7th RTD Framework Program

REALITY

Reliable and Variability tolerant System-on-a-chip Design in More-Moore Technologies

Contract No 216537

Deliverable D7.2

Risk Management Plan

At Reporting Period 1

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The REALITY Consortium consists of:

Interuniversity Microelectronics Centre (IMEC vzw)	Prime Contractor	Belgium
STMicroelectronics S.R.L. (STM)	Contractor	Italy
Universita Di Bologna (UNIBO)	Contractor	Italy
Katholieke Universiteit Leuven (KUL)	Contractor	Belgium
ARM Limited (ARM)	Contractor	United Kingdom
University Of Glasgow (UoG)	Contractor	United Kingdom

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2. Disclaimer

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3. Acknowledgements

The author acknowledges contributions by Bart Dierickx and Miguel Miranda.

4. Document revision history

Date	Version	Editor/Contributor	*Comments*
25/06/2008	V0.1	Peter Lemmens	First draft
29/06/2008	V1.0	Peter Lemmens	Final version

5. Preface

The scope and objectives of the REALITY project are :

- Development of design techniques, methodologies and methods for real-time guaranteed, energy-efficient, robust and adaptive SoCs, including both digital and analogue macro-blocks“

The Technical Challenges are :

- To deal with increased static variability and static fault rates of devices and interconnects.
- To overcome increased time-dependent dynamic variability and dynamic fault rates.
- To build reliable systems out of unreliable technology while maintaining design productivity.
- To deploy design techniques that allow technology scalable energy efficient SoC systems while guaranteeing real-time performance constraints.

Focus Areas of this project are :

- “Analysis techniques” for exploring the design space, and analysis of the system in terms of performance, power and reliability of manufactured instances across a wide spectrum of operating conditions.

- “Solution techniques” which are design time and/or runtime techniques to mitigate impact of reliability issues of integrated circuits, at component, circuit, architecture and system (application software) design.

The REALITY project has started its activities in January 2008 and is planned to be completed after 30 months. It is led by Mr. Bart Dierickx and Mr. Miguel Miranda of IMEC. The Project Coordinator is Mr Peter Lemmens. Five contractors (STM, ARM, KUL, UoG, UNIBO) participate in the project. The total budget is 2.899 k€.

6. Abstract

This report describes the risk management plan that has been defined and implemented at the start of the “REALITY FP7” project by the project consortium. The purpose of this methodology is to manage risks such that the execution of the project becomes more reliable and to maximize the chance of having success.
The common methods that are used are described in this report, but also examples are given on how these methods are applied in the context of the REALITY FP7 project.
As risk management is not static but instead is a continuous process. This risk management plan provides the framework for the daily operations throughout the entire project lifetime.
Risk management was considered by the project consortium to be an important aspect in reaching successfully the project objectives. Therefore great emphasis was put in the DOW on setting up a proper risk management process.
Risk management is a closed loop control process, which relies on periodic tracking mechanisms, risks being assessed and quantified, containments planned and executed. Its status will change throughout the project and the examples given in this report are those present at T0+M6.

7. List of Abbreviations

REALITY	Reliable and Variability tolerant System-on-a-chip Design in More-Moore Technologies
CAD	computer aided design
DSP	digital signal processing
DOW	Description of work
FFT	fast Fourier transform
HW	hardware
IC	integrated circuit
T0+M6	June 2008
MS	Microsoft Corporation
QoS	quality of service
SoC	system on chip
SOHO	small office/home environment
SW	software

8. Risk Management General Approach

The risk management plan defines the methodology and specific steps that are taken by the REALITY project team in order to manage risks from the project kick-off until the project closing. These project related risks can be research oriented, as well as organizational, schedule or resource (meaning operational, within the consortium) oriented. Risks that are external to the project but which may have a direct impact are also considered. These latter are usually outside the control of the project coordinator or the projectteam.

