful the company is from the owners point of view for carrying the risk of their investment.
Net income ratio (profit margin on sales) = Net income / Net sales	$\frac{22}{14}$	Net income ratio is showing the percentage of net income in total sales, higher the better.
basic earning power = EBIT / Total Assets	$\frac{9}{1}$	Basic earning power is telling us how much operating profit the company is making with existing assets.
Cash Flow		
Cash flow ratio = Cash flow from operating activities / Current liability	$\frac{15}{7}$	Cash flow ratio is meassuring how well the current liabilities are covered by cash flow generated from a company's operations. It can gauge the company's liquidity in the short term. Using cash flow as opposed to income is sometimes a better indication od liquidity simply as we know, cash is how bills are normaly paid off
Cash investment ratio = (Cash flow from operating activities - cash dividend) /fixed assets + long-term investment + other assets + working capital)	$\frac{15-16}{5+17+18+19}$	
Leverage		
Operating leverage=(net sales - cost of good sold)/EBIT	$\frac{14-12}{9}$	A business that makes few sales, with each sale providing a very high gross profit , is said to be higly leveraged. A business that has a higher portion of fixed costs and a lower portion of variable costsis said to have used more operating leverage
Financial leverage= EBIT/ (EBIT-nterest expense)	$\frac{9}{9-10}$	Financial leverage is showing the financial coverage the company is making with its EBIT towardinterests

Table 8. Input table

Input table (potential to analyze up to 10 years)

	USD	2013	2012	2011	2010	2009
1	total assets					
2	equity					
3	long term debt					
4	short term debt					
5	net fixed assets					
6	current assets					
7	current liability					
8	inventory					
9	EBIT					
10	interest expense					
11	account receivable					
12	cost of goods sold					
13	account payable					
14	net sales					
15	cash flow from operating activities					
16	cash dividend					
17	long term investment					
18	other assets					
19	working capital					
20	cash end of the year					
21	credit rating					
22	net income					
No. of years	5	SHOW		SHOW ALL		

Table 9. Currency converter

12.9.2014	EUR	USD	DKK
EUR	1,0000	1,2920	7,4436
USD	0,7740	1,0000	5,7613
DKK	0,1343	0,1736	1,0000
TWD	0,0258	0,0333	0,1919
JPY	0,0072	0,0093	0,0537
HKD	0,0999	0,1290	0,7433
HUF	0,0032	0,0041	0,0236
SEK	0,1085	0,1401	0,8073
MYR	0,2421	0,3128	1,8024
NOK	0,1213	0,1568	0,9032
THB	0,0240	0,0310	0,1789
CONVERTER			
FROM	USD	TO	USD
	Convert		

50

Table 10. Traffic light report

FINANCIAL COEFFICIENTS	2013	2012	2011	2010	2009
Equity to Total liabilities	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Long-term financing	0,00%	0,00%	0,00%	0,00%	0,00%
FA vs TA	0,00%	0,00%	0,00%	0,00%	0,00%
Return on assets	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Return on equity	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Net income ratio	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Basic earning power	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
DU PONT ROA	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
DU PONT ROE	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Current ratio	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Quick ratio	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Interest protection	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Operating leverage	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Financial leverage	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Cash flow ratio	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Cash investment ratio	● 0,00%	● 0,00%	● 0,00%	● 0,00%	● 0,00%
Net sales vs account receivable	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Inventory turnover	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Account payable turnover	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Fixed assets turnover	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Total assets turnover	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
A/R turnover day	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00
Inventory turnover day	● 0,00	● 0,00	● 0,00	● 0,00	● 0,00

Financial coefficient table (the tool automatically colors the values in the table according to the traffic light setup for better visualization)

