D9.2

Risk Assessment Plan

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Abstract:	The risk assessment plan shows how potential risks are assessed and mitigated in order to avoid any negative influence on the M3TERA project objectives. The interrelated risk assessment plan – risk identification, handling and monitoring – were established.
Keywords:	risk identification, risk assessment, qualitative risk analysis, quantitative risk analysis, risk monitoring, contingency plan

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Editor

Martina Truskaller (TEC)

Contributors (ordered according to beneficiary numbers)

Sandra Moschitz, Jan Seda, Michael Höberl (TEC)

Umer Shah (KTH)

Franz Dielacher, Diana V. Pop (IFAT)

Yinggang Li (ERICSSON)

Itziar Maestrojuan (ANTERAL)

Herbert Zirath (CHALMERS)

John Faserotu (CSEM)

Executive Summary

The M3TERA risk assessment plan describes how the project contemplates to manage risks, intends to predict risks, estimates impacts and defines mitigation measures. It outlines the management components, the approach and tools used. In order to be aware of the central project activities in relation to the project timeline, the critical path of M3TERA has been defined. Within M3TERA, the iterative and interrelated steps of risk identification, risk analysis and monitoring as well as risk handling are accompanied by easy-to-use tools, clear responsibilities and efficient communication channels towards effective risk management. On this basis, a probability/severity matrix supports the regular qualitative evaluation of risks. As the M3TERA consortium is aware of the swift changing environment it is contributing to, risks are regularly monitored, mitigation plans updated and actions taken, if necessary.

This document outlines the risk assessment procedure established within M3TERA based on scientific theoretical background, including project-specific risks and the latest status of them.

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Chapter 1 Introduction

"Avoiding rocks on the road to success" [1] - following this guiding principle, the M3TERA consortium has established an effective project risk management strategy to avoid tripping over rocks on the road to successfully reach the planned project outcomes or go even beyond.

M3TERA is a unique, innovative H2020 project, which envisions the wide-spread use of low-cost THz technology in our society, enabled by the proposed micromachined heterogeneous integration platform, which provides an unprecedented way to highly-integrated, volume-manufactuable, reliable, reconfigurable, and cost-and energy-efficient submillimeter-wave and terahertz (THz) systems. Developing and dealing with such an ambitious and highly innovative project, only *"innovation, fused with an agile, sophisticated approach to risk management, can create a powerful, value-driving partnership."* [2]

According to the ISO 31000 standard on risk management, a **risk** can be defined as an "*effect of uncertainty*" towards parts of objectives. An effect is described as a positive or negative deviation from the expected work-plan. Every step towards the project objectives has an element of risk that needs to be managed. [3]

In the context of risk management, **uncertainty** exists whenever the knowledge or understanding of an event, consequence, or likelihood is inadequate or incomplete. [3]

Risk management describes a coordinated set of activities and methods which supports the control of risks that may affect the projects ability to achieve part of its objectives. The project risk management process is meant to form part of the project management routine at all stages of the project lifecycle. [3]

In order to raise awareness for the central project activities and as a starting point for risk management, a critical path has been defined, which is described in Chapter 2. Failing to follow a structured project risk management process for projects in a self-disciplined manner would quickly lead to project failure. [1] Therefore, within M3TERA a clear structured process of risk identification, risk monitoring & analysis and risk handling has been established (see Chapter 3). This process already started with the risk identification during the proposal phase, continued in all process steps within the first year of the project and will accompany M3TERA throughout the project's lifetime. In order to settle this process as a vital one, communication as well as easy tools turned out to be critical factors. Chapter 4 displays the practical risk assessment of M3TERA including an evaluation of probability and severity as well as mitigation plans for defined risks. Section 4.10 is concluding and summarizing the way M3TERA is dealing with risk management and how it will be continued.

Chapter 2 Critical Path of the Project

As a starting point for risk management, the critical path of M3TERA has been defined in order to be aware of the central project activities. The critical path determines the targeted time to complete the project and the critical activities, which might be able to threaten the project objectives. The items of the critical path are mostly reflected by project milestones, presenting central and critical achievements during the project lifetime.

