D 5.2

Risk assessment and risk-mitigation reports

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Version	Date	Modified by	Modification reason
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v.02	14/07/2020	Arrigo Calzolari Luisa Neri	Second version: risk assessment, SWOT table
v.03	29/07/2020	Mara Di Berardo	Review
v.04	30/07/2020	Luisa Neri	Final Review

D5.2 Risk assessment and risk mitigation reports

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[1] Acronyms are marked in purple in the text and defined at the end of the document.

Executive summary

During the lifetime of a project, many unforeseen or unfortunate events can occur, that can hinder the good implementation of the planned activities. It is therefore a main task for the management of the project to identify, evaluate, monitor, and mitigate the upcoming of such events, and this is done by way of a Risk assessment and mitigation plans.
In its work plan, INTERSECT identified a certain number of risks, related to scientific and technological advancement and to management of the consortium, which are reassessed in this deliverable D5.2 Risk assessment and risk-mitigation reports, output of WP 5 Management and Project Coordination (Leader CNR).

Moreover, unfortunate events did occur in the last few months in Europe and worldwide, such as the outburst of a global pandemic. This of course affected the people's lives firstly, and their ability to work and meet secondly. Therefore, new unforeseen risks are added to the previous existing list.

A continuous commitment to update and monitor the threats and setbacks that can affect the development of the tasks for which the project is funded is taken by the management and all partners according to guidelines and tools described below.

1 Introduction

Risk management is a continuous process throughout the lifetime of a project and addresses the planning of risk management, identification, analysis, monitoring, and control. This document outlines policies and procedures for identifying and handling uncommon causes of project deviations that may compromise objectives, i.e., risks. Risk assessment will be updated throughout the project lifecycle as unexpected sources of risk can be identified at any time. It is the objective of the risk management plan to decrease the probability and impact of events adverse to the project. In contrast, any event that could have a positive impact should be exploited.

INTERSECT "Interoperable Material-to-Device simulation box for disruptive electronics" aims at driving the uptake of materials modelling software in industry, bridging the gap between academic innovation and industrial novel production, with a goal of accelerating by one order of magnitude the process of materials' selection and device design and deployment. INTERSECT involves different types of actors such as academic, industrial (SME and LE) and R&D Institutions. The INTERSECT consortium joins seven partners: two from Italy (CNR, AMAT), two from Germany (FRA, FMC), one from Spain (ICN2), one from Belgium (IMEC), and one from Switzerland (EPFL).

Transparency and a good communication between the Governing Board (GB), Management Committee (MC), Project Coordinator (PC) and the project members are key factors to avoid problems and conflicts before they arise. A good internal communication strategy favors the cohesion among the participants, thus giving an external positive image of the project in return. Some of the major perceived risks related to the project work plan are listed in Section 4, including a classification of their probability and a description of contingency measures envisaged by the consortium.

The goal of this document is to allow the Management Team to accurately and timely try to avoid unwanted risks and, if necessary, take action in mitigating or applying corrective measures to control potential negative effects to the project.

Based on this analysis, a general view on the system requirements is also presented in terms of rational, risk, and mitigation. In summary, work is going on as planned with no major deviations.

2 Role and Responsibility

This section explains the roles of people within the project regarding risks management.

Project Coordinator (PC)

The Project Coordinator, Arrigo Calzolari, is responsible for the coordination of the financial, administrative, technical, and scientific activities of the consortium and monitors day-to-day, operational progress of the project objectives, deliverables, and milestones. The project risk management execution is the responsibility of the PC. In collaboration with the MC, he reports to GB the risks occurred during the project and implements the mitigation actions taken by the GB. Finally, the PC is the formal contact for communication with the European Commission and its officers.

Management Committee (MC)

The MC is composed of the WP Leaders and has the operational control of the project. The MC assures the identification and management of the risks and keeps the Project Coordinator informed about them. If new risks are identified, they should be reported to the PC who will update Table 3 with such unforeseen risks. At M18 a Risk Assessment table is produced, in order to assess the actual state of the project in relation to risks.