Table 11. Financial Coefficient table

FINANCIAL COEFFICIENTS	2013	2012	2011	2010	2009
Equity to Total liabilities	0,00%	0,00%	0,00%	0,00%	0,00%
Long-term financing	0,00	0,00	0,00	0,00	0,00
FA vs TA	0,00%	0,00%	0,00%	0,00%	0,00%
Current ratio	0,00	0,00	0,00	0,00	0,00
Quick ratio	0,00	0,00	0,00	0,00	0,00
Interest protection	0,00	0,00	0,00	0,00	0,00
Net sales vs account receivable	0,00	0,00	0,00	0,00	0,00
A/R turnover day	0,00	0,00	0,00	0,00	0,00
Inventory turnover	0,00	0,00	0,00	0,00	0,00
Account payable turnover	0,00	0,00	0,00	0,00	0,00
Inventory turnover day	0,00	0,00	0,00	0,00	0,00
Fixed assets turnover	0,00	0,00	0,00	0,00	0,00
Total assets turnover	0,00	0,00	0,00	0,00	0,00
Return on assets	0,00	0,00	0,00	0,00	0,00
Return on equity	0,00	0,00	0,00	0,00	0,00
Net income ratio	0,00	0,00	0,00	0,00	0,00
Basic earning power	0,00	0,00	0,00	0,00	0,00
Cash flow ratio	0,00	0,00	0,00	0,00	0,00
Cash investment ratio	0,00	0,00	0,00	0,00	0,00
Operating leverage	0,00	0,00	0,00	0,00	0,00
Financial leverage	0,00	0,00	0,00	0,00	0,00
DU PONT ROA	0,00	0,00	0,00	0,00	0,00
DU PONT ROE	0,00	0,00	0,00	0,00	0,00
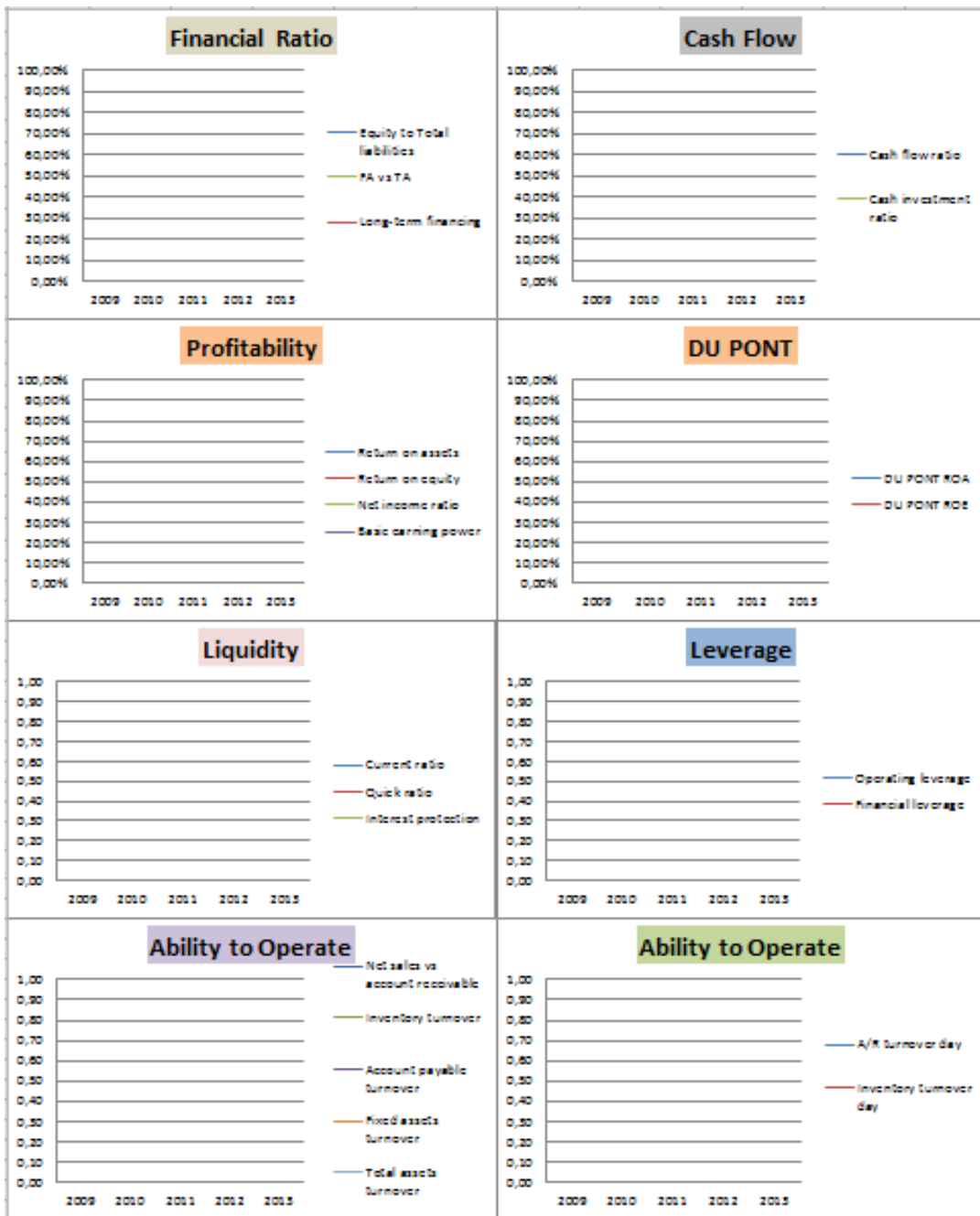
Figure 19. Graphs