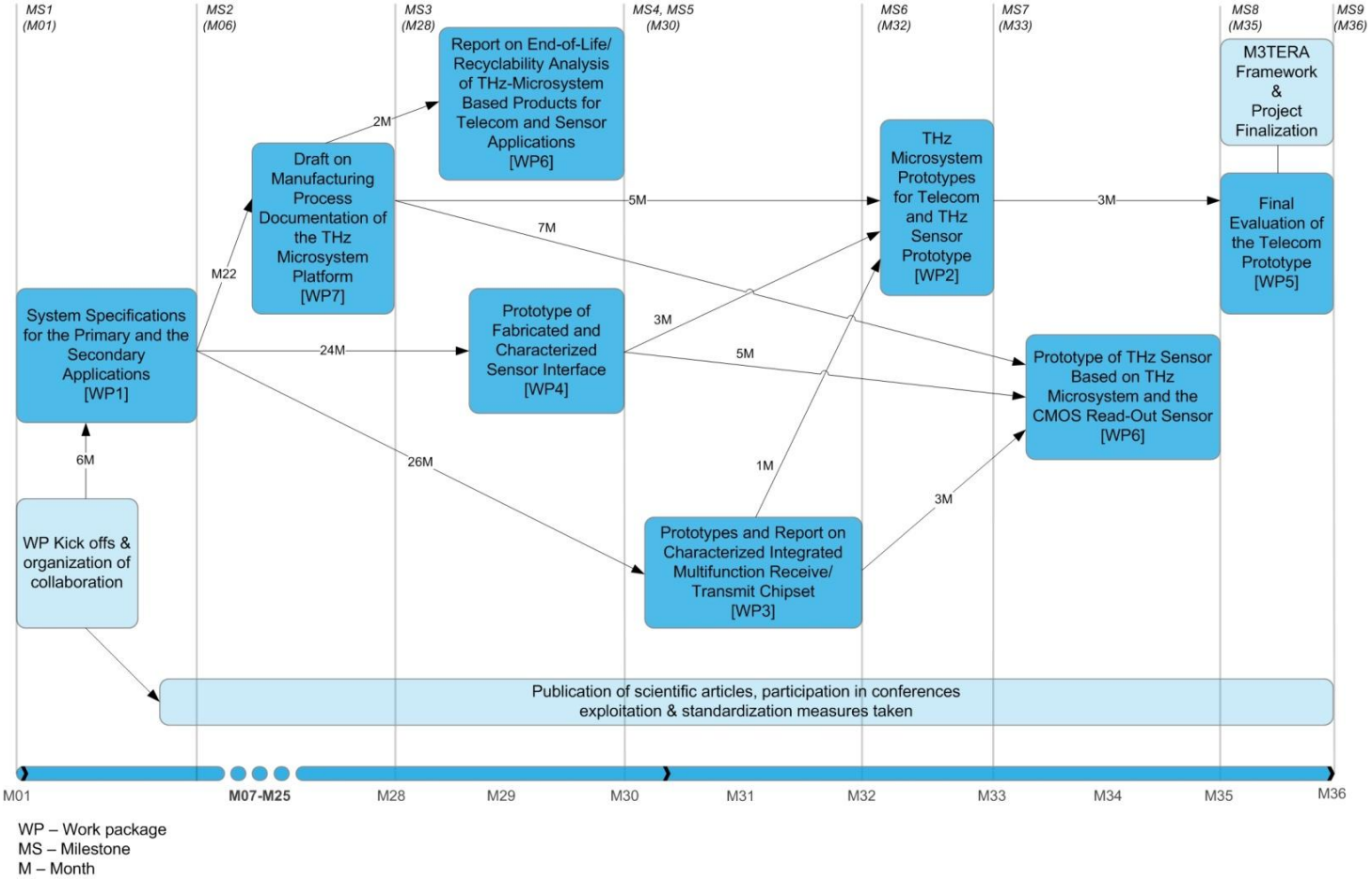

Figure 1: M3TERA Critical Path

Figure 1, as shown above, indicates the key activities of M3TERA that must be completed in order to meet the planned objectives successfully and on time. The critical path analysis helps the consortium to monitor whether the project can be completed on time and as it progresses, to keep the project's completion on track and ensure that deliverables are ready as scheduled. A good part of the critical items and activities are located rather in the final project phase. Therefore we focussed especially on this period (M25 – M36) in the illustration above, in order to enable more detailed overview of the items in the project finalization phase. Besides the critical path, which the consortium is challenged to pass on risks will occur on different project levels and might influence the projects' development and strategic direction. Therefore, the critical observation and examination of risks got a central role during the project lifetime. The following chapters focus on the risk management process established within M3TERA.

The project can be divided into three phases – the first phase is represented by overall system specifications between milestones MS1 (M01) and MS2 (M06); the second phase between MS2 and MS3 (M28) involves research as well as manufacturing activities of the defined building blocks from the first phase; and the third project phase from MS3 to the final MS9 (M36) collects and uses the outputs from the second phase to finalize the project. Therefore, the boxes in the graphical illustration in Figure 1 represent only the important project milestones and their corresponding work package. Nevertheless, the work packages are ongoing and are active throughout the entire project.

Figure 1 illustrates that after a successful project kick-off in March 2015, the M3TERA partners focused on the application and technology specifications within WP1. The final specifications were completed in due time and the second project milestone was successfully reached in July 2015 (M06). Besides that, the project partners have been intensely working on other WPs, in order to continue with the progress and to reach upcoming milestones. The most critical parts of the project will be *"Prototype of Fabricated and Characterized Sensor Interface"* within WP4 due in M30, and "*Prototypes and Report on Characterized Integrated Multifunction Receive/Transmit Chipset"* within WP3 in M32. The right timing of the project is highly dependent on these WPs, and therefore, the partners will pay special attention to them. Further, the project consortium will publish scientific articles and present the project to external stakeholders. In conclusion, it can be said that M3TERA followed the critical path of the project very well until now and managed to handle and continuously assess the identified risks (as explained in the tables in Chapter 4) within the consortium.

Chapter 3 Risk Management Procedure

This chapter is focussing on the risk management procedure that systematically applies management policies, processes and practices on project activities.

Within M3TERA we basically established a risk management framework including three major strides, which are correlating and interacting continually:

- Risk identification (Section 3.1)
- Risk analysis & monitoring (Section 3.2)
- Risk handling (Section 3.3)

The set up of the risk management process needed to be aligned with the project objectives and might be adjusted if required due to changes in the research objectives. The risk management procedure has been established around the routine project work and is accompanying the project through its lifetime. Figure 2 indicates that project stakeholders (EC, related projects, suppliers etc.) and the project environment (regulations, duties, etc.) form the outermost layer, are influencing causes of risks, which may impact the project collaboration with the project objectives in the centre of attention.

