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THEME [SC1-DTH-03-2018]

Adaptive smart working and living environments supporting active and healthy ageing

BIONIC

body information on an intelligent chip

„Personalized Body Sensor Networks with Built-In Intelligence for Real-Time Risk Assessment and Coaching of Ageing workers, in all types of working and living environments"

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Table 1: List of Abbreviations

Term / Abbreviation	Definition
DFKI	Deutsches Forschungszentrum für Künstliche Intelligenz
TUK	Technische Universität Kaiserslautern
IBV	Instituto de Biomecánica de Valencia
RRD	Roessing Research and Development
UPRC	University of Piraeus Research Center
IAW	Interactive Wear AG
HQ	Hypecliq IKE
AC	Acciona Construcción
MTU	Rolls-Royce Power Systems - MTU
BAUA	Bundesanstalt für Arbeitsschutz und Arbeitsmedizin
FLC	Fundación Laboral de la Construcción
IPR	Intellectual Property Right
WP	Work package
DoW	Description of Work

1 EXECUTIVE SUMMARY

The deliverable D9.2 with the title “Risk Log I” is one of the three documents based on the results of each partners task involved within the BIONIC project.

The risk analysis 12 months after the project start is intended to revise the initially mentioned risks.

It has to be considered that the content of the following document will influence all other work packages and therefore the corresponding deliverables.

2 INTRODUCTION

2.1 WHAT IS A RISK?

ISO 31000 and ISO 73 both define risk as the “effect if uncertainty on objectives”. This broad encompasses:

1. Either a positive or negative effect
2. Objectives that can reflect one or many different categories, such as safety, environmental, or financial goals
3. The uncertainty reflecting the likelihood (probability) of events actually occurring.

This broad definition allows for qualitative, semi-quantitative and quantitative risk analysis of the consequences and associated probabilities.

Correspondingly, risk has been traditionally defined as the likelihood and the consequence of an event where the expected value of the risk is expressed mathematically as:

*Risk Value (level) = Impact * Likelihood*

2.2 RISK IN THE CONTEXT OF BIONIC

Risk in the context of this project is therefore defined as any future uncertain event with a probability of occurrence and a potential Impact. Thus the two main characteristics of risks are probability of occurrence and possible impact.

Risk monitoring includes the delivery, maintenance and update of a risk log, including a list of both already known risks (see pp. 61-62 of the DoW), as well as any unforeseen events that may appear during project execution. Preventative measures, as well as contingency plans are foreseen for each potential risk along with a prediction of the likelihood and the impact that any risk might have on project success in general or project specific objectives.

The purpose of the Risk Log is to enable the timely implementation by the project coordinator or the relevant WP Leader of any required changes to the original workplan in cooperation with the project coordinator and the technical manager.

This first version of D9.2 integrates some first additional risks apart from those already identified in the DoW (risk table, page 66-67).

An accompanying spread sheet is used to collect and classify the identified risks.

3 RISKS TYPOLOGY

3.1 RISK TYPES

The authors in [2] categorized software risks into 6 types, namely risks attributed to requirement specification (REQT'S), project complexity (COMPL), the software team (TEAM), the organizational environment (ENVIR), Planning and Control (PLAN), as well as End Users.

The first five types have been selected for the purposes of BIONIC Task 9.2 (WP9), since they represent a quite realistic typology according to the past experience of the software team partners.

The risks to be examined are therefore mainly related to technical, managerial and organisational issues.

1. Analysis of risk and obstacles within the project consortium, such as:
    - **Conflict of interest** – IPR, ownership of prototypes and future competition
    - **Lack of support** – any sign that a partner organisation may not be fully behind a project
    - **Final-phase issues** – any change that could endanger a project's chance of success during its final stage, such as a shift in the interests of some of the partners.
2. Risks and obstacles independent of the consortium, such as :
    - Market developments that may impact the exploitation potential of the anticipated project results.
    - Impact of the development of other technologies addressing the same challenge or the same market.

