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Risk Management in New Technology Deployment Projects

Timea Czirner | Dr. Romeo V. Turcan, PhD.
Department of Business Economics,
Aalborg University

Abstract
Risk appears in every kind of investment. If a company wants to change technology, it has to count with the risk of failure and other possible hazards. Identifying, monitoring and mitigating the risks are necessary. This thesis will investigate how risk identification and management should be carried out by (small/medium sized) companies participating in new technology projects (e.g. ICT-PSP[1] projects of the European Union). ICT-PSP (ICT Policy Support Programme) is aiming at stimulating innovation and competitiveness. It implements this goal through the wider uptake and best use of Information and communication technologies (ICT) by citizens, governments and businesses.

Keywords: *Risk Management, Technology Deployment Projects, Project Management*

1.0 INTRODUCTION

A simple definition of 'risk' is "a problem that has not yet happened but which could cause some loss or threaten the success of the project if it did"[2] Risk analysis has a very important role before deploying a new technology. In order to discover the possible risks of a new technology deployment project, one has to understand how an appropriate basic risk analysis can be implemented. Risks should not only be analysed, it has to be well managed as well. It is not only important to know the risks but to find solution for each possible (most probable) scenario is the key of managing risks and lowering the chance of failure. Big corporations often have a whole department for analysing new investments (impact assessment, risk management, reports on key indicators etc). Small companies do not have the chance to have this kind of facilities so for them it is very important to be aware of the procedure and techniques of risk analysis and use their resources at a maximum level. For a small company, the whole operation can be dependent on the success or failure of the project. Before identifying risks and plan to manage them, defining the paradigms, their use and how to choose the right approach, is very important. Usually companies do not include this chapter but it is useful to know what the backgrounds of the persons are that implement the risk assessment as well as the tools available for this analysis and the reasons for the methods chosen.

In this thesis the subjective approach was chosen. An analysis is strongly dependent on the observer's background hypotheses, experiences and presumptions. The aim is to be objective but it is never fully possible to reach 100% objectivity. After the methological framework, lists of expectations of the partners are made in Chapter 5.2. This is the first step before identifying risks. Later, in Chapter 5.3, a SWOT analysis is made where the environment and the external/internal factors are introduced of the project. Secondly, the technology adoption life cycle is described. This helps to identify the stage where the technology currently is and the groups of companies/ people already using it.

After these, with the help of an internal brain storming, the main risks of the project are analysed. This gives a good overview of the project partners' expectations and discovers the subjective, internal expectations and fears. Discussing these risks, and trying to create mitigation plans for each of them, helps the involved partners to understand the possible problems. It also gives a positive feeling for the project partners, the feeling to create something together and being prepared if some of the risk arises. In the end, the best practices of implementing risk management are discussed. These are part of the conclusions of the project.

2.0 LITERATURE REVIEW

2.1 Introduction to paradigms

In order to begin to discover the possible risks, a guideline is needed. Without an appropriate methodological framework, the process can be very hard and not well organized, nor profound. This chapter will introduce the key terms that are important base for the analysis.

Definition of risk: First of all the definition of risk is required. Risk is the probability of something (hazard) happening[3]. "Hazard" is used to mean an event that could cause harm. So risk the probability that a future hazard appears. These hazards are possibly occurring so in order to protect against, one has to develop a plan for this procedure.

[1] http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm, retrieved 05-08-2010
[2] Karl E. Wiegers, Know your enemy: software risk management, page 6.
[3] Cornelius Keating

2.2 Paradigm

"Thomas Kuhn gave the name "paradigm" its contemporary meaning. He refers to the set of practices that define a scientific discipline at any particular period of time. Kuhn himself came to prefer the terms exemplar and normal science, which have more precise philosophical meanings. However, Thomas Kuhn defines a scientific paradigm as:"[4]

- what is to be observed and investigated
- the kind of questions that are asked in relation to this subject
- how these questions are should be structured
- how the results of the observation can be interpreted, presented

On the other hand, a paradigm is "a pattern or model, an exemplar."[5] It answers the question:

- How is an experiment implemented, and what equipment is available to conduct it.

In normal science, the paradigm is the set of exemplary experiments that are likely to be copied or emulated. In this scientific context, the prevailing paradigm often represents a more specific way of viewing reality, or limitations on acceptable programs for future research, than the more general scientific method."[6] It is important to understand the meaning of the term paradigm because it is the basis of defining scientific disciplines. According to Kuhn, "every field of research is characterized by a set of common understanding of what phenomenon is being studied, the kinds of questions that are useful to ask about the phenomenon. It also defines how researchers should structure their approach to answer their research questions, and how the results should be interpreted. These common characteristics give a paradigm. Further that science does not progress only from a balanced accumulation of facts but also by successive and overlapping waves which fundamentally re-frame ideas. These ideas may change the nature of what researchers accepts to be facts. Based on this understanding, most scholars of philosophy of science define paradigms in terms of four sets of assumptions – i.e. ontological, epistemological, methodological assumptions and assumptions about human nature"[7] To understand this four sets of assumptions, and how they are related to the study object (risk assessment), each of them will be presented in the next paragraphs.

2.3 Ontology

Major questions of ontology are "What can be said to exist?", "Into what categories, if any, can we sort existing things?", "What are the meanings of being?", "What are the various modes of being of entities?". Various philosophers have provided different answers to these questions.[8] So for example in case of identifying risks, the Ontology can define what the exact term "risk" refers to (see in the beginning of Chapter 3) and what can be understood under risk, collecting the key features of risks and the impact on the projects. Also groups of risks can be identified, relating to key business areas. (see in Chapter 5.4)

3.4 Epistemology

Epistemology or theory of knowledge is the branch of philosophy concerned with the nature and scope (limitations) of knowledge.[9] It addresses the following questions:

- What is knowledge?
- How is it acquired?
- What do people know?
- Where does our knowledge come from?

Most of these questions are focusing on analyzing the origin of knowledge, how it relates to similar concepts such as the truth, belief, and validation. It also deals with the means of production of knowledge, as well as scepticism about different knowledge claims. Concerning the risk management, it refers to the applied theories that are used for the analysis as well as the knowledge of the observers that are involved in the risk assessment. It is important to know

[4] Clarke, Thomas and Clegg, Stewart (eds). Changing Paradigms. London: HarperCollins, 2000
[5] Oxford English Dictionary
[6] Handa, M. L.(1986) "Peace Paradigm: Transcending Liberal and Marxian Paradigms" Paper presented in "International Symposium on Science, Technology and Development, New Delhi, India, March 20–25, 1987, Mimeographed at O.I.S.E., University of Toronto, Canada (1986)
[7] John Kuada: Paradigms in International Business Research - Classifications and Applications, November 2009, WP53, page 5
[8] Topics on General and Formal Ontology (Paolo Valore ed.)
[9] Encyclopedia of Philosophy, Volume 3, 1967, Macmillan, Inc

what and how we know the theories and models we know. Once one understands the origin of the knowledge, it can be justified if it is a valid source.

2.5 Human nature

Human nature is the next important term, which describes how the researcher sees the relationship between the human beings and their environment. It aims to set up whether the observer sees the social environment as outside the human being or individuals and the environment codetermine each other. This observation is also important for knowing how knowledge is acquired and what is understood by the researcher under "Truth". While methodology may be a description of process, or may be expanded to include a philosophically coherent collection of theories, concepts or ideas as they relate to a particular discipline or field of inquiry. Referring to the risk management, it is crucial to define what is considered by the researcher as being "truth". How he sees the world, the collection of methods and procedures in his head and all the relevant subjective knowledge acquired before the analysis. The data collected in the thesis is provided by the project partners (see in Chapter 5.1.1). The RFID-ROI-SME is a real project with a budget of 2 million Euros, co-funded by the European Commission. Most of the information was provided by the project partners through phone conversations and emails. The coordinator of this project is UEAPME, The European Association of Craft, Small and Medium-sized Enterprises. I am currently working at UEAPME as the Coordinator of this project and have a daily connection with most of the partners. The subjective approach is chosen. This subjectivity is only partly subjective, the aim is to be objective but the analysis is never independent of the observer's believes.

3.0 METHODOLOGY

Another use of this term refers to anything and everything that can be incorporated in a discipline or a series of processes, tasks and activities. As an example, it plays a key role in software development, project management as well as in business process fields. It answers the questions and outlines who, what, where, when, and why. "In the documentation of the processes that make up the discipline that is being supported by "this" methodology that is where we would find the "methods" or processes. The processes themselves are only part of the methodology along with the identification and usage of the standards, policies, rules, etc.
Researchers acknowledge the need for rigor, logic, and coherence in their methodologies, which are subject to peer review."[10]

3.1 Burell and Morgan approach

Burrell and Morgan (1979) were comparing the two divergent perspectives regarding their ontology, epistemology, human nature and methodology. These differences can be seen in the following table:

Table 1 Burrell and Morgan[11]

Dimensions	The Objectivist Approach	The Subjectivist Approach
Ontology	Realism	Nominalism
Epistemology	Positivism	Anti-positivism
Human Nature	Determinism	Voluntarism
Methodology	Nomothetic	Idiographic

This will be the starting point of looking at the paradigm. In their understanding, there are two main approaches. The description of each of these categories will be according to Fast and Clark's research. According to Fast and Clark[12], realism claims that the social world is real and external to the individual perception. That is, the

[10] Creswell, J. (2003). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, California: Sage Publications.
[11] Burrell, G. and Morgan, G. (1979) Sociological Paradigms and Organisational Analysis: Elements of the Sociology of Corporate Life Heinemann Educational , London
[12] Fast, Michael and Clark, Woodrow W., (1998): Interaction in the Science of Economics:

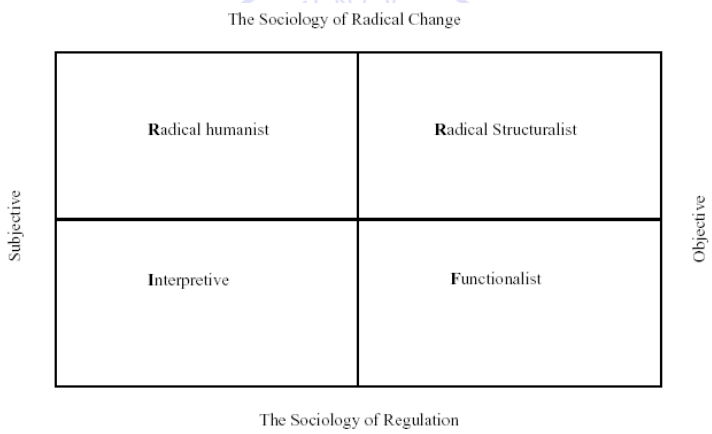
"real" world is composed of hard, tangible and relatively unchangeable structures. While nominalism supposes that reality is devised by individuals through relations and interactions with each other and exists in the form of names, labels and concepts. One can therefore talk of multiple realities in social science. "Positivism is an epistemology that seeks to explain and foresee what happens in the social world with an emphasis on regularities and causal relationships between its constituent elements. The positivist researcher believes that in social science researcher can be objective and conduct his investigations like an external observer. One can therefore study the constituent parts of a social observable fact in order to understand the whole. That is, he looks for regularities and causal interaction to understand and predict the social world."[13]

Anti-positivism has a lot of sides but in general it assumes that the social world is in actual statement relativistic (e.g. socially constructed) and can only be understood from the point of view of individuals that are directly involved in the social activities under research. Researchers adopting this position are not comfortable with the concept that social science research can create any kind of objective knowledge. The nomothetic approach encourages studies that are based on systematic practice and techniques like survey methods. In the meanwhile, the ideographic approach considers reality in terms of symbols as well as ideas. Methodology publications usually illustrate the objectivist research as positivistic and the subjectivist investigation as interpretive.