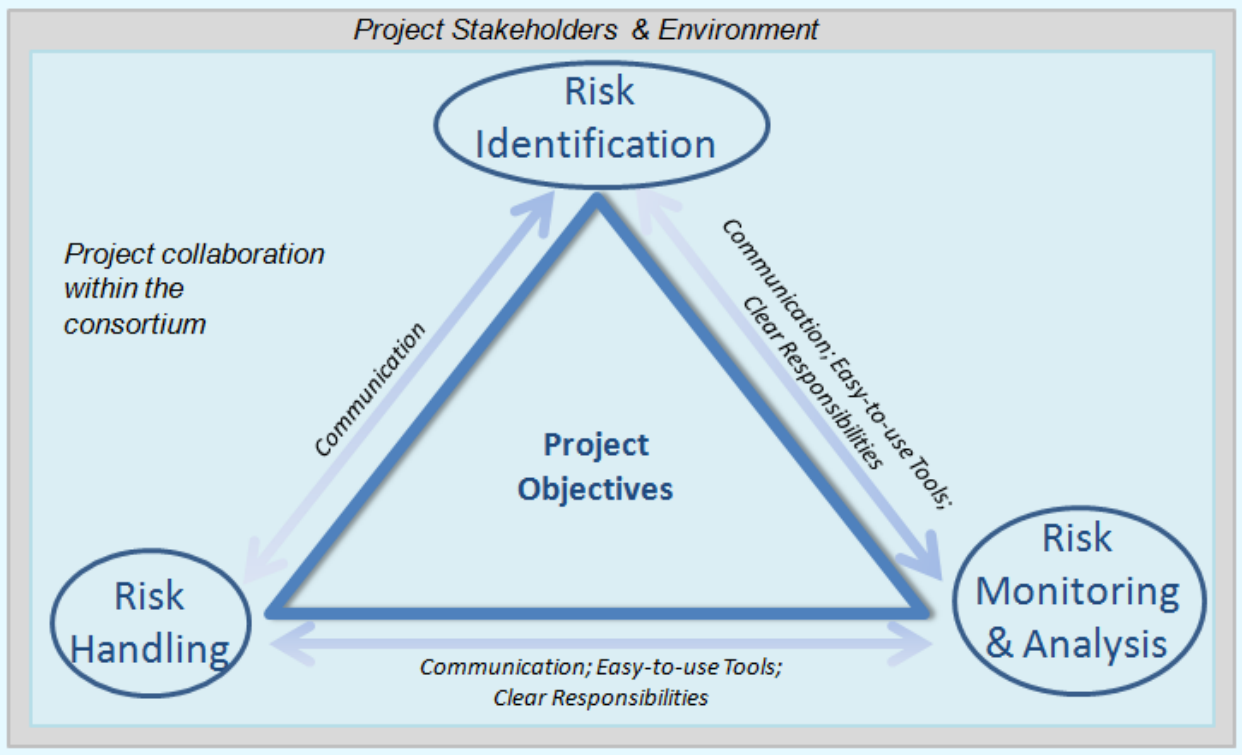

Figure 2: Risk Management Procedure

Taking into consideration all project-environmental factors, channels to allow the efficient implementation of the three major steps in the shown risk management procedure, needed to be established. On the one hand, a clear structure for communicating risks including clear responsibilities are required and need to be assured with all partners. On the other hand, it has to be easy for the partners to perform risk management by themselves through easy-to-use tools.

How the above mentioned tools and steps have been integrated into the project and how they will support to mitigate negative consequences for the project will be described within the following subchapters.

3.1 Risk identification

"Risk identification is a process that is used to recognize, find, and describe the risks that could affect the achievement of objectives."[3]

The target of risk identification is being aware of possible risk sources in addition to the events and circumstances that could affect the achievement of objectives. Further, it includes the identification of possible causes and consequences.

The identification of risks started already during the proposal phase. When developing the idea for an innovative technological advancement, it needs to be formed the way it creates the most value at an acceptable level of risk. For the identification of risks in such a highly innovative field it is necessary to have experts, who understand on the one hand, the technical challenge and its impact and have on the other hand deep insights to the industry and market needs. The project consortium unifies all these know-how in its consortium and is therefore, capable of identifying the risks for the innovative action pursued in M3TERA.

Risk identification has not terminated after the proposal phase, but it is rather a continuous process of attaching awareness for potential risks. To address this awareness best, the consortium defined the WP Leaders as risk managers for their WPs. The WP leader is an expert in the field his or her WP is concentrating on and therefore, the most capable person to identify risks. On project level, the technical lead (IFAT), the scientific lead (KTH) and the coordinator (TEC), pay close attention to the identification of potential risks. This structure and distribution of responsibilities allows the continuous identification of new risks and encourages the discussion of potential risks within telcos, face-to-face meetings and the WPs themselves.

The risk table shown in Chapter 4 allows all partners to add new risks at any time. Additionally, we ask them to pay special consideration on risks on a regular basis within the Interim Management Reports (IMR).

3.2 Risk analysis & monitoring

"Risk analysis is a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist. To monitor means to supervise and to continually check and critically observe - it means to determine the current status." [3]

The process of risk analysis and monitoring is iterative, which means that the risks are evaluated, mitigation measures are re-considered and updated, if necessary, as well as the progress, are monitored on a regular basis. Interim Management Reports (described in Section 3.2.2) serve as main tool for regular analysis and monitoring.

Before setting up the structure and requesting inputs from the project partners, the consortium faced the challenge of making our risks measureable and tangible. While a merely quantitative approach is not applicable due to the high degree of innovation, a pure qualitative approach would be hard to evaluate. Therefore, a mixture of quantitative and qualitative elements has been chosen and is described in the following Section 3.2.1.

3.2.1 Quantitative and qualitative approaches to risk analysis

"Qualitative Risk Analysis assesses the priority of identified risks using their probability of occurrence, the corresponding impact as well as other factors such as the time frame and risk tolerance. When using quantitative analysis the risk level can be estimated by using statistical analysis and calculations combining severity and probability." [3]

While qualitative risk analysis is performed for all project risks, quantitative risk analysis has a more limited use within the M3TERA project, based on the type of project risks, and the limited availability of data to conduct a quantitative analysis.

Our quantitative analysis of risks is using a probability and severity matrix to prioritize the risks. The WP leaders are asked to indicate probability and severity of the stated risks, which have been identified in the previous step.