Governing Board (GB)

The Governing Board is the formal decision-making body of the project and has the overall responsibility of its administrative, contractual, and financial issues. The GB endorses the risks management of the project and is responsible of the risks management process, assuring the monitoring and control of risks of all project activities.

3 Risk Management Action Plan

3.1 Risk identification and assessment

Risk identification was made at the proposal stage of the project and is described in Task 5.2.2 Quality control & Risk Management of WP5 Management and Project coordination (Task Leader: CNR). A full list of risks and mitigation actions was given in the Work Plan, see WP5 Critical implementation risks and mitigation actions. Risks will undergo continuous assessment throughout the life-cycle of the INTERSECT project. The following issues shall be considered as tools and techniques for risk assessment and identification:

- Analysis of deliverable status;
- Analysis of WP schedules and scopes;
- Regular communication of the Management team with the WP leaders.

In Figure 1 a schematic representation of the INTERSECT risk management process is shown.

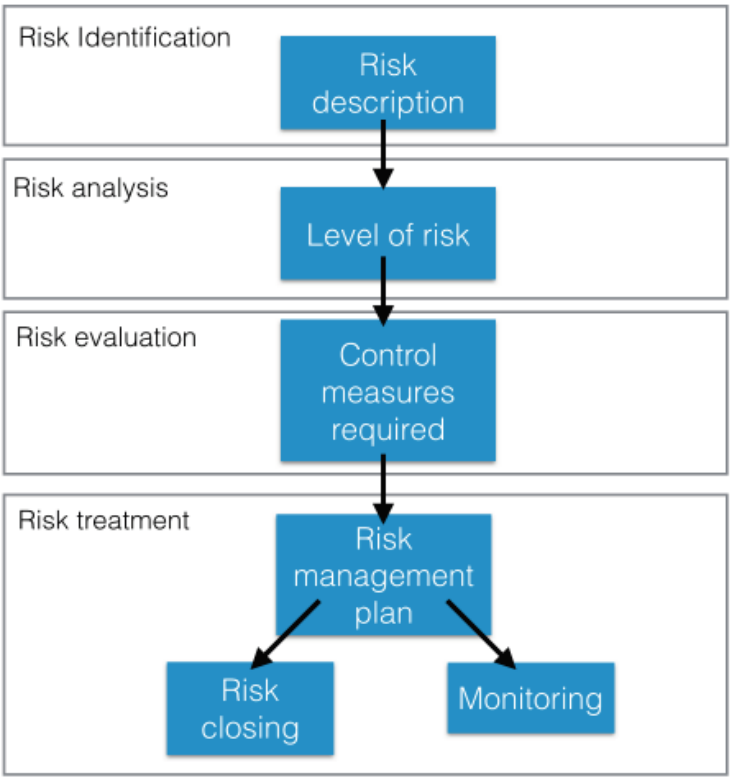

Figure 1 Risk Management process flow

The risks are written down in a **Risk Assessment Table** by the Project Coordinator. This register is accessible to all members through the INTERSECT intranet website. The risk management register contains the following information:

RISK No.	DESCRIPTION OF THE RISK	PROBAB M1	WP No.	PROPOSED RISK MITIGATION MEASURES	PROBAB M18	MOTIVATION OF VARIATION AND CORRECTIVE ACTIONS FOR MITIGATION	PROBAB M36

The exposure to a given risk (probability) is estimated using the risk matrix in Figure 2. Concerning each of the risks, the Project Coordinator, in collaboration with the MC, will estimate the probability they could happen (Low/Medium/High) at different times during the project life. Seemingly, they will identify new risks if these arise (e.g., the Covid-19 pandemic was not at all expectable 18 months ago, but has had and is still having a prolonged serious impact on everyday life and work and cannot be dismissed in a serious analysis).