3.2 The RRIF Classification

In the common work of Gibson Burrell and Gareth Morgan[14] a distinction was made between the „sociology of regulation" and the "sociology of radical change" According to the authors these paradigms should be considered contiguous but separate.[15]

Table 2 Burrell and Morgan's Four Paradigm Model of Social Theory



3.2.1. Functionalist paradigm (objective - regulation)

This is the leading concept for organizational study. It seeks to provide rational explanations of human matters. Relations are concrete and can be identified, studied and measured by the use of science. The functionalist paradigm in Burrell and Morgan's understanding is a combination of objectivity and order. It is based upon the basis that society has a real, concrete existence, a systematic character and is directed toward the production of order and regulation. From this viewpoint, issues in business economics (and international business, for that matter) would be assumed to be objective and value free. The researcher can therefore distance himself from the subject matter by the inflexibility of the method that he/she adopts.

3.2.2. Interpretive Paradigm (subjective-regulation)

University of California, Davis and Aalborg University

[13] John Kuada: Paradigms in International Business Research - Classifications and Applications, November 2009, WP53, page 5

[14] Burrell, G. and Morgan, G. (1979) Sociological Paradigms and Organisational Analysis: Elements of the Sociology of Corporate Life Heinemann Educational , London

[15] Burrell, G., & Morgan, G. Sociological Paradigms and Organizational Analysis, Heinemann (1979) page 23.

The interpretive paradigm rejects the analysis of structures "sovereign of the minds of men"[16]. Consequently if students view business proceedings as taking place in complex, uncertain, and poorly defined contexts, they usually favour an individual approach to their research. The interpretive paradigm seeks to explain the stability of behaviour from the individual's viewpoint. They are more interested in understanding the subjectively created world "as it is" in terms of actual processes. It emphasizes the spiritual nature of the world.

3.2.3. Radical Humanist (subjective-radical change)

The Radical Humanist paradigm is sharing with the interpretive paradigm the supposition that everyday truth is socially constructed. Scholars adopting this approach see the dynamics of social change process in terms of interactions between individuals' world views and the external institutionalized world in which they live. The outside world is often so dominant that social change requires the emancipation of the awareness of individual participants within the society. This understanding is at the derivation of missionary endeavours. The actions of high profiled non-profit organizations are the best examples of institutions with radical humanist orientations. In this view the consciousness of man is dominated by the ideological superstructures with which he interacts, and these drive a cognitive wedge between himself and his true consciousness, which prevents human fulfilment. These theorists are mainly concerned with releasing this social constraints that bind potential. Most of this paradigm is actually anti-organization.

3.2.4. Radical Structuralism (objective - radical change)

They believe that radical change is built into the nature of societal structures. "Modern society is characterized by fundamental conflicts which generate radical change through political and economic crises. Scholars subscribing to Radical Structuralist Paradigm see natural structural conflicts within society. These conflicts create constant change through political and economic crises. This is the basic paradigm of scholars for example Marx and Engels.

3.3 Data collected

As described in Chapter 3.1.3, a subjective paradigm was chosen, the anti-positivistic, radical humanist approach leads through the thesis. The project is highly dependent on individuals while the evaluation process is dependent on the European Commission (as the external institutionalized world). All the work done is the result of human knowledge and interpretation of the goals, tasks and required efforts. So from the above mentioned paradigms, only a subjective can be chosen and in this thesis the observer considers the world as radical humanist. The world is strongly dependent on human interactions and humans have to create institutions in order to have influence on the external rules and world. Such non-profit organisations are e.g. associations at European level representing the interests of different groups. As in a project all participants have different interests, expectations and involvement, the goal of the project will never represent the aim of all of the participants. Each participant has to adapt to the overall aim and – with some exceptions- is not able to fulfil all its expectations.

Even though it is a subjective paradigm, the aim is to be objective and investigate the study object from all perspectives. That is the reason why the thesis uses different methods to discover possible risks. (SWOT, Staffordshire Community Risk Register, internal brainstorming of main risks...) The anti-positivistic approach prefers using qualitative methods so in Chapter 4.5. This analysis will be implemented. The evaluation of each risk (impact and probability) is also based on human capital. The background knowledge of the observer is not always appropriate. Even if the observer (in this case, me and the project partners) has the relevant education, it is hard to collect all the technological risks. Very important step is to communicate and not only identify management related risks but also technical risks. Often managers and the team are not well qualified in engineering and do not know the technology related risks. In any case, a strong collaboration between the technicians and the management team is required.

3.4 Methodological approach

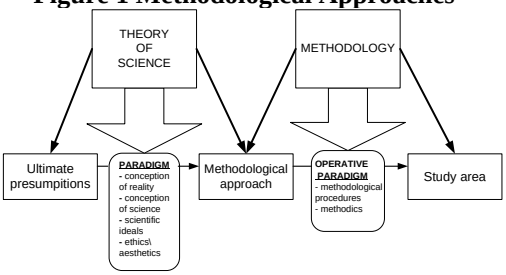
A methodological approach is the idea of when and how to use various methods for developing business knowledge, and which method is suited best for different subject areas or unique business situation. Methodological approaches have different features, characteristics, concepts, opinions, assumptions about the reality and thus these are guide for the creator of reality. When applying the different approaches in practice, one should know how to proceed in order to understand, explain and improve business.[17] The figure below shows a distinction between the

[16] Burrell, G. and Morgan, G. (1979) Sociological Paradigms and Organisational Analysis: Elements of the Sociology of Corporate Life Heinemann Educational , London, page 260.

17 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 49

theory of science and methods and between paradigms and methodological approaches drawn by Abnor and Bjerke. The theory of science covers the ultimate presumptions in the social sciences and is used to describe the importance to practical research or investigation of a company. The methodological approach clarifies the ultimate presumptions and sets up a framework for the operative paradigm, where the methodical procedures and methodics are discussed. An operative paradigm is the link between the methodological approach and the study area.[18]

Figure 1 Methodological Approaches[19]



First, the theory of science will be discussed and then the methodological approach that has been chosen will be shortly considered.

3.4.1. Ultimate presumption

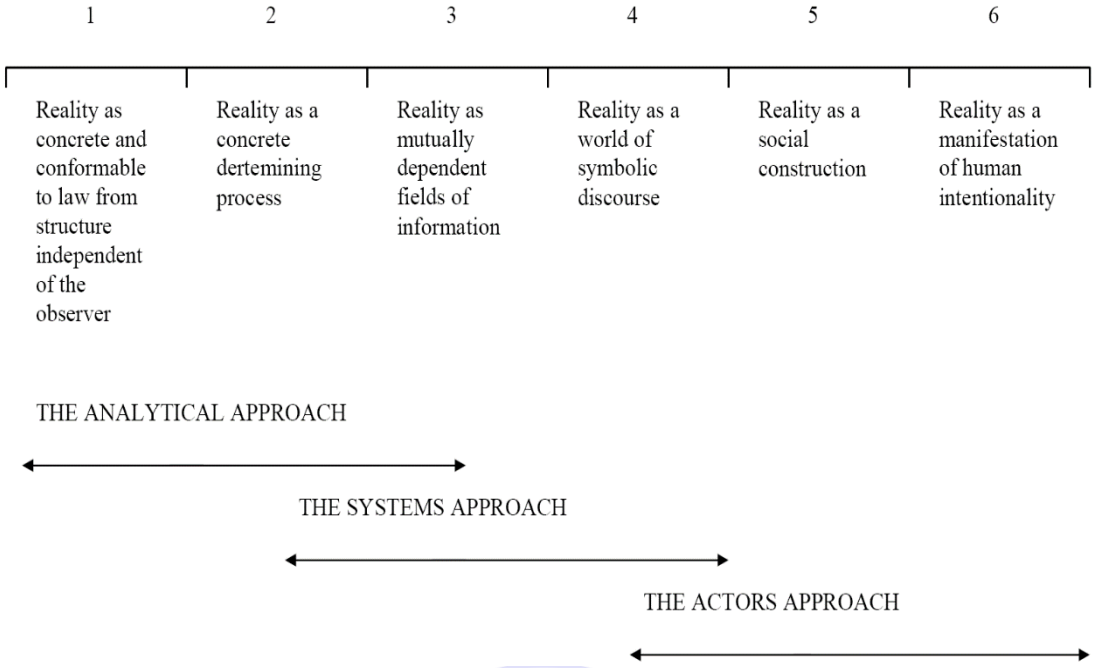
An ultimate presumption refers to the background hypothesis of the current regulation of RFID in Europe and the trust in this technology and the already existing operational RFID technologies.

3.4.2. Paradigm

The theorists of science have developed a so-called "language" – the concept of paradigm- to describe the relation between ultimate presumptions and the practical use of methodological approaches.[20] It is a common term for presumptions, background hypotheses, and normative theses. The three different methodological approaches relate to paradigmatic categories and deal with different observations of reality, as shown in the figure below.

Figure 2: The relation of the methodological approaches and paradigmatic categories[21]

18 Kuada, J., Research methods in social science (2008), p. 49
19 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 17
20 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 11
21 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 44



As it can be seen in the figure above, in the most left side is the analytical approach which has an assumption that reality is completely independent from the structure and going to the right side human effects and different determining factors come into the picture and at the end reality is understood as the manifestation of human intention by actors approach. So from objectivity it turns more and more to subjectivity. Throughout the thesis, one of the three fundamental approaches, the systems approach, will be used and shortly discussed.

3.4.3. Systems Approach

"A system is a set of components and the relations among them".[22] The main assumption of the systems approach is that the reality as the whole is much more than only the sum of its parts, it is synergy. The components of the system are mutually dependent on each other, so not only the content of individual parts, but also the order they put together, provides the value – synergistic effects. The system's researcher is always seeking to draw the more general "whole" picture. The society is much more than the sum of different parts. In order to analyse a system it is necessary to analyse it within its own context or environment. The systems approach suits the best for the study object because the RFID-ROI-SME project will be presented as a whole and will be considered as a synergy of individual pilots in European countries, where each country's regulation and level of RFID technology are different and it all has influence on the whole risk of the implementation of the project. The project seeks to describe the world piece by piece, as a collection of systems.[23] At European level there are plenty factors influencing the system, each country has different features and technological background. I only relatively agree with the statement in the systems approach that the world is objective or objectively accessible. The goal to be objective is creditable, but in reality is difficult to implement it. Subjectivity is the criteria for the risk analysis of the RFID-ROI-SME project and the project report will be dependent on the creator (in this case me) and will have subjective picture of reality. However, objectivity is still tried to be achieved. I put the framework for the project, determined the delimitations for the study object, and chose the approach and the references, which in my understanding are valid. But the project as a created picture of the chosen study object as a real life problem cannot be qualified according true or false criteria, it is just one way to see, to describe and try to solve the problem. The ambition to draw a general, as objective as possible, picture of reality from a lot of various subjective pictures is one of the goals of the thesis.