Probability describes the relative likelihood that a risk will eventuate. It can be defined, determined, measured objectively or subjectively and can be expressed either qualitatively or quantitatively.[3] The probability may be dependent on various factors like the project environment, consortium characteristics, external effects, technological breakthroughs etc. For the evaluation of the M3TERA project risks the following classifications were defined:

- **High** – More than *<70%>* probability of occurrence
- **Medium** – Between *<30%>* and *<70%>* probability of occurrence
- **Low** – Below *<30%>* probability of occurrence

Severity defines the effects and consequences, a project may face in case of risk occurrence. The severity may be influenced by various risk triggers arising from the project environment, consortium characteristics, external effects, technological breakthroughs etc. and may affect the technological and financial performance as well as the schedule of the project. [3]

- **High** – Risk has the potential to greatly impact the projects technological and financial performance as well as the schedule
- **Medium** – Risk has the potential to impact the projects technological and financial performance as well as the schedule
- **Low** – Risk has relatively little impact on the projects technological and financial performance as well as the schedule

Classifying risks with the indicated scale, allows the appraisal if any action might be needed. The qualitative analysis further includes the assessment if a risk did materialise as well as an explanation for the current situation. This is needed as basis for the decision if any measures need to be taken in a further step. The description of the current risk status also supports the deeper understanding and specification of the risk. At this point quantitative elements step into. The detailed assessment of the risk may include explanations of further effort requests, additional expenses etc. needed to deal with the risk consequences, which makes it quantitatively measureable.

The practical implementation of the qualitative and quantitative analysis within the M3TERA project can be found in Chapter 4.

3.2.2 Interim Management Reports

Interim Management Reports (IMRs) serve as continuous internal quality control and risk monitoring and assessment tool. IMRs have been established by the coordinator TEC, in order to ensure that the work progress and the efforts spent are reasonable and in line with the expectations. It also supports the early recognition of deviations and potential risks for the project. In order to use the IMRs also as preparation for the Periodic Reports, the partners update dissemination and exploitation activities as well, which also implies the continuous update of the project website and social media accounts. The structure of the IMR includes reports on the following key points:

- Explanation of the work carried out by the beneficiaries and overview of the progress including use of resources and deviations;
- Project meetings;

- Dissemination, Exploitation, Standardization and Cooperation activities;
- Risk Assessment;

The structure proved to be effective in various projects and turned out as an easy management tool accepted by all project partners. The IMR requests partner inputs after each quarter. It is collected and compiled by TEC. The cumulative outcome gives an overview to all partners about ongoing project issues and makes them aware of potential upcoming challenges.

Further, the IMR allows a check if the partners work is performed as planned in the DoA. This also minimizes the risk of underperforming partners, deviations in terms of efforts and allows early detection of potential delays. Furthermore, regular Executive Board telephone conferences give an update on the WP status and the partners' work, which allows the assessment and identification of further risks.

The effort reported (PMs/partner/WP) in the IMR is collected in a cumulative table over the quarters, which generates diagrams for a swift and easy understanding of over- and underspendings per partner as well as on WP level. In this way the critical key indicators in terms of efforts are presented at one glance and possible actions can be taken in due course.

Risk assessment includes the evaluation of the already stated risks according to the current status of the project by the WP leaders as well as the additions of unforeseen or potentially upcoming risks. Those inputs are included into the overall risk map and due to the evaluation it will then be decided if it is necessary to request measures (risk handling – Section 3.3) or to iteratively continue with the analysis and monitoring process.

3.3 Risk Handling

The process of risk handling starts, once a risk is assessed as likely to occur (medium/high) and has impact (medium/high) on the project. At this point a WP leader correlates with the technical leader and the coordinator to define

- if countersteering measures need to be taken, and
- which project level (project bodies) will be appropriate to deal with the risk.

Basically, the WP leader correlates with the technical leader and the coordinator regarding the risk which occurred or is expected to occur. If it has no major impact on the project and appropriate actions can be taken by the WP leader, the risk will be handled at this level. In case a risk is expected to create major impact on the project, the Executive Board (EB) or the General Assembly (GA) will be involved. In case of substantial risks, EB and GA also correlate with the Project Officer.

Therefore, the structure of the project bodies and the clear definition of responsibilities for each project body, defined during the proposal phase, have been proven and allow clear and swift communication of risks. In Figure 3 an overview of the defined project bodies and their field of responsibility can be found.