Further to the above typology, the identified risks are also classified according to:

3.2 RISK LEVEL

Likelihood and Impact are marked from 1 to 5, therefore there can be 25 levels of risk. Four different icons according to the following arbitrary convention display these risk levels as shown in figure 01.

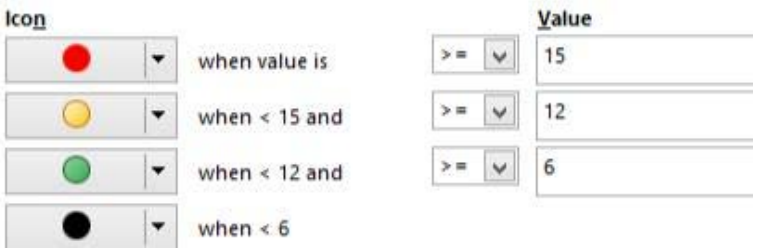

Figure 01: Picture of the risk level and associated categories as implemented in the excel table distributed to the consortium and used for collecting the imput.

3.3 RISK STATUS

The following status descriptors are used, according to the phase of risk management:

- Prevention : Preventive actions related to an anticipated risk.
- Mitigation : Activities aiming to minimise the impact of a risk when it appears.
- Redressing : Activities aiming rectifying the effects of a risk.
- Passed : Risk is no longer possible.

4 RISK LOG

4.1 DEFINITION

A Risk Register is a Risk Management Tool commonly used in Project Management and organisational risk assessments. It acts as a central repository for all risks identified by the project or organisation and, for each risk, includes information such as risk probability, impact, counter-measures, risk owner and so on. It can sometimes be referred to as a Risk Log. The following table summarises the information that has been collected in the BIONIC Risk Log as structured at Month 12 of the project. This table is an extract from the accompanying Excel spread sheet that can be find in annex.

4.2 BIONIC RISK LOG I AS PER MONTH 12

The following tables summarise the Risks identified by the responsible partner (DFKI-project Leader, see Proposal p.1) from the beginning of the project until month 12. The list includes some of the initially identified risks included in the DoW, however the majority consists of risks identified after the project Kick-Off. All risks are classified according to the above-described typology.

Up to three responsible partners are identified (also classified as risk owners in the relevant literature), including even entire working groups, which have been defined at the project Kick-Off Meeting.

Risk ID	Risk Description	Likelihood Rating	Impact Rating	Risk Level (1(low) to 25 (high))	Risk Status	Type
1	The possibilities to find a representative worksite to test the system. The worksite must let the analysis of the most representative tasks and trades. WP6. Activity 6.2	4	5	20	Prevention	Facilities
2	The representativity in the statistical sample for satisfaction survey to be made to end users. And the participation in the focus group needed for Pilot validation. WP6 Activity 6.4	2	4	8	Prevention	People
3	Who will use the system (people has to be very proactive to this kind of technologies as sometimes in construction field you can still find some outdated workers which refuse to use some “new devices” and they won´t be using seriously the system)	4	5	20	Prevention	People

4	The way of using the data monitoring applications for workers, doctors and managers	3	3	9	Prevention	People
5	Physical risks models may not be represented age-depended differences	3	5	15	Prevention	Team
6	Validation in Real working environment. BSN provide only limited information for a comprehensive physical risk assessment	3	4	12	Prevention	Team
7	High-quality 3D kinematics estimation too computationally intense to run on-board	3	5	15	Prevention	Complexity
8	Self-configuration might not provide valid and reliable results	4	2	8	Prevention	Complexity
9	Carried load estimation based on pressure insole data might not be accurate enough for risk assessment	4	4	16	Prevention	Complexity
10	Loose coupling of IMUs might have too strong cloth artefacts to be filtered out and fused with a model based kinematics estimation in a reliable way	4	2	8	Prevention	Complexity
11	Ergonomic risk models cannot be globally adapted to age	2	5	10	Prevention	Team
12	Obtain enough or adequate sample for the pilot tests	2	6	12	Prevention	Team