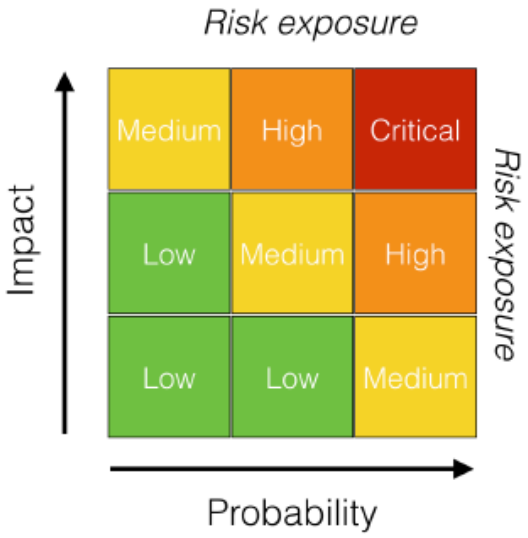

Figure 2 Risk Matrix

3.2 Risk monitoring

It is the responsibility of all INTERSECT partners to communicate to the MC or PC about the status and effectiveness of each risk and mitigation plan in order to update the risk management register and assess the relevance of the tools. Risk exposure will be continuously re-evaluated and modified accordingly. If any new risks are identified by a partner, they will be analyzed as those on the original risk list and then added in the register.

3.3 Risk-mitigation measures

Each partner is responsible for executing the risk mitigation activities which relate to the WP they lead. If a mitigation action cannot be effectively carried out or does not solve the risk, the risk exposure is likely to become more important. In this case, visibility of the risk has to be highlighted by the Project Coordinator and the mitigation measure modified in an efficient way. An item can be considered closed when it is no more likely to happen (e.g., it was connected to an expired time). In this case it is ranked as low and explained in the **MOTIVATION OF VARIATION AND CORRECTIVE ACTIONS FOR MITIGATION** section of the Register.

4 Risk Assessment Register

INTERSECT risks are registered in the **Risk Assessment Register** presented below, which is available in the INTERSECT internal platform for partners, presented here, updated at least at the end of each reporting period by all partners and presented in the periodic Reports P1 and P2. The table contains three different sections.
Sections 4.1 is dedicated to the **foreseen risks**, i.e., the risks that have been identified at the

proposal stage. For convenience they are presented with the **risk mitigating measures** that have been taken during the project. Section 4.2 lists the **unforeseen risks**, which have been identified since the beginning of the project.

4.1 Foreseen risks - Risk materialization and Risk treatment

The following table lists the Risk identified in the DoA, as they were forecast by the Consortium before the beginning of the project (see WP5 Critical implementation risks and mitigation actions). Notably, a few of them (such as R3, R7, R8, R9, R12) are intimately related to the possible exploitation activity of the project results and also to the Innovation Management activity of D4.5. The table shows the reassessment of M18.

RISK NO.	DESCRIPTION OF THE RISK	PROB M1	WP N.	PROPOSED RISK MITIGATION MEASURES	PROB M18	MOTIVATION OF VARIATION AND CORRECTIVE ACTIONS FOR MITIGATION
R1	High level interoperability requirements are either not fully consistent with the single codes (QuantumESPRESSO, SIESTA, GINESTRA™) including the interfaces.	MED	WP1	IM2D architecture will be adjusted to allow a full interoperability between the codes (QE, SIESTA, GINESTRA™) and the front-end GUI.	HIGH	High level interoperability requirements have been successfully defined (D.1.4) and are in the initial implementation stage now. Rather, semantic upscale of the Ginestra GUI is particularly challenging, especially its coherent integration of Symphony-remote with AiiDA and the rest of the simulation hub (D1.5). Internal modifications of the original hierarchical semantic rules within the interoperability hub are currently under investigation. This may cause delays in development of the GUI.
R2	GUI not allowing exploiting the full IM2D potential for material-device exploration.	HIGH	WP1	Continuous feedback from the users involved in IM2D piloting and testing in WP3 will be used to constantly update/refine/improve the GUI to make it more effective and friendly.	HIGH	-