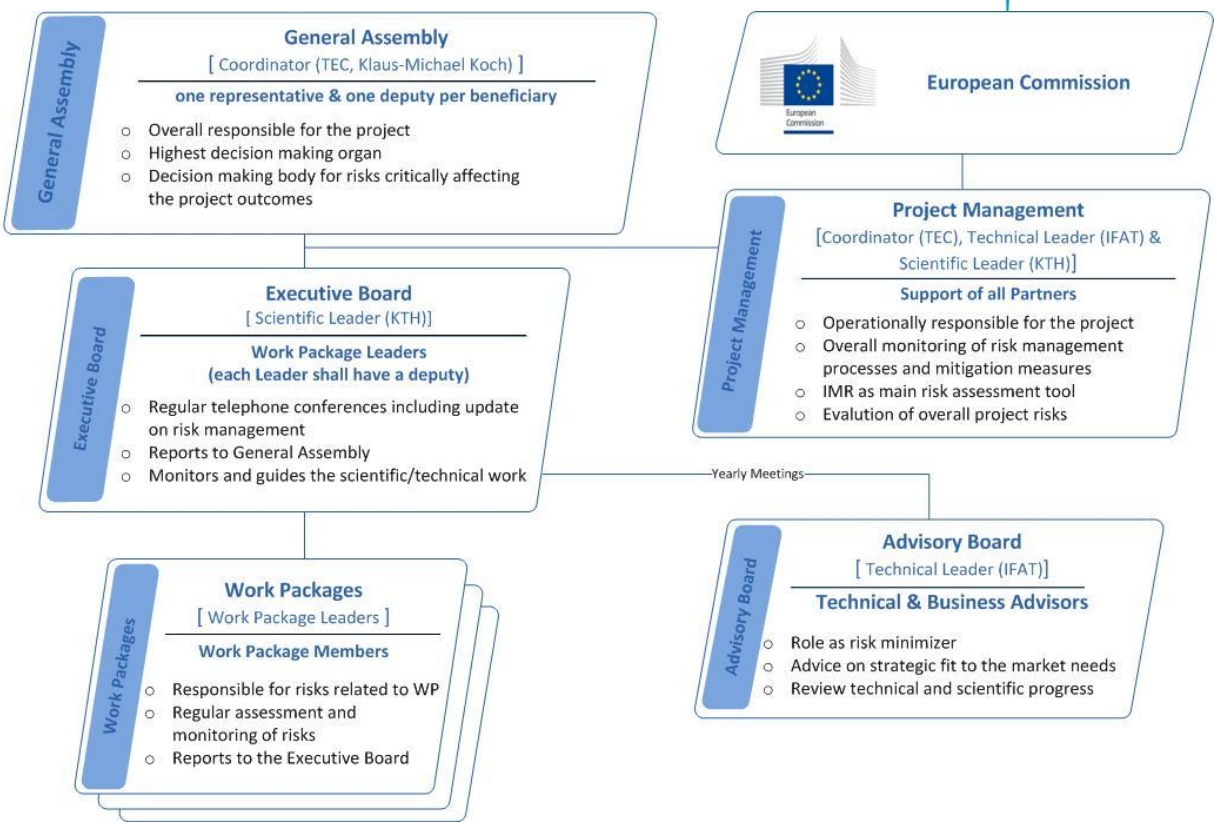

Figure 3: Project Bodies in M3TERA

The governing culture of M3TERA is based on democracy, co-determination and clear leadership. Each body will operate on separate levels and have its own area of responsibility and decision-making power. Based on the expected impact of a risk, the coordinator will assemble the EB or GA in a telephone conference to discuss countersteering measures. For risks affecting the overall strategy, which may threaten part of the project outcomes, the GA, as the highest decision making body will deal with this risk. Risks causing minor delays or minor changes in the work plan will be handled by the EB.

The GA and EB members are experts in their fields and therefore, capable of estimating the effects of the risks as well as of countermeasures. The responsible body discusses if the already proposed mitigation plan is still suitable or if other actions need to be taken or are more suitable to the risk occurred. The decision regarding the countermeasures will be taken according to the voting rules defined in the Consortium Agreement (based on MCARD model). Basically, the WP leader will be in charge of appropriate realization of the defined risk mitigation measures. All applied measures, arising challenges or chances will be documented in the risk table.

Beside the decision making bodies in the M3TERA structure, an Advisory Board supports the consortium with external, unprejudiced view. This can also be seen as a risk minimizer as it makes sure that the project outcomes will meet the market expectations and do not fail to meet substantial market-specific needs.

Chapter 4 Managing M3TERA risks

This chapter illustrates the implementation of the previously described risk tools into the M3TERA project structure. It presents the defined risks, shows the development of the risks based on probability/severity estimations at several evaluations and tries to assess the current status of the risk. As the WP leaders are the main responsible persons for the risks of their WPs, this section is built up on WP level.

As described in detail in Section 3.2, a probability/severity matrix is used to qualitatively evaluate the risk status. The scale for these variables has been defined as low, medium or high and is described in the table below.

	Low [L]	**Medium [M]**	**High [H]**
Probability	Less than *<30%>* probability of occurrence	Between *<30%>* and *<70%>* probability of occurrence	More than *<70%>* probability of occurrence
Severity	Risk has relatively little impact the projects technological and financial performance as well as the schedule	Risk has the potential to impact the projects technological and financial performance as well as the schedule	Risk has the potential to greatly impact the projects technological and financial performance as well as the schedule

Table 1: Risk level

4.1 WP1 Application and Technology Specifications [M01-M06; ERICSSON]

The Executive Board did not predefine any risks for WP1. Nevertheless the WP1 leader (Yinggang Li, Ericsson) as well as the MGT team (scientific and technical lead as well as the coordinator) monitored the internal and external challenges as well as the WP1 objectives. Besides the short duration of WP1 (it was only active for the first 6 project months), no specific risks have been identified neither came up and the WP1 team finalized WP1 with the submission of deliverables D1.1 “System Specifications for the Primary and the Secondary Applications” and D1.2 “Assessment of Technology Capability” timely in M06. Hence, the milestones MS1 and MS2 were successfully reached.