The methodology as used within the REALITY project consists of 2 main parts : “risk assessment” and “risk management”. An overview is provided in figure 1 :

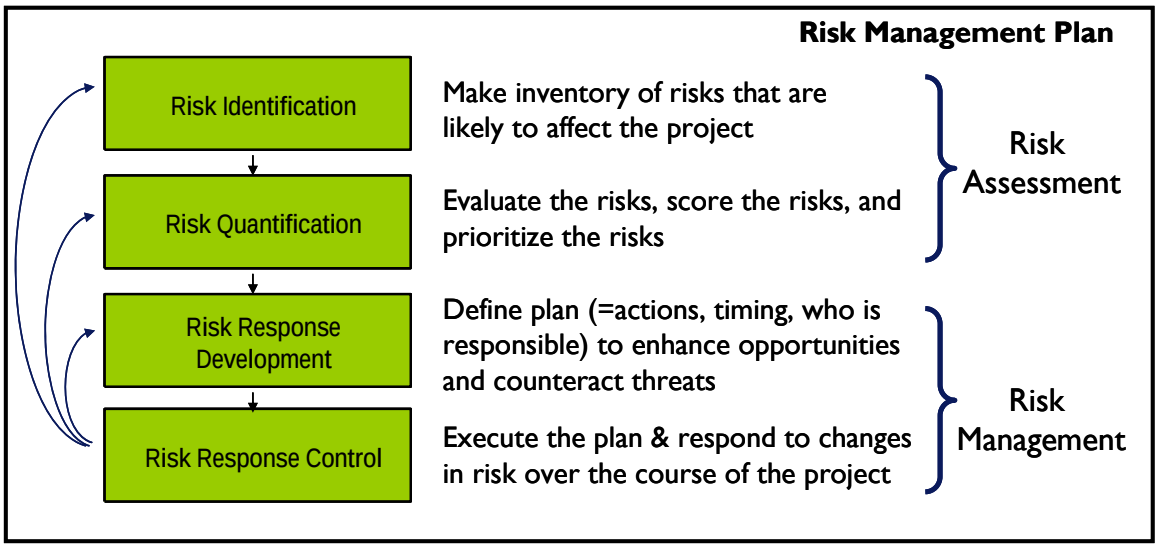

Figure 1 : REALITY risk management plan methodology

The building blocks of this methodology are not stand-alone. Instead, a regular and continuous monitoring, interaction, feedback and update between each of the steps is required.

A MS Excel template is used to facilitate the risk management process and to capture the results of each of the depicted steps in a transparent way. This template is managed and owned by the project coordinator and updates are under version control.
The consortium partners are able to provide their input and view at least with a monthly frequency (typically at each monthly project meeting). The template is updated periodically with result of an evaluation that decides if the previously defined risks and actions are still applicable and if the assigned risk level is still appropriate. If managed well, the total risk value of the project should reduce over time.

For major risks a separate report may be created. This report contains a more elaborate outline of the risk, a detailed action schedule and proposed strategy on how to tackle the risk, as well as additional tasks may be defined in the work package of the DOW.

Detailed examples of the template used in the REALITY project will be shown in the next paragraphs.

9. Risk Identification

The risk identification of the REALITY project has started at the conception of the initial project proposal (October 2006). At that moment a general inventory of potential risks was compiled by the consortium members. The purpose was to identify potential problems in an early stage that were likely to affect the project and to consider a strategy in case these risks would actually occur. This initial risk identification list did not contain a strategy for each of those risks, however it was more than suitable to gain an insight in the overall project risk and attention points.
The inventory was defined based upon brainstorming with a small team at the project proposal initial meeting, under guidance of the project coordinator. Based upon the expertise of each of the consortium partners in the research area of the REALITY project, their historical experience in similar projects and by interviewing a limited number of experts belonging to the respective organizations (e.g. science directors), a fairly accurate initial inventory was made. This output was integrated into the DOW proposal.

It was decided by the consortium members to compile a more detailed risk overview, including elaborate descriptions for cause and effect, at the project kick-off meeting (January 2008).

10. Risk Assessment

The risk assessment sheet as used within the REALITY project consists of the following elements :

- **Risk description :** a concise description of the risk itself
- **Cause :** defining what makes this a risk and what triggers the problem. This can also include risk symptoms or indirect indicators of actual risk events
- **Cluster :** area of the risk, like : technology, external, organizational, schedule
- **Probability P** : chance of the risk in case it occurs
- **Effect :** importance of the risk in affecting or impacting the project
- **Severity S :** describing the extend or impact in case the risk occurs
- **Product PxS :** used to prioritize the risks
- **Action strategy** : 4 categories are being used
- **Action description :** general description of the defined action

A value between 0 and 5 for P and S is used to express the weight.