Continued

4.10 Supplier evaluation table score

Based on all the data and analyst approach I am confident we will be able to create the system for a supplier evaluation score and somehow evaluate each individual supplier. The system and process to do so will be discussed internally inside the company and I cannot share it inside this Master's piece as it is part of the company's know-how.

CONCLUSION

Managing risks is gaining awareness on the highest management levels and it is becoming part of everyday life in a company. Managing risk is also a necessity and an essential part of the TS standardization if a company wants to become certified according to the TS standard.

At the beginning of this project I wanted to create a credit risk model. After consulting with several bank employees who are probably the biggest experts in using this kind of models I realized that a

typical credit risk model is over specified for the needs of the company I am working for. For minimum requirements to create a credit risk model I would need data for 30 operating companies and 30 bankrupt ones in order to calculate the appropriate correlations between the different financial indicators. As this data was not possible to obtain and also looking from the time perspective and outcome benefit we decided this is not worth while doing. I also learned that one of the main purposes for credit risk conduction in banks is to put a final premium price on the loan when approving it for individual company. Therefore this kind of credit risk models are being developed for months or years and constantly being proved and optimized. Developers of these models are many times educated mathematicians or physics who are also very proficient in statistical knowledge.

For our internal needs we needed some structural system and approach that would enable us to improve our knowledge in financial analytics and improve our knowledge in financial analysis of our business partners and their environment where they are operating. For a multinational company as ours it is very important to know in which direction our suppliers, cooperators are developing. As we just become certified according to the TS standards it is important that we are capable to help develop our suppliers where needed in order to grow together. One of the biggest risks that can happen is that a supplier doesn't deliver the ordered goods and by that causes a production stop for the customer. Production stop can cause a major loss for the buying customer not only that the customer is not able to produce and sell his finished products to the market it can also loose the market because the competitor taking advantage of this shortage.

I believe that with this work on data mining of 25 companies and obtaining the vital data for the past five years where possible we are getting a lot of information about the EMS industry its developing trends and can better assess the suppliers in the industry and not only this we can now see and calculate how our current suppliers are doing comparing with the others and comparing with the general trend.

I also strongly believe that the financial tool I have developed during this project is very user friendly and that it can easily be upgraded or modified per user's needs. Quality of the outcome will only increase if we start to use it frequently and if we decide to include even more companies into the analysis. There are also many other potential how to use this tool in the future.

One of the interesting activities in the near future will be how to create an evaluation table based on the obtained results from this financial tool so we could put a final score to a individual company showing its financial health.

As additional improvement potential I would also mention to include the soft indicators next to the accounting ones in order to obtain other valuable information about the companies we are working closely together.

With this project I believe at the end we have something in our hands that will improve our credit risk management and support our strategic management decisions. With this analysis we should be

able to detect potential problems in advance and still have time to react on time. Of course as also mentioned in this work there are always traps and obstacles we need to be aware of. So always when doing this kind of analysis we need to keep this in mind and we need to use them carefully and wisely.

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