4.2 WP2 Heterogeneous Integration Platform [M01-M33; KTH]

Within WP2, there were three risks pre-defined before the project started. According to the WP leader, none of the risks is applicable at the moment, as it is too early for the risks to materialize. Furthermore, there were two new risks identified by the WP leader, more specifically “Key personal leaving KTH”, and “Failure of MMIC to waveguide or waveguide to antenna/sensor transitions”. The partner proposed risk-mitigation measures and evaluated the probability of both risks as low, however, severity as high.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R1	Concept failure	The consortium has discussed the concepts during the proposal writing in detail, which excludes a failure of the overall THz microsystem platform concept. Even if the concepts of some components, for instance the tuneable phase-shifters, shouldn’t work properly that won’t have a large impact on the overall success of the project.	August 2015	x					x	No	The risk is not applicable at the moment.	No	Not applicable at the moment.
			November 2015	x					x	No		No	
			January 2016	x					x	No		No	
R2	Delay in microsystem fabrication	There could be delays in fabrication, for instance due to maintenance issues of production machines in the KTH cleanroom. A delay in the fabrication of the first round has no significant impact on the project work, a delay in the second round	August 2015		x		x			No	The risk is not applicable at the moment.	No	Not applicable at the moment.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
		will result in delays in the prototypes delivered to the system users ERICSSON and CSEM. In the worst case, the whole last phase of the project and thus the project end would be delayed. IFAT has a large number of microsystem production tools, and in case of longer down-time of a tool at KTH, can carry out individual process steps. This is also assisted by the design for manufacturability (WP7) which takes care of process compatibility between IFAT and KTH.	November 2015		x		x			No		No	
			January 2016		x		x			No		No	
R3	Delay in MMIC delivery	The prototypes delivered in D2.4 in month 33, contain also the heterogeneously integrated MMIC active circuits of WP3, delivered in month 32. A delay of the MMIC would also result in a delay of the delivery of the prototypes. Also here, a delay would in the worst case only result in a project delay and not in a failure of the project.	August 2015	x			x			No	The risk is not applicable at the moment.	No	Not applicable at the moment.
			November 2015	x			x			No		No	
			January 2016	x			x			No		No	
R22	Key personal leaving KTH	Key personal at KTH, in particular Dr. Umer Shah and Dr. Joachim Oberhammer, are important for the project. Even if one of these key personal should be leaving the project, the second person	August 2015	x					x	No	The risk is not applicable at the moment.	No	Not applicable at the moment.
			November 2015	x					x	No		No	
			January 2016	x					x	No		No	

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
		could take care of the proper continuation of the project and for KTH to fulfill their tasks											
R33	Failure of MMIC to waveguide or waveguide to antenna/sensor transitions	There is a possibility that the various transitions designed for interfacing might not function. KTH and Chalmers is working together on more than one transition concepts to mitigate the impact of this risk.	January 2016	x					x	No	The risk is not applicable at the moment.	No	Not applicable at the moment.

Table 2: WP2 risk table

4.3 WP3 Active Circuits and their Intra-Platform Interfaces [M01-M33; CHALMERS]

WP3 leader Chalmers evaluated the five pre-defined risks as stated in DoA, and so far did not add any new risk. Except for the risk R7, all the risks maintain the same level of probability and severity.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R4	Designed circuits deviate too much with respect to simulated performance	Revise models and make redesign. Two scheduled tapeouts allow for design correction. In worst case more tapeouts will be required.	November 2015		x			x		No	Not applicable at the moment.	No	Not applicable at the moment.
			January 2016		x			x		No		No	
R5	Cut-off frequency of transistors in the process is lower than expected	Redesign of circuits, improve the MMIC-process.	November 2015	x					x	No	Not applicable at the moment.	No	Not applicable at the moment.
			January 2016	x					x	No		No	
R6	Skilled MMICdesigners lacking	Chalmers has highly-skilled and experience MMIC designers. If insufficient internal resources can be allocated for the project, new personal will be recruited.	November 2015	x					x	No	Not applicable at the moment.	No	Not applicable at the moment.
			January 2016	x					x	No		No	
R7	Important measurement instruments break down	Renting of measurement equipment or measure at other places (for instance: Aalto University, Finland; access through contacts via KTH and through Prof. Räisänen, advisory board member).	November 2015	x					x	No	Not applicable at the moment.	No	Not applicable at the moment.
			January 2016		x			x		No		No	
R8	MMICs cannot be processed	Circuits must be re-designed in another MMIC-technology.	November 2015	x				x		No	Not applicable at the moment.	No	Not applicable at the moment.
			January 2016	x				x		No		No	

Table 3: WP3 risk table

4.4 WP4 Sensor and Antenna Interfaces [M01-M30; ANTERAL]

WP4 includes two risks identified before the project kick-off. Moreover, the WP leader Anteral identified one new risk “Delay in reflector Antenna fabrication” that has nevertheless not yet occurred. The current risks were evaluated as low on both probability and severity level since the beginning of the project, which is a positive indicator. None of these risks have yet materialised, therefore there was no need for any mitigation measures.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R9	Delay in fabrication of sensor interface with THz platform (WP2)	The work plan allows to identify delays at an early stage. Intense communication between WP2 and WP4 takes care of early problem awareness, and WP2 will be specifically addressing the risk of delays in fabrication.	July 2015	x			x			No	The risk is not applicable at the moment.	No	Not applicable at the moment.
			October 2015	x			x			No		No	
			January 2016	x			x			No		No	
R10	Alignment issues between the horn antenna and the integrated THz microsystem platform	Alternative fabrication technologies like DRIE silicon micromachining can be considered to improve the alignment precisions. Another option to be considered would be a possible integration of the primary horn antenna functions on the THz microsystem platform, at reduced performance, or even a mixed approach with a first antenna segment integrated in the platform, followed by an external antenna segment. Some relaxation of the requirements of the antenna could be assumed in this latter case.	July 2015	x			x			No	The risk is not applicable at the moment.	No	Not applicable at the moment.
			October 2015	x			x			No		No	
			January 2016	x			x			No		No	

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R23	Delay in reflector Antenna fabrication	A good communication between Anteral and the workshop in charge of the fabrication is reached. For this reason, a fast detection of any possible delay can be obtained and worked on.	January 2016	x			x			No	The risk is not applicable at the moment	No	Not applicable at the moment

Table 4: WP4 risk table

4.5 WP5 Telecom Proof-of-Concept Prototype [M01-M36; ERICSSON]

There is one pre-defined risk in WP5 that has been continuously evaluated by the WP leader Ericsson. Eventually, the risk severity was downgraded to “low”. In addition to the existing risk, Ericsson identified new risk “MMIC-to-Si waveguide and Si waveguide-to-antenna transitions cause large losses”, possibly threatening the project. The new risk is currently rated as “medium” in probability and severity, however, the possible occurrence of the risk is anticipated after the transition measurements and completion.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R11	MEMS-based components below performance expectations in terms of tuning range and insertion loses	The telecom prototype will be designed as such that its basic function is guaranteed even if the full performance of the MEMS-based front-end components is not fulfilled, namely, validation of the proposed integration platform will not be significantly affected.	July 2015		x			x		No	After re-consideration of the severity of this risk, a proper grade should be “L”	No	Not applicable at the moment.
			October 2015		x			x		No		No	
			January 2016		x		x			No		No	
R11a	MMIC-to-Si waveguide and Si waveguide-to-antenna transitions cause large losses	Demonstrate the final linkover a shorter distance, as performance degradation.	January 2016		x			x		No	This anticipated risk will not show up until the transition is built up and measured.	No	Not applicable at the moment.