The categories used to define the action strategy are :

- **Preventive :** measures to avoid or reduce the effect or probability of the risk.
- **Reduction :** what to do to reduce the probability of the risk occurring and/or reducing the effect of the risk.
- **Avoidance :** what to do to stop the risk occurring.
- **Contingency :** what to do if the risk occurs, i.e. a planned reaction.

Figure 2 shows the output result, being a list with prioritized risk events.

REALITY RISK ASSESSMENT

No.	Category	work package	Risk description	Cause	P	Probability 0–5 / Effect / Severity 0–5	S	PxS	P = Preventive C = Contingency A = Avoidance R = Reduction / Actions
1	external	wp1	Availability of process data in 32nm cannot be guaranteed	- the strong link with Crolles2 - the current and future uncertainty in the Alliance	5	difficulty in preparing the device variability modelling	4	20	[C] use preliminary data and TCAD simulation for 32nm
4	schedule	wp1	Lack of timely delivering, or not delivery at all, of a nominal SPICE model, DRD deck and a set of RDR recommendations from STM resulting from PullNano	multiple causes, manpower or key personnel priorities, changing company strategy, IP confidentiality...	3	difficulty in building a limited standard cell library to be used as demonstration vehicle for WP3 and WP5.	3	9	[C] Using the device model developed in WP1 or a 32nm predictive model public available data and thus create a LIBERTY file using standard library characterisation tools
6	external	wp4	UNIBO may not receive or have a platform (e.g. ARM9+accelerators) available	late or no delivery of platform by ARM or ST	2	planned tasks cannot be exectued at all or not to the full extend as planned	3	6	[A] Get confirmation from ARM about the delivery of a platform to UNIBO. [R] continue based upon existing platform, available at UNIBO
2	external	wp2	Statistical spice models including process parameter variations and their spatial correlations in 45nm and 32nm can not be guaranteed, given the uncertainty in the Crolles2 Alliance	Currently ST has an on-going project for 65nm, but there are no plans for next technologies	4	This might limit the effectiveness of SSTA	1	4	[C] use the spice models that ideally will be developed in WP1
5	technoology	wp5	Longer than planned (extended) delivery time of low level building blocks	multiple causes, manpower or key personnel priorities, changing company strategy, IP confidentiality...	4	limited integration and evaluation time-scales	1	4	[P] Identify critical blocks and follow their development closely
3	technoology	wp3	the developed methodologies and flows being may not be implementable	- low implementability in existing tools - computationally too expensive	1	impossible integration and evaluation at a system level. Only academic value	2	2	[P] Adapt the approach and rely upon own (KUL) sources.
7								0	

Figure 2 : risk assessment list at kick-off milestone

The initial list as shown in figure 2 is also being used by the REALITY project team to indicate and prioritize which risk is seen as acceptable and for which risk further follow-up actions need to be defined.

Some risks require multiple actions and multiple owners and may change in time. To be practically and in order not to overload the risk assessment list, the REALITY project team decided to organize the follow-up in a dedicated action tracker list. This list contains assigned owners for a risk and detailed actions with due dates. The owner is the person responsible for following up and tracking of the risk, and can only be one of those consortium partners which attend the meeting. Every month, during the regular project meeting, this action-tracker should be reviewed and the status updated. The owner of the risk may change over the course of the project.

The project coordinator is owner of both the action tracker and risk assessment list. Appropriate version control should be maintained and this is being documented by keeping track of changes by a revision history tab (see figure 3).

Revision History

Project ID:	**REALITY**
Document ID :	
Document Scope :	

Sheet Name	Author	Risk Review: Key Points, Participants
Risks 20080101	NA	Initial version, meant as starting point with constraints
Risks 20080129	Peter Lemmens	Update version, based upon discussions held during project kickoff meeting. Modified actions of risk 1 ; added risk nr6

Figure 3 : risk management revision history

11. Quantification

A value between 0 and 5 for P and S is used to express the weight of each risk as follows : 0-1 for LOW ; 2-3 for MEDIUM and 4-5 for HIGH.

In research projects it is common to assign the weight values based upon “expert/team judgement”, rather then calculation or simulation even if that would be very well possible. The value itself may change as the project evolves in time, because technical insights may change or containment actions may effectively reduce the probability.
The product of PxS is used to prioritize the risks in descending order (highest risk is ranked on top of the list). Even though several scoring techniques for risk quantification exist, the described method which is used by the REALITY projectteam seems most practical for this kind of project and straightforward.