Project Risk Analysis and Management: Project Risk Analysis and Management is a process which enables the analysis and management of the risks associated with a project. "Properly undertaken it will increase the

22 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 110
23 Abnor, I. and Bjerke, B. Methodology for creating Business knowledge (1997), p. 131

likelihood of successful completion of a project to cost, time and performance objectives."[24] Risks for which there is ample data can be assessed statistically. However, no two projects are the same. Often things go wrong for reasons unique to a particular project, industry or working environment. Dealing with risks in projects is therefore different from situations where there is sufficient data to adopt an actuarial approach. Because projects invariably involve a strong technical, engineering, innovative or strategic content a systematic process has proven preferable to an intuitive approach. Project Risk Analysis and Management has been developed to meet this requirement.[25]
"The first step is to recognise that risk exists as a consequence of uncertainty"[26]. In any project there will be risks and uncertainties of various types as illustrated by the following examples:

- The management is not trained to do risk analysis, it is not an usual practice of the company
- The Technology Is Not Yet Proven
- Resources May Not Be Available At The Required Level

"All uncertainty produces an exposure to risk which, in project management terms, may cause a failure to:

- Keep Within Budget
- Achieve The Required Completion Date
- Achieve The Required Performance Objective"[27].

Project Risk Analysis and Management is a procedure that aims to eliminate or mitigate the risks which threaten the achievement of project objectives. The next section describes the benefits that Project Risk Analysis and Management might bring to a project as well as the wider benefits to the organisation and its customers. It should be regarded as an integral part of project or business management and not just as a set of tools or techniques.

The Project Risk Analysis and Management Process: "Experienced risk analysts and managers hold perceptions of this process which are subtle and diverse. In order to simplify the process this Guide divides the overall process into two constituents or stages: Risk Analysis **and** Risk Management"[28].

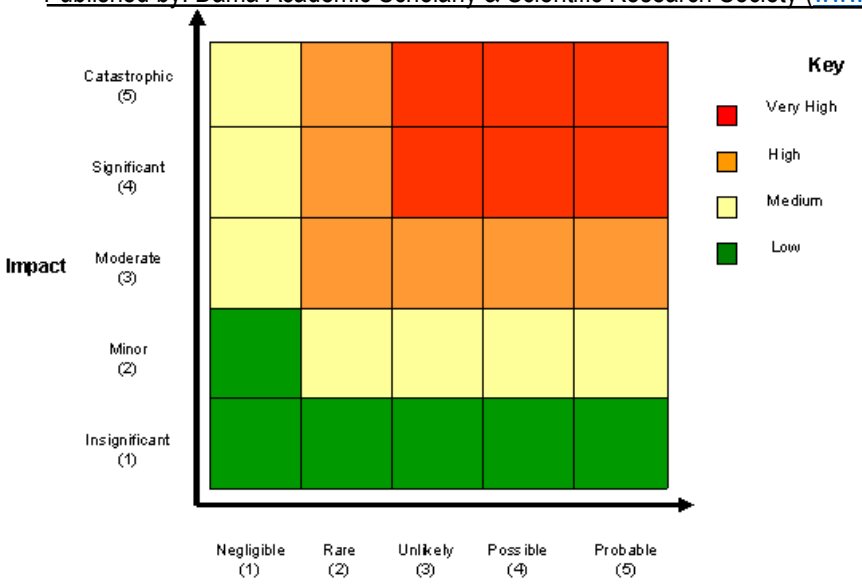
Risk Analysis: Risk Analysis is one of the two stages of the process that usually split into two 'sub-stages'; a qualitative investigation 'sub-stage' that focuses on identification and subjective estimation of risks and a quantitative analysis 'sub-stage' that focuses on an objective evaluation of the risks.

3.5.1 Qualitative Analysis

A Qualitative Analysis allows the main risk sources or factors to be identified. This can be done, for instance, with the help of check-lists, interviews or brainstorming. This is usually associated with some form of appraisal which can be the explanation of each risk and its impact or a subjective labeling of each risk (e.g. high/low) in terms of both its impact and its likelihood of occurrence. In the table below an illustration is shown of the presentation of different risks and the impact and probability of the occurrence. As discussed in methodology chapter, the paradigm is anti-positivistic, that usually uses qualitative methods. In the thesis, this analysis will be conducted.

Figure 3 Staffordshire Community Risk Register matrix

[24] Yuanyuan Zhang: How the Principle of Risk Management Can Be Applied to Different Types of Projects?
[25] P Simon, D Hillson and K Newland: Project Risk Analysis and Management (PRAM), ISBN 0953159000.
[26] Tony Merna, Faisal F. Al-Thani: Corporate risk management
[27]
[28] P Simon, D Hillson and K Newland: Project Risk Analysis and Management (PRAM), ISBN 0953159000



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A main aim is to identify the key risks, perhaps between five and ten, for each project (or project parts in large projects) which are then analysed and managed more detailed.

3.5.2 Quantitative Analysis

A Quantitative Analysis often includes more complicated techniques, usually requires computer software. To several people this is the most formal aspect of the whole process requiring: Measurement of uncertainty in cost and time estimates and Probabilistic mixture of individual uncertainties. Such techniques can be applied with varying levels of effort ranging from simple to extensively thorough. It is recommended that new users start slowly, perhaps even ignoring this 'sub-stage', until a level of acceptability has been developed for Project Risk Analysis and Management in the organisation. A preliminary qualitative analysis is required. It brings significant benefits in terms of understanding the project and its problems irrespective of whether or not a quantitative analysis is carried out. It may also serve to highlight possibilities for risk 'closure' i.e. the development of a specific plan to deal with a specific risk issue.

Experience has shown that qualitative analysis - Identifying and Assessing Risks - usually leads to an initial, simple level of quantitative analysis. If, for any cause – e.g. time or resource demands or cost constraints - both a qualitative and quantitative analysis is unfeasible, it is the qualitative analysis that should be implemented. This thesis will be focusing on the qualitative analysis. Since the relevant software is not accessible and the observer has not the relevant knowledge to make a deep quantitative analysis, a simple - but appropriate for the basic professional risk analysis – will be implemented.

3.5.3 Risk Management

This phase of the procedure involves the formulation of supervision responses to the major risks. Risk Management might begin in the qualitative analysis stage as the need to react to risks may be pressing and the solution rather obvious. Iterations between the Risk Analysis and Risk Management stages are likely.

Benefits: Examples of the most important benefits of Project Risk Analysis and Management techniques are:

- Improved understanding of the project that consecutively leads to the formulation of more practical plans, in terms of cost estimates as well as timescales.
- A better understanding of the risks the possible impact that can lead higher awareness and consequently to a team that is able to handle them
- Effective supervision of the risks
- Ability to evaluate contingencies

Who benefits from its use?

[29] Staffordshire Community Risk Register (http://www.staffordshireprepared.gov.uk/risk/) Accessed 14-07-2010

- The organisation and its management to have a better overview of the planning and the budget
- Customers because of better time management (more efficiency in production, more convenience for customers)
- Project managers because of the improved system, higher quality of work, implementing the same work with possibly less efforts

Costs: The costs of use Project Risk Analysis and Management techniques differ according to the extent of the work carried out and the commitment to the process. The cost of using the procedure can be as little as the cost of one or two days of a person's time up to a maximum of 5-10% of the management costs of the project, even this higher cost, as a percentage of the total project cost, is reasonably small. This cost incurred can be seen as an investment. If risks were not identified during the process maybe they would occur when it is too late to react.

Time: The time taken to carry out a risk analysis is partly dependent on the accessibility of information. If the person that is in charge of the analysis has the relevant knowledge, it can take less time. It is also dependent on the technology used e.g. having a relevant software to support this activity. A detailed cost and time risk analysis usually requires at least one, and up to three months, depending upon the scale and complexity of the project and the extent of planning and cost preparation already carried out. It should not take too long time because the environment is continuously changing and in some cases the values have to be modified constantly. However, as indicated above, a functional basic analysis can take as little as 1-2 days.

Resources: The minimal resource requirement is obviously just a person within an organization with relevant experience of using Project Risk Analysis and Management techniques. The other solution can be that the company hires an outside consultant. It is probable that once a Project Risk Analysis and Management have been introduced to an organisation, in-house expertise will develop swiftly. Project Risk Analysis and Management are relevant to all projects and are main parts of project management. The categories of its costs vary by organisations. Some of them treat these costs as an overhead to the organisation, and not to the project.

Risk Management: The basis of risk management is the risk analysis. It uses the information collected during the analysis phase to make decisions on improving the probability of achieving its cost, time and performance objectives. Risks should be optimised especially on the main areas. Contingency and mitigation plans are crucial. With the management of these risks, usually an amendment in the project plans is carried out e.g. moving high risk activities off the significant path, developing contingency plans to allow swift reaction if certain risks occur or setting up monitoring actions for critical areas to get early notice of risks occurring.

3.6 Risk management methods

The Software Engineering Institute (SEI)[30] defines risk as the possibility of suffering loss. In a development project, the loss could appear in the form of diminished quality of the work, increased costs, delayed completion, loss of market share, failure, etc. Risk and opportunity are very close related to each other. Success cannot be achieved without at least a minimal degree of risk. "Risk in itself is not bad; risk is essential to progress, and failure is often a key part of learning. But we must learn to balance the possible negative consequences of risk against the potential benefits of its associated opportunity"[31] Risk management is a process that is regular and permanent and it can best be described by the SEI risk management concept. The elements of the risk management theory are introduced below. These steps take place sequentially but the activity occurs continuously, concurrently (e.g., risks are monitored while new risks are identified and analyzed), and iteratively (e.g., the mitigation plan for one risk may yield another risk) throughout the project life cycle.

- **Identify**: Discovers the possible risks of the project
- **Analyze:** Transforms these identified risks into decision-making information.
- **Plan:** Setting up a chain of actions regarding each of the risks and mitigation plans
- **Track**: Monitoring the indicators and the mitigation
- **Control**: Making corrections if the current environment and risks are different than the planned
- **Communicate:** Enabling an appropriate information flow

[30] Ronald P. Higuera, Audrey J. Dorofee, Julie A. Walker, Ray C. Williams: Team Risk Management: A New Model for Customer- Supplier Relationships(1994) http://www.sei.cmu.edu/reports/94sr005.pdf

[31] Carnegie Mellon Software Engineering Institute Web site. Van Scoy RL. Software development risk: opportunity, not problem. Technical report no. CMU/SEI-92-TR-030. Available at: www.sei.cmu.edu/publications/documents/92.reports/92.tr.030.html. Accessed April 9, 2004

3.6.1 Software Risk Evaluation Methodology (SRE)

The Software Risk Evaluation Methodology (from now on: SRE) is an analytical decision-making tool and is used in projects where software is involved in the deployment of new technology. It identifies and categorizes specific project risk statements originated from product, process, and constraint sources. Usually the companies' own staff is involved in the identification and analysis of risks, and in the mitigation of risk areas. It is important that the staff has an insight of the procedures of the company so they have the relevant knowledge to contribute to this task.

Solution provider: "[32]A solution provider is a vendor, a service provider or a value-added reseller that comprehensively handles the project needs of their client from concept to installation through support. This process normally involves studying the client's current infrastructure, evaluating the client's needs, specifying the mix of manufacturers' hardware and software required to meet project goals, installing the hardware and software at the client's site(s). In many cases, the "solution" also includes ongoing service and support."