Table 5: WP5 risk table

4.6 WP6 Ubiquitous THz Sensor Prototype [M01-M36; CSEM]

WP6 includes three pre-defined risks, with no additional risks identified by the WP leader CSEM. All three risks have not yet materialized and are being rated constantly throughout the project.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R12	Sub-block of the CMOS sensor circuit is out of specifications.	A second tape-out is planned for improvement.	November 2015	x			x			No	The IC design is too early to say anything about the risks. We have nothing to report on risk assessment at this stage.	No	Not applicable at the moment.
			January 2016	x			x			No		No	
R13	Final sensor circuit out of specifications.	The first tape-out should validate the individual sub-blocks in order to de-risk the final assembly.	November 2015		x			x		No	The IC design is too early to say anything about the risks. We have nothing to report on risk assessment at this stage.	No	Not applicable at the moment.
			January 2016		x			x		No		No	
R14	The requirements for food safety detection exceed capabilities (e.g. detection of bacteria)	The feasibility of multiple sensor applications are investigated based on the M3TERA microsystem platform (e.g. food safety, radar, medical apps)	November 2015		x			x		No	The IC design is too early to say anything about the risks. We have nothing to report on risk assessment at this stage.	No	Not applicable at the moment.
			January 2016		x			x		No		No	

Table 6: WP6 risk table

4.7 WP7 Technology Transfer to High-Volume Manufacturer [M03-M36; IFAT]

Within WP7, there are two risks that were identified prior the project start. The WP leader IFAT evaluated both risks as low on probability and severity, with clear explanation of the developed rules and close cooperation with partner KTH, which further prevents the risk to materialise. No additional risks were yet identified.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R15	Technology immaturity for starting technology transfer	Transfer of a premature technology is no option. In order to start the transfer the complete platform has to be quite stable. The project duration could be too short to reach this goal. If this situation occurs, the milestone will be shifted and effort will be moved into stabilization. No implications on the prototype development. No implications on other project parts, but delays in potential post-project commercialization.	October 2015	x			x			No	Rules were developed in close cooperation with partner KTH. They are well explained and perfectly understood between the partners. Therefore no risks occur at the moment.	No	The final design rules for final microsystem platform - D7.2 will be delivered in M16.
			January 2016	x			x			No		No	
R16	Insufficient process documentation for efficient technology transfer	The volume-manufacturer IFAT will be involved in the specifications of the process documentation procedures of the microsystem-platform development at the academic partner KTH.	October 2015	x			x			No	Rules already transferred.	No	Not applicable at the moment.
			January 2016	x			x			No		No	

Table 7: WP7 risk table

4.8 WP8 Dissemination, Communication, Exploitation and Standardisation [M01-M36; TEC]

WP8 represents two pre-defined risks on dissemination and standardisation activities. Regarding the first risk, the major dissemination activities are planned for year two and three, therefore the risk is not yet fully relevant and was rated as low on probability and medium on severity level. The second risk was rated as low in both categories and did not yet occurred, because of the close supervision by the WP leader TEC. No additional risks were identified.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R17	Low number of dissemination activities	Show leadership for the promotion of project results; advise partners to create scientific and operational visibility; Use additional channels for dissemination	July 2015	x				x		No	According to the DoA the major dissemination activities are planned for Y2 and Y3 (see dissemination plan table)	No	Not applicable at the moment.
			November 2015	x				x		No		No	
			January 2016	x				x		No		No	
R18	Problems to identify relevant standardisation activities	Technical lead triggers new Working Group items at ETSI, ISO or any other relevant standardization bodies	November 2015	x			x			No	So far no obstacles have been occurred.	No	Not applicable at the moment.
			January 2016	x			x			No		No	

Table 8: WP8 risk table

4.9 WP9 Project-, Risk-, and Innovation- Management [M01-M36; TEC]

There are three pre-defined risks in WP9. The WP leader TEC stated that none of these risks have yet materialized because of a close supervision, therefore there was no need to apply any mitigation measures. Except for the first risk "Underperforming partners" that was downgraded in probability level from medium to low, all the remaining risks stay the same. There was no additional risk identified within the WP9.