R3	Changes of hardware architecture due to vendors do not support our codes.	MED	WP2	In order to minimise the dependence on a single specific architecture we follow the developments pursued by hardware vendors to avoid this to happen.	MED	-
R4	Plugins for codes interoperability do not support automated workflows for material's data on demand as requested by Ginestra™.	MED	WP2	The automated material modelling workflows already implemented by AiiDA will be exploited as examples to mitigate this risk.	LOW	Most plugins for extraction of 'materials on demand' have been successfully designed and implemented (or in phase of implementation, see D2.1). Initial workflows for Ginestra's requests have been implemented. No critical issues appeared on this point.
R5	Communication error between codes (QuantumESPRESSO, SIESTA, Ginestra™) due to ambivalent semantic definitions.	MED	WP2	This risk can be mitigated by increasing the ontological assessment of physical quantities and processes, through the use of shared (EMMO compliant) vocabularies and schema.	LOW	Coherent development of ontology-based definitions for exchange data and parameters mitigated this risk. No critical issues appeared on this point.
R6	Interoperability hub implementation can be threatened by conflicting workflows in data and process pipeline.	LOW	WP2	A strong collaboration among partners involved into development will minimize this risk.	LOW	-
R7	Atomic defect models will not allow to accurately reproduce electrical characteristics of electrical devices and OTS selectors.	MED	WP3	A close collaboration between partners involved in material and device modelling through the IM2D box will be established to constantly check the impact of the material/defect parameters on the device performances.	LOW	Results collected in D3.1 and D.3.2 showed that the atomic models can properly account for the electrical characteristic of selectors and Ferroelectric devices. The definition and the treatment of defects in disordered or amorphous systems (e.g. chalcogenide materials for selectors) is a scientific challenge. However, the use of large scale ab initio simulations in connection with classical MD approaches seems to be a profitable

						strategy to mitigate this risk (D3.2).
R8	Negative feedback from users about the IM2D box utility and easiness of use.	HIGH	WP3	A constant communication between partners involved in IM2D testing (WP3) and development (WP2, WP1) will be the support of a web-based documentation system.	HIGH	-
R9	Negative feedback from users about the friendliness in input preparation of input and output readability.	MED	WP3	Initial trial examples for beginners (distributed with the code) and user guide will be constantly updated and improved to solve the critical aspects reported by users.	MED	-
R10	Disputes over ownership of Intellectual Property Rights (IPR) among partners.	LOW	WP4	Standard IPR and access rights clauses will be included in the Consortium Agreement (CA) that is signed before the Grant commences.	LOW	-
R11	Breach of IPR conditions set out in the consortium agreement.	LOW	WP4	Coordinator ensures that IPR clauses are properly understood before signing the Consortium Agreement. Clauses that present difficulties will be negotiated beforehand signing.	-	Consortium Agreement has been signed and R11 is no longer a risk.

R12	Lack of interest in the INTERSECT project outputs from external stakeholders.	LOW	WP4	All partners will manage continual activities in communicating outputs to the multiple stakeholders. Dissemination and exploitation activities will raise awareness of and increase interest in the outputs.	LOW	-
R13	Definition of specification and targets are too generic, lack of details.	LOW	WP5	Specifications and targets will be determined and utilised with this risk in mind. Close collaboration between all partners on these targets.	LOW	-
R14	Definition of targets is too ambitious.	LOW	WP5	Targets are based on partner experience and expertise and will be reviewed throughout.	LOW	-
R15	Consortium has no harmony.	LOW	WP5	The Project Coordinator is continuously in contact with partners. This ensures that issues are identified and solved before they escalate.	LOW	-
R16	Partner leaves Consortium.	LOW	WP5	Consortium has been prepared so that risk of strategic partners leaving is low. Coordinator will ensure appropriate control management of the work so that remaining partners can undertake the work, until a new partner is found (if necessary).	LOW	-
R17	Poor quality of deliverables and delays.	MED	WP5	Proper internal review procedures and criteria will be in place in order to ensure the quality and timely preparation of the deliverables.	MED	-