13	Gamification app might not be able to motivate users to engage in being more active by performing physical activity	3	3	9	Prevention	Complexity
14	Fatigue algorithm might not be able to detect fatigue reliably in workplace and leisure scenarios	4	2	8	Prevention	Complexity
15	NFMI communication might not mature enough to be used in uncontrolled environments	3	5	15	Prevention	Complexity
16	BSN integration of electronic parts into standard work wear to be used in pilots may not be at production level in time - coordination with 3rd party companies (work wear) required	2	6	12	Prevention	Plan
17	Complexity of full BSN is too high for pilot testing in industrial and uncontrolled environments	3	5	15	Prevention	Complexity
18	Roll out of pilots and technical support at pilot location is not planed	4	4	16	Prevention	Plan
19	Flow in the specification of the communication protocol	2	4	8	Prevention	Team
20	Delays in the development of the BSN (software and hardware) will cause delays in testing the storage system capabilities.	2	5	10	Prevention	Team
21	Do not satisfy the identified privacy requirements in all parts of the BIONIC system	2	5	10	Prevention	Team

22	Workers don't accept and trust the given services	2	6	12	Prevention	People
23	Communication on unshielded textile wires might not work in industrial environment	2	5	10	Prevention	Complexity
24	SPINAL concept of heterogeneous point to point network might add to much overhead and lead to more complex time alignments	2	6	12	Prevention	Complexity
25	Sensor Calibration of the pilot hardware could delay the rollout of the systems	3	3	9	Prevention	Plan

Table 1: Classification of all identified risks by Month 12 according to Level, Status and Type

Risk ID	Risk Description	Risk Level	WP No1	WP No2	Respons. Partner 1	Respons. Partner 2	Respons. Partner 3
1	The possibilities to find a representative worksite to test the system. The worksite must let the analysis of the most representative tasks and trades. WP6. Activity 6.2	20	WP6		FLC		
2	The representativity in the statistical sample for satisfaction survey to be made to end users. And the participation in the focus group needed for Pilot validation. WP6 Activity 6.4	8	WP6		FLC		
3	Who will use the system (people has to be very proactive to this kind of technologies as sometimes in construction field you can still find some outdated workers which refuse to use some “new devices” and they won´t be using seriously the system)	20			FLC		
4	The way of using the data monitoring applications for workers, doctors and managers	9			AC	RRPS	
5	Physical risks models may not be represented age-depended differences	15	WP4	WP7	IBV	BAUA	
6	Validation in Real working environment. BSN provide only limited information for a comprehensive physical risk assessment	12	WP7		BAUA	BAUA	DFKI
7	High-quality 3D kinematics estimation too computationally intense to run on-board	15	WP3		TUK	DFKI	

8	Self-configuration might not provide valid and reliable results	8	WP3		TUK	DFKI	
9	Carried load estimation based on pressure insole data might not be accurate enough for risk assessment	16	WP3		TUK	DFKI	
10	Loose coupling of IMUs might have too strong cloth artefacts to be filtered out and fused with a model based kinematics estimation in a reliable way	8	WP3		TUK	DFKI	
11	Ergonomic risk models cannot be globally adapted to age	10	WP4	WP5	IBV	BAUA	RRD
12	Obtain enough or adequate sample for the pilot tests	12	WP7	WP1	IBV	AC	RRPS
13	Gamification app might not be able to motivate users to engage in being more active by performing physical activity	9	WP5	WP4	RRD		
14	Fatigue algorithm might not be able to detect fatigue reliably in workplace and leisure scenarios	8	WP4	WP5	RRD		
15	NFMI communication might not mature enough to be used in uncontrolled environments	15	WP2	WP3	IAW	TUK	

16	BSN integration of electronic parts into standard work wear to be used in pilots may not be at production level in time - coordination with 3rd party companies (work wear) required	12	WP2		IAW		
17	Complexity of full BSN is too high for pilot testing in industrial and uncontrolled environments	15	WP2		IAW		
18	Roll out of pilots and technical support at pilot location is not planed	16	WP2	WP3	IAW	HQ	
19	Flow in the specification of the communication protocol	8	WP6	WP2	ALL		
20	Delays in the development of the BSN (software and hardware) will cause delays in testing the storage system capabilities.	10	WP6		HQ		
21	Do not satisfy the identified privacy requirements in all parts of the BIONIC system	10	WP1	WP6	UPRC		
22	Workers don't accept and trust the given services	12	WP1	WP6	UPRC	AC	RRPS
23	Communication on unshielded textile wires might not work in industrial environment	10	WP2		DFKI	IAW	