The SRE has the following attributes:

- trains staff to be able to implement systematic risks identification and develop mitigation plans
- focuses on risks that can influence the delivery and quality of the products
- provides project manager and personnel with several perspectives on identified risks
- creates foundation for constant team risk management

An SRE warns the project manager to anticipate and address project risks. When SRE is introduced, the operation of the company will involve additional activities e.g. setting up expectations, measuring the achievements, monitoring mechanisms etc.

Benefits include:

- creates a new perspective on looking at processes and staff will be more aware of risks
- develops a common understanding and creates mitigation plans
- provides a snapshot of the current risks
- monitors the risks
- monitors the mitigation efforts
- creates decision-making information to the project management

There are two views that must be considered regarding SRE. First, the SRE is useful as a stand-alone analysis. The SRE is more efficient than the continuous risk management (CRM[33]) within the project and the team risk management (TRM[34]) among customers and suppliers. The SRE is the base of CRM and TRM by investigating a "baseline" of risks. As baseline a "critical mass" of risks is understood that serves as a focus for later mitigation and management activities.

4.0 NEW TECHNOLOGY PROJECTS

New technology is the key to create innovative, cost-efficient and competitive companies in the long-term. Most of the big companies have own R&D department with a group of researchers, place for testing new technology and evaluating them. In the meantime, SMEs have less chance to create these "centres" and adapt to technological changes because of the lack of financial and human resources. However, in both cases the risks of adapting a new technology have to be considered and analysed before the implementation of the project. Also, the Return on Investment is a key indicator to evaluate the expected future cash-flow and benefits.

4.1 Radio-frequency identification technology as an example

Radio-frequency identification (RFID) is a new technology that can be used in various sectors. The technology itself is the use of an object (typically referred to as an RFID tag) applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader.[35] Radio-frequency identification includes interrogators (readers), and tags (labels). Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. There are generally three types of RFID tags: active

[32] earchITChannel.com Definitions (Whatis.com)

[33] Dorofee et al. Continuous Risk Management Guidebook. Pittsburgh, Pa: Carnegie Mellon University, 1996.

[34] Team Risk Management: A New Model for Customer-Supplier Relationships (CMU/SR-94-SR-005). Pittsburgh, Pa: Software Engineering Institute, Carnegie Mellon University, 1994.

[35] Wikipedia description of RFID

tags (contain a battery and is able to transmit signals autonomously, passive tags (have no battery and need an external source to provoke signal transmission) , and battery assisted passive (BAP) tags (require an external source to turn on but have significant higher forward link capability providing great read scope.). RFID is already used throughout Europe (in the bigger cities in France, Portuguese highway system and public car parks, in Italy, and Belgium). RFID passes meeting the requirements of the Calypso international standard that is used for public transportation systems.

4.1.1. "RFID-ROI-SME"[36], a project for SMEs

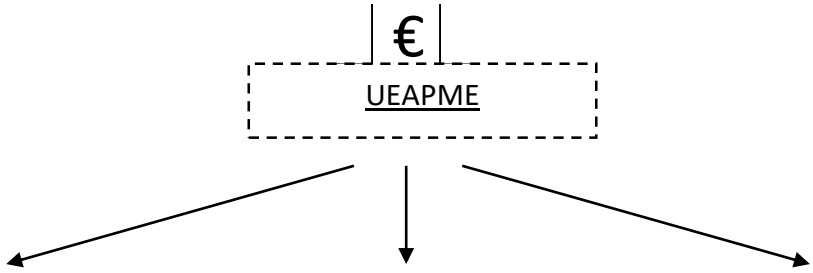
The European Commission had a call for providing support for companies willing to deploy new technology, and to be more specific, RFID technology. Two groups of companies (consortium) got this support. One of them is named as RFID-ROI-SME. The main goal of RFID-ROI-SME project is to integrate the RFID technology in different companies across 6 European countries (Spain, Greece, Bulgaria, Denmark, the UK and Italy). In each country, a solution provider company and an end-user company is given, they will work together in order to deploy this new technology. The project covers different sectors:

- E-ticketing (Denmark)
- Logistics (Bulgaria)
- Apparel (Greece and Bulgaria)
- Security (United Kingdom)
- Document tracking (Italy)
- Packaging (Greece)
- Plastics (Spain)
- Construction (Italy)

Each of the end- user companies will integrate the RFID technology for a better, safer and faster operation and with the aim at reducing cost in the long term. At the end of the project (it lasts for 2 years), the results of the different pilots (the experimental deployment of RFID from the solution provider to the end-user) will show if the Return on Investment (ROI*) was positive and if it was more efficient than the previously deployed technology. ROI is a measure of cash that had been generated/ lost due to the investment. It measures the cash flow (income stream) of the project to the investor, relative to the amount invested.

Financial help for SMEs: In this project, 50% of the costs are covered by the European Commission. So it means that one Partner (end-user) e.g. DUF-rejser[37] in Denmark has to pay half of the costs of deploying the new technology. This is a big help for SMEs, since the integration of new technologies are very expensive.
The project partners are presented in the following Table.

Table 3: Partners in RFID-ROI-SME project



End-Users	Associations	Solution Providers
Cablecommerce Ltd. (BG) Makes cables and conductors Goal: better tracking, planning	BASSCOM (BG) Bulgarian Ass Software Companies Goal: experience, nat. dissemination	Balkan Services (BG) IT business > work with Cablecom Goal: further knowledge, spread usage

[36] www.rfid-sme.eu
[37] http://www.duf-rejser.dk/

Dansk Ungdomsferie (DK) Travel Agent (ES, BG destinations) Goal: green it, security, efficiency		RFID-Specialisten (DK) In charge of DUF trial Goal: best pract. travel & tickt handling
Styl Koskinidis S.A. (EL) Packaging Business Goal: aut. monitoring & qual control Staff Jeans (EL,*BG) SME consultant (bookkeeping & taxes) Goal: observe supply/value chain gains		SENSAP S.A. (EL) IT for printing, packaging and logistics Goal: knowledge, disseminate through case studies, blueprints (!!)
Rete Servizi srl (IT) SME consultant (bookkeeping & taxes) Goal: safe document tracking, mngmnt Bridge 129 S.p.A. (IT) Safety & Security (surveillance) Goal: better/new surveillance tec	CNA (IT) Conf. Naz. Artigianato e P&M Impresa CAN Milano Goal: acquire methodology on RFID application development (nat. diss.)	SATA (IT) IT provider for Italian trials Goal: knowledge, exploit open source, EU-wide networking
PICDA S.L. (ES) Plastic bags (any tipe) Goal: better SCM, invoicing	ESTIC (ES) Asoc. Emp. Del Sector TIC de la CAV Goal: dissemination, opensource RFID	Alu Group S.L. (ES) Software consultant > work with PICDA Goal: show RFID benft, more customers
Sovereign Security (UK) Security (officers, guards, CCTV) Goal: automate data coll. (time, ppl)	UKITA (UK) UK IT Association Goal: diss, más business for members	SERO Solutions Ltd. (UK) Near Field Communication Technology Goal: improve core SME processes(info)

ATHEN'S INFORMATION TECHNOLOGY

A. – Contribute with expertise
B. – Lead Evaluation Process

Goal: Strengthen open source RFID, further business in Greece and Balkan

For the better understanding, the Danish pilot will be introduced: RFID-Specialisten is one of the RFID solution providers of the project; its base is in Arhus. It will be in charge of the deployment of the DUF-rejser trial. So RFID-Specialisten will provide the RFID technology for DUF-rejser. DUF-rejser wanted to apply this technology originally but with this co-financing provided by the European Commission, it can save half of the costs. Dansk Ungdomsferie (DUF-rejser) is a Danish travel agency dedicated to youth charter, with destinations in Spain and Bulgaria. Its main activities include: Arrangements for events on the destinations and Arrangements for excursions and sports on the destinations. The main objective for this pilot is to give the guests a better service and ensure the validation of access for events and excursions.

The pilot workflow is as follows: when the customer arrives in the airport or enters the bus at the start of the holiday they get a RFID card as holiday voucher. This RFID-voucher contains all information for travel, hotel, events and all other additional paid for. When the customers check in for travel it is registered in the central database, meaning

that all information is updated online. The information can be send to the hotel, and when the customer arrives at the hotel, the RFID-card is again used as identification and all information for quick check in are available via the central database. If the customer wants to add an extra event on the card it is done online with the handheld mobile from the guide. Participation in an event is validated with the RFID-card quick and easily. Expected benefits of the pilot is to have more and better security for guests and tickets legalization, more efficient administration for the travel arrangement and to reduce number of papers send to customers and partners. (Green IT) As a first step of risk assessment, the overall environment has to be analysed. This can be implemented with the help of SWOT analysis.

4.2 Key requirements

The following key requirements of the end-users can be identified before the deployment of RFID technology. It is important to know what the expectations are within the company so later the achievement of these concrete goals can be monitored. Source of this Chapter are the end-users.

User Interface and Tooling Requirements: Business Process Description and Configuration. The solution should provide flexible and graphical user interfaces enabling configuration and monitoring of new technology business processes. Several end-users expressed also a need for participating in modelling these business processes. Management Tools. The availability of management tools is important to several end-users. The expressed need covered a wide array of tools, ranging from managing the RFID network to business process management. Also, management tools were deemed essential to ease the collaboration effort between stakeholders of an RFID project. Hardware Management Tools. End-users were keen on hardware management tools that could ease integration efforts and to lower maintenance costs.

Hardware Interface Requirements: Integration of heterogeneous hardware components. End-user business cases are in need of several reader types and hardware devices. This creates the requirement for drivers / connectors to a variety of reader vendors, legacy optical bar scanners and other devices. Reuse of legacy AutoID technologies. End-users expressed a need for (re-)using the existing hardware components for auto-id, e.g. bar-code technology.

Software Interface and Integration Requirements: Standardized data formats. Standardized business data exchange mechanisms (e.g., EDI, Web Services, Electronic Product Code (EPC) interfaces). Such mechanisms could reduce integration costs, while increasing compliance with existing IT infrastructures and services. Integration with other technologies (including legacy). The importance of integration with other technologies, including existing technologies e.g. barcode and sensor technologies. This point seems to be of high importance for the SMEs especially because RFID is a relatively new technology and companies would want to operate it in parallel with more mature technologies and already deployed systems. Hence, the companies needed the convenience of step by step testing new technologies and gradually replace legacy systems.

Cost Requirements: Total Cost of Ownership. Due to the high cost of RFID tags, many end-users underlined that a low total cost of ownership, would be a prerequisite for migrating to or deploying an RFID solution. Hence, low cost readers, royalty free software and low-cost integration services were deemed important elements of a potential solution. It is also important that many companies are already using traceability solutions and feel quite confident with these existing solutions. For these companies, an RFID solution has to be low-cost in order to be appealing.

Privacy/Security Requirements: Secure Access to RFID Data. Several companies underlined the need for secure access to the data embedded into the tag memory, as well as possible integration of cryptographic modules to secure the data. Security concerns were also raised given that most of the companies are compelled to exchange data, for instance for traceability or logistics reasons. These exchanges have to assure at all points confidentiality. Privacy. Privacy concerns were also expressed. For companies compliance with privacy directives seemed to be important.