As highlighted, R1 has been increased for the semantic upscale of the Ginestra GUI has proven particularly challenging, especially its coherent integration of Symphony-remote with AiiDA and the rest of the simulation hub (D1.5). Therefore, internal modifications of the

original hierarchical semantic rules within the interoperability hub are currently under investigation. This may cause delays in development of the GUI, hence, the highest evaluation of the risk. On the other hand, R4, R5, and R7 have been lowered to LOW, due to successful implementation of the project (details are given in the table).

A few notes are also needed on the unchanged risks and their assessment. In the case of R8 and R9, a specific feedback procedure (see D3.2) has been implemented to mitigate these risks. Rather, due to the initial implementation stage of the IM2D box, no extended user feedback is still available (only internal tests have been carried out) and the risks remain at present. R2, R3 and R6 are related to implementation of the IM2D infrastructure that is still in progress. In these cases the initial risk conditions have not changed. Finally, risks R10 and R11 deal with disputes and harmony within the consortium partners. This team worked in good collaboration and has been able to solve some critical points in the preparation of the CA. This has been signed and R11 is no longer a risk.

4.2 Unforeseen risks

The following table lists new risks arisen after the project kick-off, as evaluated at M18. Given the worldwide situation and the general positive progress of the project, they are strictly connected to COVID-19 health emergency.

RISK NO.	DESCRIPTION OF THE RISK	PROB M18	WP N.	PROPOSED RISK MITIGATION MEASURES	MOTIVATION OF VARIATION AND CORRECTIVE ACTIONS FOR MITIGATION
U1	Global pandemic emergency. Lockdown of all activities.	HIGH	WP1-WP5	Actions will be undertaken to keep activities going on as done during the first COVID-19 outbreak. While virtual meetings and training events can be organized and work from home can be pushed in order to reach the goals, an outbreak may affect the pace of activities and difficulties with spending and hiring, or person/effort in general, may arise. These need to be assessed within the consortium in the full respect of national restrictions and laws.	All members have been affected by the COVID-19 outbreak, and faced some stepbacks in their work due to less powerful workstation at home; impossibility to meet and travel (our internal meeting planned for June 30-July 1 was promptly turned into a virtual one); need to cancel or reorganize and reschedule dissemination events; difficulty in hiring new staff, having full time work accomplished, etc. Unfortunately, the future perspective is not yet clear and we expect to face new delays and restrictions.

U2	Delay on recruitment of new resources.	HIGH	WP1-WP5	Besides all possible support given to complete hiring and deliver in time, reallocation of tasks to partners with available effort will be considered.	The high skills (scientific and informatics) and high formation level (materials science, electronic engineering) requested to participants in this project limit the choice of good candidates, especially Phd students and young postdocs. The restrictions caused by COVID-19 disease (see also U1) on travels and immigration (especially from extra EU countries) further limit the possibility of hiring new personnel. This could cause delays in next deliverable achievement (R17) and/or deviation from the initial financial plan. The evolution of this geopolitical situation is not under our control and cannot be foreseen at present.

5 SWOT analysis

An overview of the risk plan and quality management of the project can be given through a SWOT table in which internal and external points of strengths and weaknesses are given as follows.