24	SPINAL concept of heterogeneous point to point network might add to much overhead and lead to more complex time alignment	12	WP2		IAW	DFKI	
25	Sensor Calibration of the pilot hardware could delay the rollout of the systems	9	WP7	WP2	DFKI		

Table 2: Classification of all identified risks by Month 12 according to Level, Affected WP and responsible Partners.

Risk ID	Risk Description	Risk Level	Respons. Partner	Potential Mitigations Foreseen	Impact on results	Impact on delivery Status
1	The possibilities to find a representative worksite to test the system. The worksite must let the analysis of the most representative tasks and trades. WP6. Activity 6.2	20	FLC	Careful search of the worksite. This must fix all the checking needs of the system so it must be as much heterogeneous as possible in regard the trades developed on it		
2	The representativity in the statistical sample for satisfaction survey to be made to end users. And the participation in the focus group needed for Pilot validation. WP6 Activity 6.4	8	FLC	Careful search of the worksite. This must fix all the checking needs of the system so it must be as much heterogeneous as possible in regard the trades developed on it		
3	Who will use the system (people has to be very proactive to this kind of technologies as sometimes in construction field you can still find some outdated workers which refuse to use some “new devices” and they won´t be using seriously the system)	20	FLC	Careful search of workers (+doctors +managers), so they are appropriate to use the app. Choosing those who are more proactive to hate use of new technologies and more involved in the field we are trying.		
4	The way of using the data monitoring applications for workers, doctors and managers	9	AC	Development of an app and system adapted to the needs of the user group		
5	Physical risks models may not be represented age-depended differences	15	IBV	A systematic literature search and the exchange of experience between the project partners could reduce the risk.		
6	Validation in Real working environment. BSN provide only limited information for a comprehensive physical risk assessment	12	BAUA	Close cooperation with software and hardware developers to better estimate technical potential of the BSN		
7	High-quality 3D kinematics estimation too computationally intense to run on-board	15	TUK	Off-load parts of the algorithm to the edge device, an external laptop or a server; or use a more lightweight algorithm with less accuracy		

8	Self-configuration might not provide valid and reliable results	8	TUK	Use pose based calibration with local calibration corrections, where possible		
9	Carried load estimation based on pressure insole data might not be accurate enough for risk assessment	16	TUK	Manually enter or assume carried load for ergonomic risk assessment, if applicable, detect pick-up events based on kinematics		
10	Loose coupling of IMUs might have too strong cloth artefacts to be filtered out and fused with a model based kinematics estimation in a reliable way	8	TUK	Foresee tight coupling for the hardware to be used in the field tests		
11	Ergonomic risk models cannot be globally adapted to age	10	IBV	Alternatives to general ergonomic models adaptation have been discussed in the team.		
12	Obtain enough or adequate sample for the pilot tests	12	IBV	Pilot planning according to the usage scenarios in close collaboration with pilot partners (AC, FLC, RRPPS)		
13	Gamification app might not be able to motivate users to engage in being more active by performing physical activity	9	RRD	The gamification app could be used as a health monitoring tool		
14	Fatigue algorithm might not be able to detect fatigue reliably in workplace and leisure scenarios	8	RRD	Focusing the detection of fatigue on the long term rather than aiming for a real-time fatigue alert.		
15	NFMI communication might not mature enough to be used in uncontrolled environments	15	IAW	The robustness of NFMI needs to be tested in the pilot environment while using machines electrical tools, etc.		
16	BSN integration of electronic parts into standard work wear to be used in pilots may not be at production level in time - coordination with 3rd party companies (work wear) required	12	IAW	Work with 3rd party companies (work wear) to develop an integration concept of the BSN into their products.		
17	Complexity of full BSN is too high for pilot testing in industrial and uncontrolled environments	15	IAW	Define multiple BSN sub systems to be tested in pilots, rather than to have only the full BSN - worker 1 uses upper body -		