Social dimension: The social dimension of RFID technologies is directly associated with the RFID's potential to improve various products and services. The objectives of RFID-ROI-SME emphasize the need to foster RFID technology (within SMEs), which will SMEs enable them to improve the quality of their products and services in a wide range of fields including supply chain tracking, retail and inventory management, baggage handling, credit cards, health care ID and medical records management, smart passports, import/export processes, intelligent electronic ticketing, electronic check-in, efficient manufacturing process management, care safety and many other opportunities for novel products and services. Note that several of the above products and services are offered by SMEs, which in various cases tend to be innovative and customer-focused. Improved quality of products and services in the above areas can have a direct positive impact for EU citizens. The RFID-ROI-SME project will produce best practices for optimizing RFID implementations by SMEs and within SMEs. Hence, it will boost citizen quality of life as a result of better RFID deployments.

Information security management and privacy impact assessment: Information security management requires controls to be balanced in terms of risk, cost and effectiveness. The cost/benefit ratio of security controls cannot be expressed in an absolute manner. Rather, it depends on the application context and, in particular, the value

of the assets or business process that need to be protected. An RFID tag can be likened to token carrying information. Its security value depends on the asset it is attached to (e.g. a car key) and the purpose for which it is being used (e.g. verifying identity, providing access to restricted areas, paying goods, etc.). If RFID tags are used as an electronic wallet or tickets in a subway card or to open doors, criminals may be interested in stealing, copying or modifying them. When RFID is used for access control to other systems and networks, a successful attack could compromise not just the RFID system itself but also all systems and networks it was supposed to secure. Risk increases when the benefits of an attack outweigh its costs. Before committing crimes, even criminals perform risk assessments of existing systems to identify whether and how they could exploit weaknesses. They also perform a cost/benefit analysis to determine which attack strategy is the best for reaching a given objective. Criminals will for example decide whether cloning an RFID hotel door tag is easier than bribing the domestic staff or breaking in via a window. Appropriate security controls can boost the cost of a possible attack so the cost outweighs the benefits. Insufficient security controls with regards to the value of the asset to protect will likely trigger the interest of a potential attacker.

A set of efficient security controls will likely not suppress the intention of an attacker to commit a crime, but it may force him or her to use another technique or to target other less-protected systems or victims, or to take more risk. When the information stored in a tag can be related to an identifiable individual, the protection of the information should be regarded from the double perspective of security and privacy. In some cases, the stored data can be sensitive: information identifying a medicine taken or carried by an individual can reveal personal health data; medical data recorded in a patient RFID wrist band can lead to life threatening situations if lost or corrupted; unauthorised access to biometric data in a passport or identity document can lead to identity theft. Some sensitive personal data, such as biometrics, require more sophisticated protections than others, such as the use of effective encryption and electronic authentication mechanisms. It is possible that, in a given scenario, a risk assessment concludes that the level of risk and the cost of the necessary security controls to cope with the risks versus the benefit of using RFID technology is not worth deploying the system or requires a partial or complete re-evaluation of the project. In a given context, one particular affordable RFID technology may appear to be insufficiently protected against a certain class of risks but sufficiently against another. A decision could be made to invest in a more secure type of RFID technology, or to associate the initial low-cost RFID technology with non-RFID security controls (e.g. video surveillance, human monitoring, etc.), or to use other technologies than RFID.

In some cases, RFID data is personal without ambiguity (e.g. in many access control applications). In other cases, RFID data may become personal data when it is possible to relate it to an identifiable individual. For example, when RFID is used in supply chain systems, the unique number stored on an RFID chip attached for example to a box of medicine to identify and track it, is not personal data. But the same RFID data can become personal data if it is collected or processed in such a manner as to enable a party to associate it with another set of information relating to an individual, i.e. by a nurse to track which patient has been provided with which medicine or by a drug-store to provide assistance services to patients.

Security and privacy management: All RFID systems require the development of a security management strategy which considers each phase of the whole system life cycle and each component of the system. Not all RFID systems require a privacy management strategy. Such strategy is required when an RFID system collects or processes information relating to an identified or identifiable individual, in terms of personal data (e.g. name or personal identifier), or while not personal data (e.g. object identifier) can be linked to an identified or identifiable individual (e.g. at the point of sale). In both cases, the RFID system requires a privacy management strategy which considers each step of the RFID data lifecycle, each stage of the system's life, and each component of the system.

Security risk and privacy impact assessment: Security risk assessment and, where applicable, privacy impact assessment are essential tools for managing security and privacy in relation to RFID systems. They should take into consideration the technology, the application and operational scenarios, and consider the entire life cycle of the actual RFID tags including those that remain functional even when no longer under the control of the organisation. The "Privacy Impact Assessment (PIA)" of an RFID system should consider whether it is necessary to collect and process information relating to an identified or identifiable individual. It should also take into account the possibility of linking data collected or transmitted using RFID with other data and the potential impact those linkages could have on individuals. This becomes even more important in the case of sensitive personal data (e.g. biometric, health, or identity credential data), as does the issue of protecting the data.

4.3 SWOT analysis

SWOT analysis is a method used in decision making and planning process. It helps to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. It specifies the objective of the project and identifies the internal and external factors that are favourable and unfavourable to achieving the objectives. In consist of the following components:

Strengths: added value of the consortium/ person/ company that are helpful to achieving the objective(s).
Weaknesses: features of the consortium/ person/ company that are harmful to achieving the objective(s).
Opportunities: external conditions that can be helpful to achieving the objective(s).
Threats: external conditions which could damage to the objective(s).

Identification of SWOTs are essential because subsequent steps in the procedure of planning for achievement of the selected aim may be originated from the SWOTs.[38] The effectiveness of SWOT analysis is not limited to profit-seeking organizations. SWOT analysis may be used in any decision-making situation in any kind of organizations when a desired objective has been defined. For example, SWOT is usually used by non-profit organizations, governmental units, as well as by individuals. SWOT analysis may also be used in preventive crisis management. SWOT analysis may also be used in creating a recommendation during a viability study.

4.4 SWOT analysis for the RFID-ROI-SME project

It is important to highlight that this analysis is subjective. As discussed at the methodology chapter, the approach is anti-positivistic and in the frame of the radical humanist paradigm. However, these descriptions of the environment are varying by the different observers concluding these observations. The risks are connected to future hazards that give the chance to the investigators to rely on their assumptions that derives from their background knowledge, experiences and hypotheses. This analysis was done focusing on an SME involved in the project but also taking into consideration the rest of the SMEs that have not the chance to participate in such kind of support projects.

4.4.1 Strengths

Novelty: Deploying a new technology is focusing on innovative functionalities. This innovation is an asset for a better operation and satisfaction of the employees as well as the full exploitation of RFID services.

Technology Know-How: Solution providers must be specialized in RFID integrators, with vast experience and expertise in the relevant technologies, which are going to be used. At the same time most of the technological components that will support the new technology, has to be already implemented and tested in the scope of other background research projects and/or other pilot deployments.

Diversification of risk: The new technology is deployed within the frame of a project like the above mentioned RFID-ROI-SME project, (targeting different sectors and value chains) it gives a better information flow and as a consequence, partners can help each other to understand the possible problems and solutions.

Flexibility: At the technical level, a wide range of open source solutions can be found for supporting the deployment of the new technology. If it's more complex technology, the open source solutions can be combined with licensed software.

Sustainability: If the new technology is successful and the ROI will be high in long term, the companies will maintain using the technology and this helps to have a more efficient operation.

Small equity capital of SMEs: New technology projects, supported by an organisation e.g. European Commission are generating additional chances for SMEs to deploy new technology.

Effects on standardisation: a successful project can lead to improved standards that lead to improved quality, consequently higher rate of customer satisfaction.

4.4.2. Weaknesses

Small equity capital of the SMEs: The SME market has several special features (e.g., SMEs have small equity capital and some are reluctant to innovate). Even if a project is financed by the EU, the transfer of co-financing can be delayed or dependent on bank guarantees.

Need for integration of different technological platforms (especially within the SMEs): Several solution providers have to carry out complex integration tasks, stemming from the fact that several SMEs possess proprietary (and sometimes technologically obsolete) IT platforms.

High initial costs: even if the project is co-financed by the European Commission, the pre-financing is dependent on having a bank guarantee and since the banks are not willing to give guarantee without provisions, the entrepreneur has to risk sometimes his/her own property.

Technology is not efficient: At the end of the project it can happen that the new technology does not fulfil the requirements and expectations of the project partners.

4.4.3. Opportunities

[38] Terry Hill and Roy Westbrook: SWOT analysis: It's time for a product recall

The era of economic slow-down and the increased of the need for innovation: In the current era of global recession, companies are seeking cost-effective ways for increasing their productivity, operational efficiency and competitiveness. New technologies provide a host of opportunities for improving business results.

Leading EU countries with new technology focused attention: The fact that technology (R&D) is of primary interest to many EU countries (e.g., UK, France, Germany, The Netherlands, Italy) is a positive factor for the wide penetration of the new services and solutions.

Increasing efficiency of production, trade and services: With the help of new technology the effectiveness of work can be higher so the same results can be achieved with fewer efforts and less time.

Creation of new services, new workplaces: New technology deployment promises to create range on new services, along with a set of new better workplaces (as a result of reduced human effort, accuracy, business intelligence and other benefits).

Spur for economic development: creates opportunities for contributing to overall growth and economic development at both national and EU level.

Increased convenience in citizens' everyday life: Several new applications and services have a direct impact on citizens' quality of life, increases citizen's convenience in the scope of everyday tasks.

Increased security, reliability and trust: many opportunities for increased security, reliability and trust for a variety of services and products.

Stimulation of research and development of related technologies (enabling, enhancing and concurrent): The results may stimulate research and development on related technologies.

EU expansion: The European Union has lately increased the number of its member states (and subsequent the number of end-user SMEs and EU citizens). This, along with the fact that the European Community may expand even further, increases the economic success possibilities for services systems.

EU funding: The EU co-funding of several new technology projects provides a significant boost to the development and integration activities.

Competitive advantage: deploying a new technology and having it co-funded by the European Commission is indeed a competitive advantage. While other companies might maintain their technology (e.g. because of lack of resources / information...), the partners of the project will have the chance to upgrade their system and keep the prices of their services at the same time.

4.4.4. Threats

Technological improvements in existing services and platforms: In the case where other service providers manage to offer services similar in nature, quality and results to the RFID-ROI-SME services, the consortium partners/expert will have a disadvantage.

Competitors: The provision of similar, of equal quality and options services by competitor companies, earlier than the RFID-ROI-SME solutions, will increase the difficulty of getting a respectable share of the market.

Lack of impact of an electronic/ICT based service: It is not always an easy task to predict a product's success or failure chances. Some of the RFID-enabled services offered by RFID-ROI-SME may not experience the expected customer interest from the SME side. However, the diversification of risk, existing in project, reduces the possibility of a commercial failure of all the solutions and business cases.

Many European countries with only marginal attention for RFID: While RFID enjoys good penetration in some countries, there are others that pay only marginal attention to the potential of this technology. We expect these countries to be difficult (and sometimes non-receptive) markets for the project's solutions and services.

Vulnerable image of RFID - Trust issue: RFID is frequently associated with a number of trust issues, e.g., relating to privacy, high cost and more. While RFID-ROI-SME will organize several pilots that will be assessed against the EC Recommendation on RFID privacy and security, it may not be able to overcome common misconceptions associated with trust issues.