	HELPFUL	HARMFUL
INTERNAL	**S**trengths due to INTERSECT ● Capability to manage shared data and workflows (WP1-2) ● Capability to develop and validate new technologies (WP3) ● Capability to manage IPR (WP4-5) ● Wide coverage of IT skills (all WPs) ● Development of semantic interoperability driven by standardized ontologies (WP1-2)	**W**eaknesses ● Difficulties in s/w implementation (WP1, WP2, WP3) ● Consistency between interoperability requirements and codes (WP1) ● GUI not ready for IMD2 material-device exploration (WP1) ● Possible ambivalent semantic definitions (WP2) ● Underestimation of workload (all WPs) ● IPR management (all WPs)
EXT	**O**pportunities ● New emerging technologies (WP1-3)	**T**hreats ● Reticence of industries in testing (WP3)

E R N A L	• Large users base of interested industries (WP3-4) • Development of time- and cost- reducing innovative device (WP3) • New emerging ontology and data flow interactions (WP1-4) • Development of digitalization hubs (WP4)	• Persistence of H/W architectures (WP1) • End users uptake (WP3) • Difficulty in engaging stakeholders (WP4)

The given internal Strengths and Weaknesses directly derive from the analysis of risks and are connected to difficulties that can arise in the lifespan of the project. Two aspects worth a brief comment: consistency and Intellectual Property (IP). On the one hand, the upscale of materials and device modelling codes to semantic interoperability level opens the possibility of reducing the multidisciplinary gap between academic research and technology development. On the other hand, high level interoperability requirements imply a big step forwards in standardization (e.g. ontology and taxonomy development), automatization of workflows, and data management. This can be made possible only by monitoring the coherent development of all the single aspects of the final infrastructure so as to obtain a full consistency between interoperability requirements and codes. A second relevant aspect is the management of IP. INTERSECT is a multidisciplinary project that brings together academic, industrial and research profiles, with different backgrounds (e.g., physics, material science, electronic engineering, informatic). This is an undoubted value for the realization of the project. However, the different missions, legal entities, and market interests of the participant partners impose a careful management of the background and foreground IP, especially in the exploitation phase.

Similarly, the external environment can offer opportunities to the successful development of the project as well as threats. We briefly describe those below. The realization of the project and the implementation of the IM2D platform would represent a net advancement in the design and optimization of advanced electronic devices. At present, there are no tools on the market that can combine the highest levels (quantum mechanical) of materials modelling and the simulation of advanced electronic devices and memories. This may have a tremendous impact in industrial applications (semiconductor industry and electronics in the present case). On the other hand, the semiconductor market is highly competitive and dominated by big companies with rigid development plans. The possibility of not being able to penetrate this market segment certainly exists. The raise of their interest and the demonstration of the advantages of our solutions require a clear understanding of the industrial needs, times, and procedures. This activity is the core of the exploitation plan which we based on the identification of possible stakeholders, a (semiconductor and software) market survey, industry-driven plan for innovation and targeted communication. These elements are described in details on deliverables of WP4 and WP5.

6 Conclusions

While drafting the Risk Assessment Plan, at the end of M18 we performed a reassessment of the Risks and their mitigation actions, in view of the work performed to that date. We changed some probability levels of the risks as explained above. Moreover, we added two Unforeseen Risks related to the existing COVID-19 pandemic situation that affected life worldwide.

The Project is on time with the expected deliverables and milestones, no major setbacks have been encountered. In the last few months, the full consortium has made a great effort in keeping the work going on, even if restriction rules had an impact on ongoing activities. Especially, even though we met some problems with hiring personnel and full spending. Nonetheless, in the end, we have no major delays to point out.

In the next crucial months, risk assessment will continue as explained afore in order to enhance the management of the project and the process towards the completion of results.

ACRONYMS

AEB - Advisory and Exploitation Board

CA - Consortium Agreement

EMMO - European Materials Modelling Ontology

GB - Governing Board

IM2D - Interoperable Materials-to-Device

IP - Intellectual Property

IPR - Intellectual Property Rights

LE - Large Enterprises

MC - Management Committee

PC - Project Coordinator

SME - Small and Medium Enterprises

WP - Work Package