				worker 2 lower body - worker 3 insole - worker 4 full BSN …		
18	Roll out of pilots and technical support at pilot location is not planed	16	IAW	Work on a pre-pilot roll out plan - do sequential testing in pilot 1 and pilot 2 - go through a learning curve - plan for technical support at pilot location		
19	Flow in the specification of the communication protocol	8	ALL			
20	Delays in the development of the BSN (software and hardware) will cause delays in testing the storage system capabilities.	10	HQ			
21	Do not satisfy the identified privacy requirements in all parts of the BIONIC system	10	UPRC	Engagement of the partners in the design phase of the security and privacy elicitation process and the proposed framework (D.1.4)		
22	Workers don't accept and trust the given services	12	UPRC	Involvement of the DPOs of the pilot partners (AC, RRPPS) for accepting the list of requirements and co-design the privacy policies and organisational processes together. Furthermore awareness raising programs will be designed for the workers.		
23	Communication on unshielded textile wires might not work in industrial environment	10	DFKI	Test robustness of communication also in target environment		
24	SPINAL concept of heterogeneous point to point network might add to much overhead and lead to more complex time alignment	12	IAW	Extensive testing needs to be done before the pilots are rolled out		

25	Sensor Calibration of the pilot hardware could delay the rollout of the systems	9	DFKI	The current procedure for calibrating one system takes 15 minutes and needs manual interaction with the calibration setup during this time, a more automated process could be analysed		

Table 3: Classification of all identified risks by Month 12 according to Level, Main responsible Partner, and Mitigations foreseen and Impact up to now.

Risk ID	Risk Description	Risk Level	Respons. Partner	Measures applied
1	The possibilities to find a representative worksite to test the system. The worksite must let the analysis of the most representative tasks and trades. WP6. Activity 6.2	20	FLC	Once the work has been chosen, we must adapt to the times and needs of it to interfere as little as possible in their work.
2	The representativity in the statistical sample for satisfaction survey to be made to end users. And the participation in the focus group needed for Pilot validation. WP6 Activity 6.4	8	FLC	Once the workers have been chosen, we must adapt to them so the system doesn´t interfere in their jobs.
3	Who will use the system (people has to be very proactive to this kind of technologies as sometimes in construction field you can still find some outdated workers which refuse to use some “new devices” and they won´t be using seriously the system)	20	FLC	To convince workers of the benefit of using BIONIC
4	The way of using the data monitoring applications for workers, doctors and managers.	9	AC	There must be an appropriate and correct explanation of the system to be used and the app for workers, doctors or managers in order to make them understand its correct use and benefits.
5	Physical risks models may not be represented age-depended differences	15	IBV	Several models are taken into account that perform a simultaneous assessment, to give more precise statements about the possible health risk.
6	Validation in Real working environment. BSN provide only limited information for a comprehensive physical risk assessment	12	BAUA	Using several risk assessment methods that can be implemented into the BIONIC system. With this approach, more parameters can be considered during working tasks
7	High-quality 3D kinematics estimation too computationally intense to run on-board	15	TUK	The full (validated) estimation algorithm has been benchmarked to identify the bottlenecks two specific matrix multiplications. Tests, whether a performance gain is possible when off-loading these matrix multiplications to an FPGA are being planned.