High initial and high transition costs: The initial investment on RFID technology can be totally misleading for companies in general and SMEs in particular. This is because initial deployment may also incur significant transition costs, which may not be affordable for several SMEs (especially the smaller ones). This is a threat to the project's success, and a factor that could make SMEs reluctant to further invest in the technology (i.e. beyond the project duration).

Rapid technological evolution may help displace a technology before it is widely adopted: RFID, auto-id and related technologies are progressing in a rapid pace. There is always a slight opportunities that technological advances obsolete the technologies envisaged to be deployed in RFID-ROI-SMEs. This could limit the potential impact of the RFID-ROI-SME solutions.

High hidden costs (societal and organisational such as for training and education): The success of an RFID deployment depends on the SME's investment in complementary assets (e.g., training and education). These may constitute high hidden costs that could prevent SMEs from embracing their RFID deployment.

No level-playing field for RFID across countries: RFID-ROI-SME will attempt to demonstrate interoperability in the scope of one transnational pilot involving multiple stakeholders across value chains and supply chains. There are still organizational, management and business issues hindering transnational deployments across Europe. RFID-ROI-SME will have a hard time trying to address and overcome these hurdles.

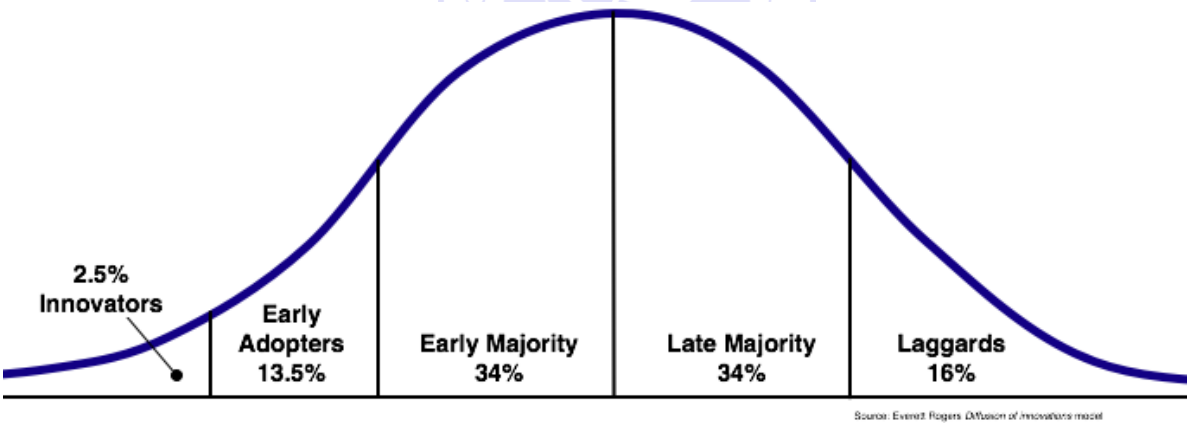
No harmonised frequency policy in the EU: RFID-ROI-SME aims at publishing pan European blueprints, case studies and best practices associated with RFID deployment (in SMEs). Still however, there are still discrepancies across national policies, a prominent one relating to the frequency policy (which varies across countries). This can be a serious set-back to the consistent dissemination of the project's results to an EU level. However, the EC has made significant efforts towards pushing harmonized and widely accepted standards at the EU level (e.g., based on the recent Recommendation about RFID privacy and security).

Possible job losses due to wide deployment: RFID automation can lead to job losses, in an era where unemployment is increasing dramatically. This can be considered another threat associated with the RFID-ROI-SME project.

4.5. Technology adoption life cycle

The technology adoption life cycle model is a sociological model that is based on a research[39], conducted by Neal C. Gross and Bryce Ryan in 1942. Later, Joe M. Bohlen, George M. Beal and Everett M. Rogers developed this model[40] according to the previously mentioned research. The model describes the acceptance of an innovative product, according to the demographic and psychological characteristics of a group of people. The process of adopting a new product on the market can be introduced as a normal distribution (bell curve). The earliest adoption of the product takes place by the Innovators. Then early adopters can be identified. These represent a higher percentage of the whole adoption cycle. However, the biggest majority is the Early and Late majority. These give almost 70% of the whole social acceptance.

Figure 4: The technology adoption life cycle



A short introduction of each group can be made:

- Innovators: people that are committed to new technology, mostly IT-education or related persons.
- Early adopters: true revolutionaries in business; want to use the newest technology, risk taking persons.
- Early majority: Less risk taking. Buy the new technology only after proven efficiency of the product. Their only interest in innovations is improving the efficiency of the system.
- Late majority: Price-sensitive, sceptical, very demanding. They do not believe that they can gain any added value from technology.
- Laggards: Not so interested in the new technology.

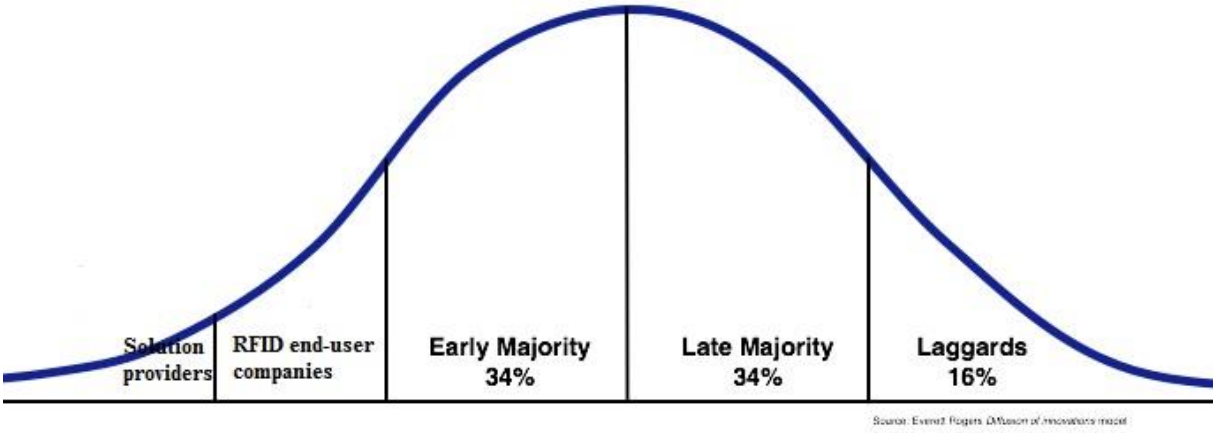
[39] Gross, Neal C. (1942) The diffusion of a culture trait in two Iowa townships. M.S. Thesis, Iowa State College, Ames.

[40] Bohlen, Joe M.; Beal, George M. (May 1957), "The Diffusion Process", Special Report No. 18, page 56-77

4.5.1. The technology adoption life cycle for RFID-ROI-SME

In this investigation, the RFID life cycle can be presented. First of all, RFID is mostly used by the governments and public transportation companies. Innovator companies (small and also medium sized) can be found all around Europe. These small companies are specialized in the RFID applications. Their know-how is the basis of innovation.

Figure 5: The technology adoption life cycle for RFID-ROI-SME



Early adopters are the companies that integrate RFID in their daily operation. These can be the transportation companies, as well as it is already used in animal tagging. And also in the RFID-ROI-SME project, all the end-user businesses are early adopters. They are taking the risk of deploying this technology, changing the previously used one and relying only on RFID. In Europe, RFID is already used by the following sectors:

Payment by mobile phones: 7-Eleven was working with Master card in order to promote the new touch-free payment system. Nokia 3220 can be used as an RFID capable Master card at any 7-Eleven[41]. Nokia 6212 has also RFID devices.

Transportation payments: In Norway and Italy, all public toll roads are equipped with an RFID payment system known as AutoPASS (Norway) and Telepass (Italy). In Ireland, the eToll system uses RFID tags for payments on all road tolls, including the barrier-free M50 toll between exits 6 and 7. Public transit: Throughout Europe, and in particular in Paris (system started in 1995 by the RATP), Lyon, Bordeaux, Grenoble, Nancy and Marseilles in France, in the whole of the Portuguese highway system and in many Portuguese public car parks, Milan, Turin, Naples and Florence in Italy, and Brussels in Belgium, RFID passes conforming to the Calypso international standard are used for public transport systems. They are also used now in Canada (Montreal), Mexico, Israel, Bogotá and Pereira in Colombia, Stavanger in Norway, Luxembourg, Gävle in Sweden, etc**.** In Gothenburg (Sweden), public transportation has used RFID cards since 2006.

Product tracking: In Berlin, Germany, the Berliner Wasserbetriebe (water treatment facility) Uses RFID systems from Psion Teklogix and Elektroniksystem-und-Logistik-GmbH (ESG) to identify and track its 60,000 assets.[42]

Animal identification: An implantable variety of RFID tags or transponders can also be used for animal identification. The transponders are more well-known as passive RFID technology, or simply "chips" on animals.[43]

[41] http://www.rfidjournal.com/article/articleview/2800/

[42] Rhea Wessel. "Berliner Wasserbetriebe Gets RFID Tagging Project Flowing". RFID Journal. Retrieved 2010-08-09. (http://www.rfidjournal.com/article/view/3110/2)

[43] http://www.thenation.com/issue/december-31-2007

These are the early adopters of RFID. As described above, the RFID is still a new technology. Its efficiency is not well proven yet in all sectors. For example, in the document tracking usage of RFID, it is a real fear that the RFID reader is not able to read the overlapping documents. These problems needs still to be solved. European projects serve this purpose. In the next chapter, the rather general, main risks will be identified when participating in a new technology project. These risks were introduced by different scholars.

4.6. Main risks identified in the new technology projects

Many of the scholars were dealing with risk analysis. Most of them identified some main groups of risks that are useful to the study. This chapter provides an overview of the most relevant concerns of these scholars.

Organizational fit: Barki[44] described a various risk factors connected to the organizational environment. This can involve the problem of task complexity, the scope of changes, resource shortage and the extent of potential loss and so on. Keil[45] developed a framework in 1998 that is dealing with the risks in the environment, namely issues over which the project officer may have no control e.g. change in the scope/objectives and conflicts among departments. These internal – but from the risk management site external – risks can lead to suspensions and blocking the project. Also Block[46] was describing the factors contributing to project failure and especially focusing on resource failures (e.g. conflicts of people, time and project scope) as well as requirement failures (e.g. poor specification of requirements). Organizational problems can be solved by informing the people in all stages and involving them.

Skills: Barki[47] and Ewusi-Mensah[48] had the same conclusion regarding the skill mixture needed in the project. According to them, the failure can be because of lack of expertise of the project manager, lack of development expertise, lack of application-specific knowledge and shortage of user experience. All these factors contribute to project risk. In Keil's framework also inappropriate staffing and personnel shortfalls are included.

Management type: Keil describes the main risk from the management side as the lack of senior management commitment. Ewusi-Mensah emphasizes the lack of agreement on a set of concrete project goals and he mentions the lack of senior management involvement as well. Block described failures in the objectives and organizational failures (e.g. lack of leadership).

Software: Risks connected to the scope and requirements of the project, include misunderstanding requirements and failing to manage amend correctly. Lack of an efficient methodological framework and poor estimation leads to cost and time overruns. Boehm[49] identified 10 software risk factors e.g. developing the wrong functions, wrong user interface, a continuing stream of changes in requirements.