The score itself is being evaluated during each project meeting (every last Friday of the month) and if necessary modified (increased or decreased).
What plays a role in the evaluation is how easy the actual occurrence of a certain risk can be detected. A risk, when becoming true, which is difficult to detect (but only after putting in a lot of effort by measuring, testing or observation) is worse than a risk that is easily apparent.

It is obvious that the coarse granularity of the used weighting is subject for discussion as it does not give an accurate quantitative measure. However, its main purpose is to be able to rank and prioritize risks in a straightforward and simple way and that is why this method proved its value.

12. Risk Response development

Once the risks have been identified it is time to define a proper response to the threats. Usually it is the owner of the risks which is taking the lead to define a risk response plan. This plan contains the action, timing and who is responsible. The main action is listed into the column “Actions” and marked with the appropriate strategy. The REALITY projectteam uses 4 kind of strategies, along 2 axes which aim to lower either the probability (P) or the severity (S), as depicted in figure 4 :

- **Preventive :** reduce the probability of occurrence by using alternative strategies
- **Avoidance :** changing plans in order to prevent the problem from arising
- **Contingency** : action steps defined to be taken if the risk occurs
- **Reduction :** decrease the impact through intermediate steps or workarounds

Cause	P	Probability 0–5 / Effect	S	PxS	P = Preventive C = Contingency / A = Avoidance R = Reduction / Actions
- the strong link with Crolles2 - the current and future uncertainty in the Alliance	5	difficulty in preparing the device variability modelling	4	20	[C] use preliminary data and TCAD simulation for 32nm
Currently ST has an on-going project for 65nm, but there are no plans for next technologies	4	This might limit the effectiveness of SSTA	1	4	[C] use the spice models that ideally will be developed in WP1
- low implementability in existing tools - computationally too expensive	1	impossible integration and evaluation at a system level. Only academic value	2	2	[P] Adapt the approach and rely upon own (KUL) sources.
multiple causes, manpower or key personnel priorities, changing company strategy, IP confidentiality...	3	difficulty in building a limited standard cell library to be used as demonstration vehicle for WP3 and WP5.	3	9	[C] Using the device model developed in WP1 or a 32nm predictive model public available data and thus create a LIBERTY file using standard library characterisation tools
multiple causes, manpower or key personnel priorities, changing company strategy, IP confidentiality...	4	limited integration and evaluation time-scales	1	4	[P] Identify critical blocks and follow their development closely

Figure 4 : risk strategies used for REALITY project

For the top 3 main risks a more detailed plan will be defined that contains: what, how, when & who. The aim is to “enhance” a potential risk to a moment earlier in time, not to wait but to take action to find out at an earlier stage. This aim is the reason why the REALITY projectteam already started with the assessment and risk management at the very begin.

Actions can be defined based upon expert judgement (the consortium partners have a strong research background in the REALITY research topic) and mutual team discussion.

Even though the main action is listed into the risk management list, for daily use a more fine grained approach is necessary. Therefore the short term actions are kept in the projectteam actiontracker (see figure 5). This actiontracker is prepared and owned by the project coordinator. At least on a monthly base via the project meetings (or more frequent when necessary) this list is updated. The risk management plan is executed and kept up to date via this way.

REALITY kickoff milestone wk824 - Actiontracker

latest update : 13/06/2008

#	Action point	Owner	WP	Entry Date	Due Date	Status
1	Add ST Thomas to communication list	IMEC		21/01/2008	M0	done
2	32nm dataset : describe which are the exact inputs from IBM/ST are required (e.g. statistical data)	UoG	WP1	21/01/2008	M1	done at the kick-off milestone meeting
3	setup a link between UoG and IBM to discuss in more detail the 32nm dataset requirements (prepare a list) as input to TCAD simulation by UOG	ST	WP1	21/01/2008	M1	done. New interface is Mr. Herve Jaouen who will be the liaison to ST/IBM for technology transfers
4	decision point M3 : review the status of availability of 32nm dataset and decide (if necessary revise) the project approach (e.g. only simulation)				M3	done on 28/04/08. ARM Note : the 32nm data would have to include the bitcell models and device sizes to get accurate simulations
5	take a decision on the project approach regarding use of IBM 32nm preliminary dataset versus purely simulation approach (= make a decision and get the approach clear)	All	-	21/01/2008	M3	done. WP2/WP3/WP5 activities will be suspended until the actual 32nm data becomes available (september '08). WP1/WP4 can continue at least until june.
6	those devices that constituted 32nm techn. as provided by IBM will be characterized	UoG	WP1	21/01/2008	end WP1	no further update from IBM on 23/05/08 ; UoG is almost ready with 45nm modelling and will distribute their output in the coming weeks.