				In parallel, a decentralized version of the estimation algorithm allowing for multicore processing has been implemented and is currently being validated.
8	Self-configuration might not provide valid and reliable results	8	TUK	The currently followed approach is based on the assumption of a rough motion pattern (e.g. straight walking), which can be performed with some variety. Moreover, the approach provides uncertainties along with the calibration estimates.
9	Carried load estimation based on pressure insole data might not be accurate enough for risk assessment	16	TUK	Different pressure insole hardware is being tested. The current algorithmic approach foresees to exploit kinematics data along with pressure insole data to detect phases, where carried load can be reliably deduced.
10	Loose coupling of IMUs might have too strong cloth artefacts to be filtered out and fused with a model based kinematics estimation in a reliable way	8	TUK	Lab experiments will be done with gradually tighter fixation until reliable fusion is possible. Uncertainties will be incorporated into the estimation approach to indicate, when estimates are reliable.
11	Ergonomic risk models cannot be globally adapted to age	10	IBV	A personalized approach to specific worker's capacities will be implemented (test to inquire workers capacities that will be compared with the ergonomic assessment to extract mismatches and prioritize problems).
12	Obtain enough or adequate sample for the pilot tests	12	IBV	Deliverable D1.2 have defined the usage scenarios for validation and a pilot plan that considers the recruiting activities.
13	Gamification app might not be able to motivate users to engage in being more active by performing physical activity	9	RRD	Experiments will be done to evaluate the likelihood of engagement in physical activity programs via gamification of the BIONIC target population

14	Fatigue algorithm might not be able to detect fatigue reliably in workplace and leisure scenarios	8	RRD	Focusing the detection of fatigue on the long term rather than aiming for a real-time fatigue alert.
15	NFMI communication might not mature enough to be used in uncontrolled environments	15	IAW	Test the BSN in pilot environments, record data and analyse data stability
16	BSN integration of electronic parts into standard work wear to be used in pilots may not be at production level in time - coordination with 3rd party companies (work wear) required	12	IAW	Implement on each step in the prototype development a review with 3rd party work were supplier
17	Complexity of full BSN is too high for pilot testing in industrial and uncontrolled environments	15	IAW	Either reduce the complexity of the full BSN used in pilots (that is a significant change how we would execute BIONIC – and requires discussion and consensus) The second option is that we need to make sure that the full BSN used in pilots runs stable and is at high quality before we deliver it to the pilots. It means we have to do quality assessment of full BSN at an controlled environment but within a pilot scenario
18	Roll out of pilots and technical support at pilot location is not planed	16	IAW	Setup a pilot roll out project plan
19	Flow in the specification of the communication protocol	8	ALL	Meetings and Telco have been already organised and will be the centre focus during development.
20	Delays in the development of the BSN (software and hardware) will cause delays in testing the storage system capabilities.	10	HQ	Project scheduling have foreseen implementation dependencies.

21	Do not satisfy the identified privacy requirements in all parts of the BIONIC system	10	UPRC	Deliverable D1.4 has defined the privacy requirements following stakeholder needs and usage scenarios, while, at the same time, ensuring that the partners responsible for the development agree that the requirements can be satisfied.
22	Workers don't accept and trust the given services	12	UPRC	In WP6 the proposed security and privacy measures will satisfy every security and privacy concern raised in WP1. The consent forms will describe in a clear way the processes followed for the protection of worker's privacy.
23	Communication on unshielded textile wires might not work in industrial environment	10	DFKI	Shield the signals when integrating it to the work wear or use differential communication
24	SPINAL concept of heterogeneous point to point network might add to much overhead and lead to more complex time alignment	12	IAW	Due to the predefined setup of the work wear the protocol could be reduced to a simple stream of sensor data to the sensor hub and some start / stop commands
25	Sensor Calibration of the pilot hardware could delay the rollout of the systems	9	DFKI	Start early enough, or roll out the system in 2 phases

Table 4: Classification of all identified risks by Month 12 according to Level, Main responsible Partner and Measures Applied up to now.

5 CONCLUSION

25 risks have been identified at the current state of the project:

- 13 of them are considered to have a low risk level
- 4 are rated moderate
- 8 has a high risk level.

The most critical risks identified so far are:

- The possibilities to find a representative worksite to test the system. The worksite must let the analysis of the most representative tasks and trades and
- The people who will use the system

Special attention will be paid on these topics and solutions will be found in the next months.

It has also to be noticed that there is currently difficulties to evaluate and estimate the impact of those risks on the results and on the delivery status. Because the present document will be updated each 12th month, the table 3 shows presently some empty fields that will be overwrite by the time.

6 REFERENCES

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