User involvement: Risks in this area are the lack of user commitment, lack of effective communication with users and conflicts among user departments.[50]

Technology: Ewusi-Mensah[51] pointed out that lack of sufficient technical know-how and an adequate technology infrastructure for supporting requirements result increase in time and cost overrun and is linked to project abandonment. The risk factors contain technological novelty, application scope, application complexity and failure of technology to meet specifications.[52]

Project management: The lack of a measurement and monitoring system for assessing and managing project risk can lead to cost and time overruns. McFarlan[53] introduced dimensions of project risk assessment, based on project scope, technology know-how and project structure. Lack of a proper project management and monitoring failures (e.g.

[44] Barki, H., Rivard, S. and Talbot, J. (1993) Toward an assessment of software development risk Journal of Management Information Systems, 10(2), 203–25.
[45] Keil, M., Cule, P.E., Lyytinen, K. and Schmidt, R.C. (1998): A framework for identifying software project risks. Communications of the ACM, 41(11), 76–83.
[46] Block, R. (1983) The Politics of Projects (Yourdon Press, Prentice-Hall, Englewood Cliff, NJ).
[47] Barki, H., Rivard, S. and Talbot, J. (1993) Toward an assessment of software development risk Journal of Management Information Systems, 10(2), 203–25.
[48] Ewusi-Mensah, K. (1997) Critical issues in abandoned information systems development projects. Communications of the ACM, 40(9), 74–80.
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[53] McFarlan, F.W. (1981) Portfolio approach to information systems. Harvard Business Review, 59(5), 142–50.

caused by inadequate planning and tracking) can result improbable schedules and budgets and consequently it can lead to project failure.

Social commitment: According to Willcocks and Margetts[54] risk factors need to take into consideration usual human and organizational practices and patterns action, as well as traditional project-related factors. It is necessary to look for opportunities of using external feedback to recognize the problem more objectively, from different point of views if possible. This can involve alternatives to accomplish the goals and preparing main stakeholders for the decision – especially if the decision is an exit strategy[55]. Ginzberg carried out a study[56] regarding user expectations as they are predictors of project's success or failure. In his findings he recommended that systems implementation failure is more probable when there are expectations about a system that are not realistic. With more realistic expectations users will likely to be more satisfied with the project's outcomes. As it can be seen in this chapter, the whole process is influenced by users, management and additional experts. In this social environment, flexibility is a key feature. It is very important to monitor the process and act and correct the possible deviations from the original plan. In the next Chapter the main risks of the new technology project will be introduced. The risks will be introduced on three levels, namely overall, inside the consortium and inside each pilot.

4.6.1. Overall risks

Overall risks are given the risks that are given by the economic/social/legal/technological situation. These factors are external, one organisation (especially SME) is not able to influence it. In this section, these risks will be introduced. Mitigation plans are not made for this chapter because external factors can't be influenced.

Table 4 Overall risks

Type of risk	Examples
Legal risks	• Data protection guidelines • Access rights • Bureaucracy • Legal and regulatory changes
Arrival of new technologies	• Makes the RFID obsolete or less effective than originally planned
Overall economic environment	• Access to finances for SMEs • Overall economic climate • Country-specific features, changes or limits
Low interest by stakeholders	• sustainability problems • Trust issues in some countries • investment and resource demands

Legal risks: Data protection guidelines: Each partner has to be aware of the law regarding data protection. The European Commission made a draft proposal on submitting a Privacy Impact Assessment[57] six weeks before the deployment of the new technology. Each partner plan how to deal with the data that is processed and set up monitoring mechanisms afterwards. Any lack of this can cause risk for the partner as well as for the whole consortium, and project.

Access rights: Some of the intellectual property is protected (copyrights, patents and so on) and thus cannot be accessed. Partners can only access technological tools from legal sources and use the background technology of another partner only with the permission of the partner. Each beneficiary shall bear sole responsibility for ensuring that their acts in connection with this project do not infringe third party rights and thus are legally sound operations.

[54] Willcocks, L. and Margetts, H. (1994) Risk assessment and information systems. European Journal of Information Systems, 3(2), 127–38.
[55] Keil, M. and Montealegre, R. (2000) Cutting your losses: extricating your organization when a big project goes awry. Sloan Management Review, 41(3), 55–68.
[56] Ginzberg, M. I. (1981) Early diagnosis of MIS implementation failure: promising results and unanswered questions. Management Science 27(4), 459–78.
[57] Draft Industry Proposal Privacy and Data Protection Impact Assessment Framework for RFID Applications, March 31 2010 (http://ec.europa.eu/information_society/policy/rfid/documents/d31031industrypia.pdf)

Bureaucracy: In some countries and also at EU level, bureaucracy is high. Business plans, requirements and all the changes during the project's duration have to be documented. If there is a partner inside the consortium that is not willing to do so, this could cause delays and lowers the overall quality and legitimisation standards of the project's work.

Arrival of new technologies: Making the RFID obsolete: Technologies relating to the perception of RFID solutions are evolving at a rapid pace. Therefore, there is always a slight probability that another new technology emerges that obsoletes certain background components of the project. RFID-ROI-SME commits to monitor such developments (through the technical management team), being also ready to adapt the initial plan with a view to incorporating new developments that could beneficial to the project's success. Technologically the project must be aware of advancements and affecting factors and developments. It is also noteworthy that the modular architectures and evolution plans of the project do not depend on particular technology. Also, they do not rule out the incorporation of new technology developments. RFID is an environment-sensitive technology (with radio waves and hardware affected by other equipment and metals in range) and so each pilot trial needs to consider this throughout. Case studies would benefit from considering environmental factors so that any business model or system that arises would pass tests when applying that model in other locations or business sectors, where possible.

Overall economic environment: The conditions for SMEs to obtain the financial guarantee and a support at the beginning of the project are in some countries still not good. Banks are not willing to give loans if there is no collateral provided. In the time of the recession and financial crisis, SMEs have to be aware of the changes in the overall economic climate and plan their finances carefully.

Low interest by stakeholders: In some countries RFID technology is not so wide-known and companies are not provided with the information of all the advantages of using RFID technology. Relevant case studies (especially SME or country specific) and information guides are hard to find, most of the time are not free and thus make the understanding of RFID even less accessible. An aim of the project is to address this through dissemination. Even if all the pilots are successful in the project, it is still not sure that the relevant audience (SMEs) are interested in deploying this technology, or if it is financially viable.

4.6.2. Main risks inside the consortium

Risks within the Consortium involve risks related to the common work and the interactions of the partners and the coordinator. The European Commission requires the Partners to deliver some documents explaining the work carried out and the costs related to the work, from time to time. These reports are called "deliverables" and the co-financing is only offered if the deliverables are prepared properly. So the coordinator and all the partners have to report to the European Commission in order to maintain the quality of work. To identify the impact and the likelihood of each main risk, the probability and impact will be introduced to the table. It will be on a 1 to 5 scale, where 1 is the lowest and 5 is the highest rate. Each of the risk will have these two indicators and later the Staffordshire Community Risk Register matrix will present all the related risks.

Table 5 Risks within the Consortium

Type of risk	Examples	Mitigation
Pilot risks' effects (PRE)	• PRE1: failure of a pilot affects dissemination, finances (I: 2,P:4) • PRE2:partner exits the project (I:2,P:3) • PRE3:new partner enters the Consortium, and thus its effects on the others (I:3,P:1)	Modification of GA, trying to find another suitable partner/ providing all the relevant information to the new partner and quality risks
Communication risks (CR)	• CR1:insufficient communication inside the Consortium (I:4, P:3) • CR2:incomplete reporting to the project and/or pilot co-ordinator(I:4,P:2) • CR3:Not communicating the problems occurred during the project to the Coordinator (I:2, P:1)	Creating different source of communication (mailing lists, teleconference, Google Docs...)
Risks related to deliverables (RRD)	• Poorly prepared deliverables (I:5,P:3) • Late contributions (I:3,P: 2) • delayed submission (I:4,P:1) • not matching requirements(I:2,P:3)	Reminders, enhanced communication, emphasising the consequences. Correct and fair and transparent Project Management team.

Problems with background technologies (PBT)	• not mature enough(I:4,P:1) • not performing as expected (I:3,P:2) • technological issues (I:3,P:4)	
Co-ordination of the pilots given the number of users and scale of the pilots (COP)	• high number of pilots (I:1,P:1) • management problems(I:3,P:1) • communication (I:5,P:1) • risk and problem solving (I:2,P:2) • documentation (I:2,P:2)	

Pilot risks' effects: If a pilot fails or does not manage to deploy RFID with a positive ROI, the project will continue but since the outcome is not positive, it has a negative effect on dissemination. Termination of the participation of a partner. Unforeseen circumstances have in several other projects pushed partners to abandon even successful projects. This could result in missing expertise at levels that could compromise the project's results. Overlapping technology providers, as well as the inclusion of multiple pilot sites and organisations will make sure that the project's success is not the jeopardized for the duration of processes relating to attracting new competent partners.

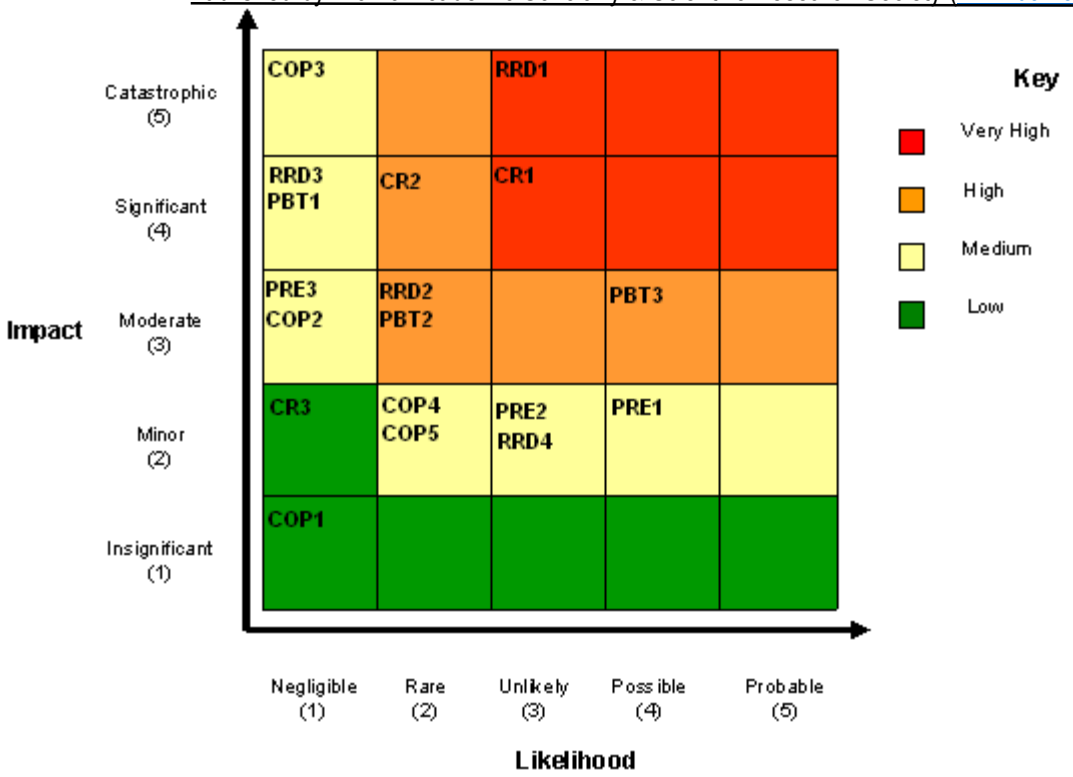
Communication problems: Communication among the partners and between a partner and the Co-ordinator is important. If there is a problem, it has to be reported to the Co-ordinator as soon as possible. The Co-ordinator has to give as many manners for communication and sharing information as possible.