Figure 5 : extraction from Project Actiontracker

13. Tracking and risk management Agenda

Once the actions are defined and documented a proper execution must take place. This involves tracking of already defined actions and responding to changes in risk over the course of the project.
Risk management is a closed loop control process, which relies on periodic tracking mechanisms, risks being assessed and quantified, containments planned and executed. As the status of this process is not static but instead will change throughout the project lifetime, the examples given in this report are those present at T0+M6.

Tracking involves the evolution in time of the overall risk score (PxS) against the plan. In the REALITY project we use the quantitative measure of PXS as a fairly simple way to follow-up the evolution. The quantification of each risk is evaluated, reviewed and updated on a monthly base (at the regular project meetings). At the same time, a common view must be established among the projectteam when a risk must be solved completely and how this risk factor would evolve from the full quantitative extend to a reduction to zero.

The tracking mechanism as used in the REALITY project consists of 6 phases.

Overview of Risk management Agenda for the REALITY project :

1. **Assessment :** definition of the risk
2. **Action Status :** periodic evaluation
3. **Risk Review :** updates of the PxS quantification
4. **Risk reduction Timeline :** planned evolution/reduction of the risk in time
5. **Decision moment :** time at which the team needs to decide which of the potential action plans will be followed
6. **Target date :** at which the risk should be resolved in order to avoid an irreversible damage to the project.

The figure 6 shows a risk reduction timeline as an example in the REALITY project. This timeline is used as a part of the containment plan for the highest priority risk (availability of process data 32nm).

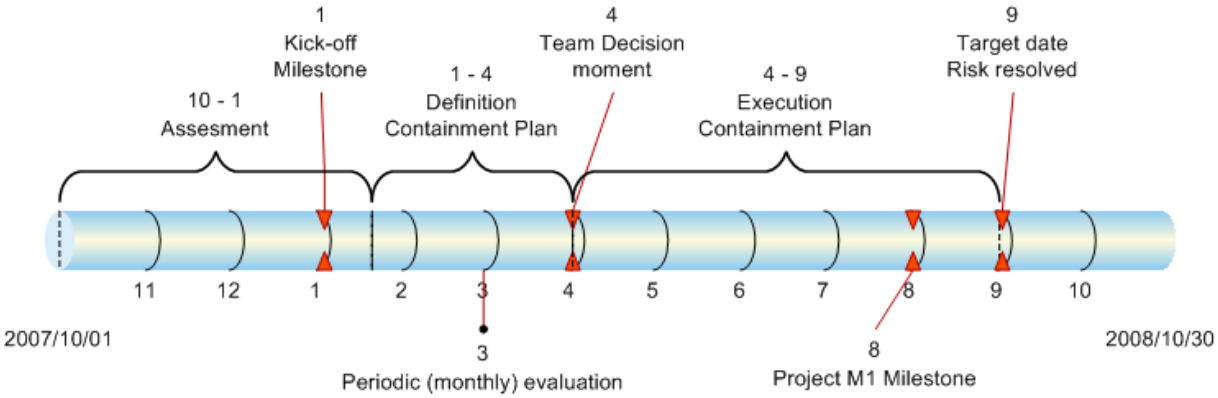

Figure 6 : REALITY risk reduction timeline example

14. Practice of the REALITY FP7 project

The following summary gives a brief overview of what the REALITY projectteam does and does not do. It is an evaluation of the risk management practice and use in this FP7 project :

- We do risk assessments at projectteam level on a periodic base
- We do have priority lists, action holders, due dates
- Most of the items have been put in a risk management template for easy follow-up
- We had problems to drive the actions to completion in a regular, “automatic” follow up on the risk items. Even though actions are worked on, often they stay “open” in the action tracker for some time.
- We do not have a fully documented plan for each one of the risks. The approach is more ad hoc, mainly be done for the most important risks and mostly triggered on projectteam team level and/or by milestone.
- A significant amount of time is reserved in the agenda of each physical projectteam meeting to be spent on risk management
- Organizational risks (at partner level) are not taken into account