Risk number	Description of risk	Proposed risk-mitigation measures	Date of last evaluation	Probability			Severity			Current assessment of risk			
				L	M	H	L	M	H	Did the risk materialise?	Explanation	Did you apply risk mitigation measures?	Update of mitigation measures / actions taken to deal with occurred risk
R19	Underperforming partners	Close contact between WP leaders and technical leader, short feedback loops and personal contacts (regular WP leader telcos; physical technical meetings, etc.)	July 2015		x				x	No	So far no obstacles have occurred.	No	Not applicable at the moment
			November 2015	x					x	No		No	
			January 2016	x					x	No		No	
R20	Conflicts between partners (technically and administrative)	Conflict Management through close and good contacts, frequent meetings (regular WP leader telcos; physical technical meetings, etc.)	July 2015	x					x	No	So far no obstacles have occurred.	No	Not applicable at the moment
			November 2015	x					x	No		No	
			January 2016	x					x	No		No	
R21	RTD efforts are not reaching the technical targets	Technical leader is present in all technical meetings and holds the expertise, involvement of additional experts if necessary.	November 2015	x			x			No	So far no obstacles have occurred.	No	Not applicable at the moment
			January 2016	x			x			No		No	

Table 9: WP9 risk table

4.10 M3TERA overall risk matrix

Figure 4 below showcases a risk matrix including all risks based on the evaluations of the WP Leaders. The newly identified risks are indicated by the cross sign. Taking into account the project risks, described in the tables above, it can be concluded that M3TERA is currently not facing any emerging risks which require urgent countersteering measures. Nevertheless, the consortium is aware of low and medium sized risks and keeps track on the overall status of the risks regularly.

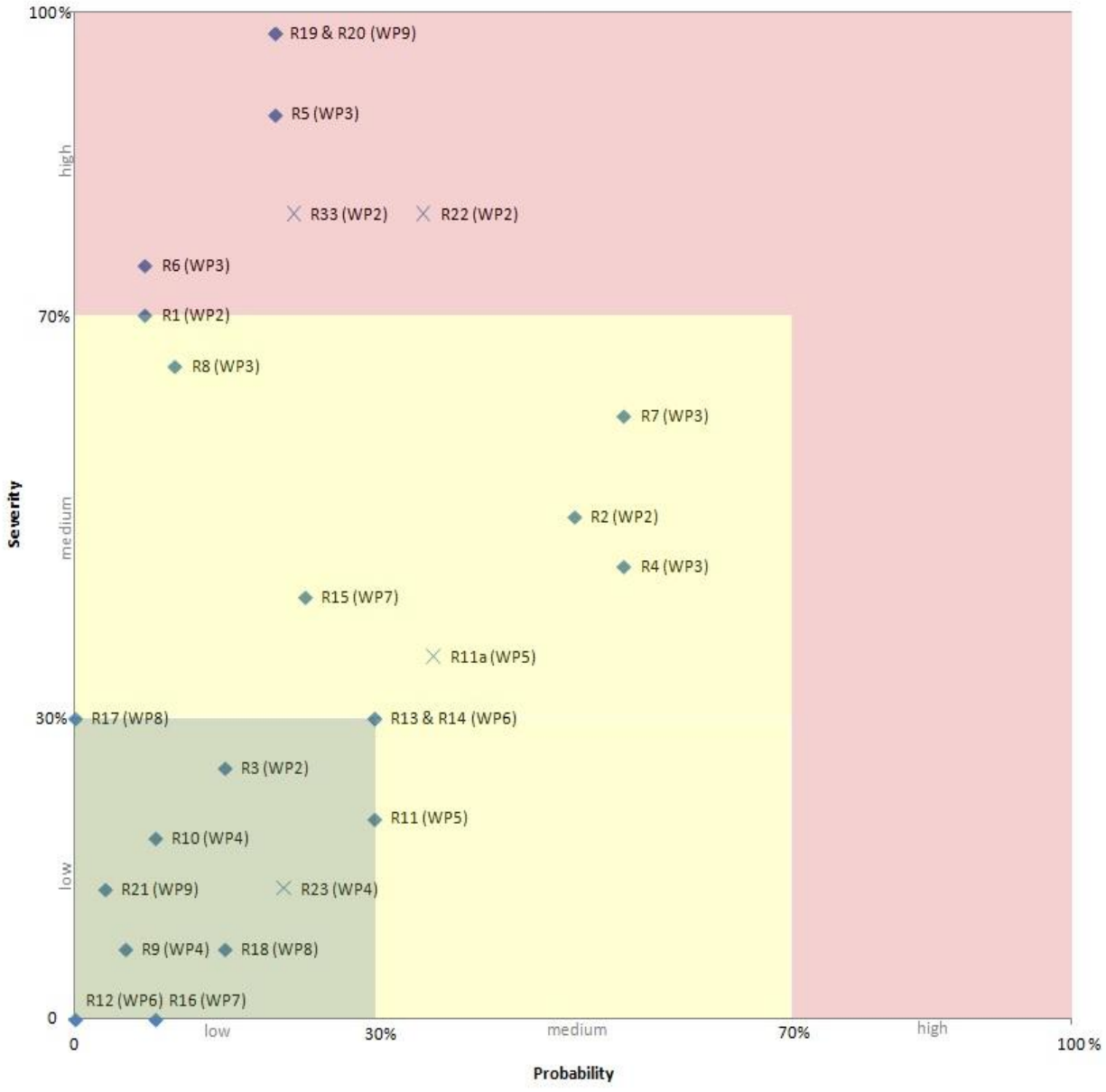

Figure 4: Overall risk matrix

Chapter 5 Conclusion

The described risk management approach indicates how the M3TERA consortium is and will avoid tripping over rocks on the road to success. Based on theoretical inputs, as described in Chapter 3, the M3TERA risk management tends to professionally identify, analyse, monitor and handle highly innovative project risks. The consortium has been very effective when monitoring the project risks. As indicated in Section 4.10, based on risk assessment by WP leaders none of the risks is likely to occur at the moment. As a result of continuous risk monitoring, partners identified four additional risks that might negatively affect the project if not handled carefully. Overall, the current level of risks indicates appropriate mitigation measures as well as close attention of all partners.

Risk Assessment is a process which will last throughout the lifetime of the M3TERA project. Updates and assessments will be regularly performed by the consortium and reported within the Periodic Reports.

List of Abbreviations

DoA	Description of Action
EB	Executive Board
GA	General Assembly
IMR	Internal Management Report
MS	Milestone
PM	Person Month
RAP	Risk Assessment Plan
WP	Work Package

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