Risks related to deliverables: Each project partner is responsible for delivering its contributions to the deliverables on time and leading the WP it is responsible for maintaining the quality of work. If a partner fails to do so, the submission is delayed and the EC can postpone the payments. Poorly prepared contributions and deliverables. Each contribution has to be reviewed by the WP Leader. The Leader can suggest the partner to revise the text and offer assistance if the partner is not fully aware of its task. Poorly prepared deliverables are not accepted by the EC and have the same consequences as in the previous paragraph. Mitigation for this risk can be the enhanced communication and providing assistance among the project partners/ partners inside a WP.

Problems with background technologies: The most relevant deliverables of the project depend heavily on existing components and technologies contributed by project partners. There is a possibility that some of these technologies are not reliable/mature or even not performing as expected for the particular tasks at hand. RFID-ROI-SME is prepared to tackle such problems based on the synergy of remedial actions featuring diverse nature, in particular: At the consortium composition level through a sufficient level of expertise with regard to the development, deployment and support of RFID solutions and at the technical level through specifying modular architectures of the RFID-ROI-SME solutions. These architectures will minimise RFID-ROI-SME dependencies on underlying technology components.

Co-ordination of the pilots given the number of users and scale of the pilots: RFID-ROI-SME includes eight pilots' sites in six countries. This results in a challenging and demanding co-ordination exercise both for the co-ordinator, as well as for organisations coordinating the pilots locally. In such a distributed and international environment there is always a slight possibility that pilot preparation or deployment in a site is delayed. The inclusion of the pilot sites ensures that a sufficient number of other sites will be available to serve the project's goals; this eliminates the consequences of the delayed pilot for the RFID-ROI-SME project.

Figure 6 Staffordshire Community Risk Register matrix -risks within the Consortium



As the Figure 4 shows, Risks are mostly in the yellow and orange zone that means that there is a balance. The most possibly occurring risks have a maximum moderate impact, while the risk with the most catastrophic impact is located in the Unlikely area. As there is no risk that is possible and significant or catastrophic, the risks within the consortium are bearable. Most of the very high impact risks are related to deliverables and communication. The project manager has a key role to mitigate these risks with enhanced communication and clarifying the exact task of the partners.

4.6.3. Main risks within each pilot

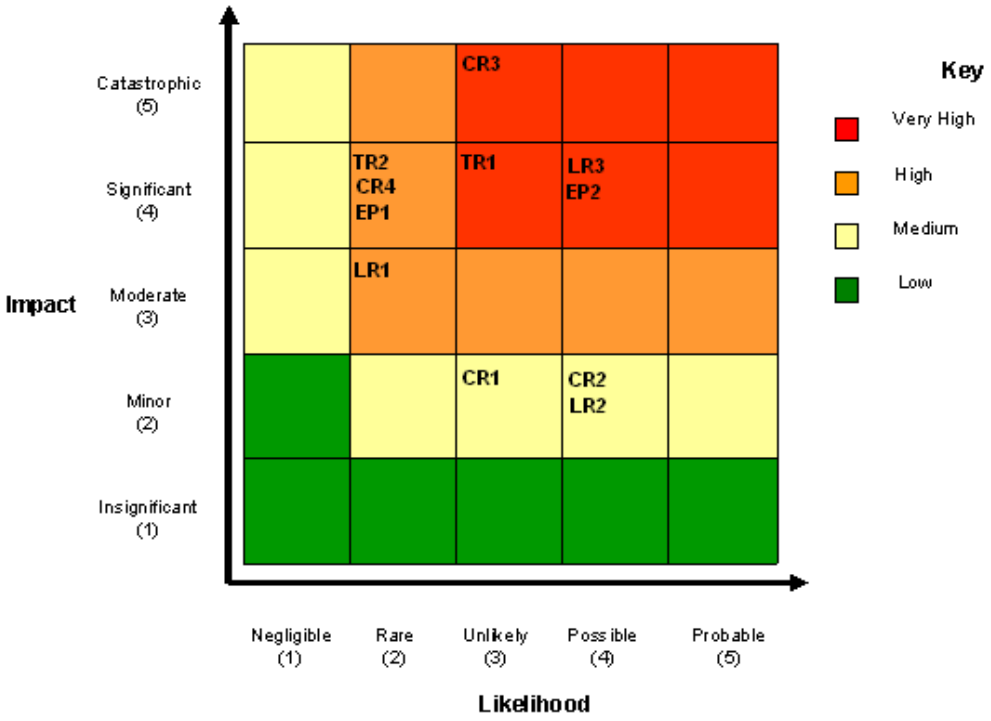
Within the different pilots other risks can arise. These risks are collected in Table 5.

Table 6 Risks within each Pilot

Type of risk	Examples	Contingency plan
Technological risks (TR)	• open source solutions are not mature or usable enough (I:4,P:3) • inappropriate facilities(I:4,P:2)	Monitoring, testing, communicating, looking for alternative solutions
Commitment risks (CR)	• poor involvement by partners/ quitting the project (I:2,P:3) • other business concerns (I:2,P:4) • poorly prepared deliverables (I:5,P:3) • lack of commitment of the employees (I:4,P:2)	Monitoring by the co-ordinator, increasing communication with the help of different tools (e.g. telephone conference, pilot site visits)
Legal risks (LR)	• access rights (I:3,P:2) • bureaucracy (I:2,P:4) • problems related to get a financial guarantee (cash flow, investment etc) (I:4,P:4)	Procedures according to consortium agreement.
Economic problems (EP)	• low return on investment (ROI) (I:4,P:2) • payment defaults (I:4,P:3) • high TCO (I:4,P:3)	Analysing the outcomes and the possible substitution solutions

As done in the previous part, risks are presented the same way, in the Staffordshire Community Risk Register matrix.

Figure 7 Staffordshire Community Risk Register matrix - risks within each pilot



The Staffordshire Community Risk Register matrix shows the Likelihood (probability) and the Impact of each risk. As it shows, within the pilots almost half of the risks are in the red area. Most of them are Technological risks but if it would be a non-co-financed project, the implementation would be very risky. First of all because of the economic problems and the probability of failure and secondly because there would be no help with the management, no exchange of ideas regarding implementation. With the help of the project, a Coordination team helps to remind the partners of their tasks (mostly legal obligations) and also the different solution providers in the countries can exchange their technology solution ideas and help each other to solve problems if needed. It is important at the beginning of the project for the relevant partners, to set requirements. In the next chapter, these key requirements will be introduced.

5.0 Conclusions

As conclusions for risk assessment, best practices will be introduced. This is a very simple but clear list as the result of the analysis. As the chosen approach was subjective, the involvement of the different interest groups is essential. Objectivity is the aim but it can be never reached. The list is the following:

1. Create a list of requirements and expectations discuss with the management team. It is very important to discuss with the relevant team members e.g. technicians and the management. Expectations should be reasonable and realistic. (See Chapter 5.2.)

2. After knowing the expectations, try to draft the main risks of the project. Theories and different models (e.g. Technology adoption life cycle. see Chapter 5.5) can help and the researcher has to take into account the result of these investigations as well. People that are involved in creating a list of risks are more aware of the risks during the process. The more people are involved, the better the list will be. Anyone can have a good idea to add to the list. Develop a sense of caution and importance concerning risk areas. (See Chapter 5.6.2.)

3. Developments of practices within the organization are important in order to be aware of risk areas, and dealing with them constructively rather than thinking of risks as a bad considering them something negative. The risks that are not discussed will not be guarded against. The real problem is when there is an incoherent attitude concerning risk across the team. Risk is a challenge and every involved co-worker has to develop solutions in case of a risk occurs. (See Chapter 5.6.3)

4. Follow the status of risk areas during the project. It is important to follow the risks and create a system or make a person responsible to monitor the key risks when reaching the milestones in the project. Try to make a graph which shows the risks in a simple and very understandable way (e.g. with colors as seen in Figure 4 and Figure 5) and review it frequently.

5. There should be a process where anyone in the project can learn about the current status of risk areas. There should be frequent project reviews that involve a level of management, also in higher levels. Reporting on risks and making them more transparent is a very good tool to make the others follow the changes and being more involved in the risk management. Important is to present the risks in a simple way so everybody has the same understanding on what is the current status of risks.

6. Create controls to deal with the introduction of new risks. Brainstorming is always a good idea, also in smaller groups. Regular meeting in small groups help to discover the risks and to find out tools to mitigate them.

7. Establishing a progressive change control strategy, meaning a continuous supervision of risks and change in the risk assessment if necessary. Possibility to make modifications in the plans as well as transparency is very important.

8. Limit the scope and degree of project commitments until the risks are mitigated. Set up a list of milestones and the risks related to them. Also impact and probability of the risks.(see Table 4 and Table 5)

9. Try to avoid making promises to the higher management until the risks are not mitigated to a very low level. Do not promise higher revenues or positive ROI if the risks are apparent even if only on a low level. (The real ROI of an investment can be only seen in long term.)

Also, look for an exit strategy that allows the project to be cancelled in case it becomes obvious that the risks are too big relative to the rewards.

10. For each risk driver, look for a strategy that will allow that element to be dropped from the project if it turns out to be too difficult to solve the problem. Consider moving risky components to make them optional to install. If risky components are not possible to be ejected, they can drag the complete project down. Make differentiation between risks that have a big impact with high likelihood and risks that are not so threatening. (See Figure 4 and Figure 5).

In addition to these points it is important to have a proper methodological framework. To know if the person responsible for the risk assessment has the relevant knowledge, if the data the observer collects are valid for the research and also the expectations and requirements of the management. For small companies that not necessarily have the relevant knowledge of risks identification and management, hiring an external person would be a good solution. An external person can introduce qualitative risk assessment and with this it creates a good practice in the company

5.1 Limitations

The thesis is focusing on the risk management in new technology deployment projects. As an example it will introduce the RFID-ROI-SME project, funded by the European Commission, with the starting date of the 1st March 2010, duration of the project is 2 years. In the methodological perspective, the system approach is chosen by Abnor, I. and Bjerke, the actors approach and analytical approach will be not introduced. Also other methodological approaches were involved, further to these views, the Burrell and Morgan definitions and distinctions are introduced. Regarding the risk analysis, the main risks identified in the project and the mitigation plans are usually more detailed. In mitigation plan naming the responsible person as well as the concrete action to prevent the risk gives a higher level of safety. In this thesis the mitigation plans are more general and involve less concrete actions because of lack of information and the limited technological background of the researcher. In the technology adoption life cycle model,

the number of companies that are currently deploying RFID technology could not be identified because of lack of sources. The information of the RFID-ROI-SME project can be found at www.rfid-roi.eu / www.rfid-roi-sme.eu. Further information will be not used in order to ensure data protection.

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