Project plan

Project: Autonomous Race car

Company: ACEcar

Place, date: Enschede, 12th February 2022

Drawn up by: Jurijs Zuravlovs
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Version: 1.1

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Version number:	[1.1]		
Clients:	A. Yuksel, A. Fiselier, Y. Kasemsinsup		

Table of Contents

I. Abbreviations

CV	Computer Vision
PCB	Printed Circuit Board
3D	3 Dimensional

1 Introduction

ACEcar has been tasked with creating the best autonomous race car. Our team believes in the best quality, service, and smartest solution to a problem. Our crew is creating the high-end product. Our management team takes care of the best service and the smartest solutions for any given problem, and our support and developer teams make all dreams come true and create the best product. This project is very important to us because our team believes that every single task makes us better and all experience is good. To succeed in the current project, our team has conversations with clients to understand what is most important and uses the MoSCoW method to get the best ideas and solutions to archive our client's needs, as well as using the V model method to make our obstacles easier to archive and manage the workload.

1.2 Description

Our team has managed to come up with a simple solution for our brand's autonomous car. The circuit of this project contains hardware such as a processor. The processor controls the entire process—all units in the car, such as various sensors, motors, and lights. Sensor one indicates when the car can safely and autonomously drive at high speed along the given line, Sensor two indicates when the car encounters obstacles and drives around them, Sensor three looks to bring the car back to the line after encountering obstacles, and Sensor four indicates when there are no more lines, and the car simply stops at the finish line or end of the road. The first motor takes the car from steering, and the second motor accelerates the whole car. Light one indicates when the car is ready to operate, light two indicates when the battery has a low level of charge, and light three indicates when something is wrong, and the car is not ready. Race car have unique 3D printed model, which is super light and keep the car looking good and aerodynamic.

1.3 MoSCoW Method.

The MoSCoW method operates by splitting the clients' requirements into the most important ("Must"), all the way down to additions which would be nice to have, but are not necessary ("Could"), while also agreeing on things which are not feasible due to either timing issues or just not enough manpower ("Won't have").

Must:

- Follow the track line.
- Drive autonomously.
- Find the track line by itself.
- Stop at the end of the track
- Avoid any obstacles.

Should:

- Fit in a box of 400mm x 250mm x 200mm
- Drive for at least 30 minutes continuously
- have a body (3D printed separate parts)

Could:

- Accelerate to the maximum speed.
- Automatic return to start for charging or restarting mission
- Have a drone that follows the car autonomously to either give visual track data or to just record the car driving
- Make the car faster with either better or multiple motors
- Process the car through the network.
- Have a light that indicates whether they oversee the vehicle.
- Manual control through either a physical remote or laptop/phone/tablet

Won't have:

- Solar powered batteries (which would contribute to sustainability and the renewable energy movement)
- More than two engines or batteries.
- An overkill engine
- Off road tires.

2 Project Objectives

The result of the project will be the design and realisation of an autonomous electrical racing car. The requirements that the car must follow are:

1. Ride autonomously.
2. Work for at least 30 minutes.
3. fit in a box of 400mm x 250mm x 200mm.
4. Follow the track line (20mm).
5. Stop at the end of the track.
6. Avoid obstacles.
7. Find the track line.
8. have a body (3D printed separate parts).

3 Project Activities

Project setup

1. Project plan.
2. User requirements.
3. Acceptance test plan.

System Requirements

1. Functional requirements.
2. Technical requirements.
3. System test plan.

Functional Design (High level design)

1. Concepts.
2. Choosing a concept.
3. Functional design concept chosen.
4. Sub-system test plan.

Technical design (Detailed design)

1. Technical block diagram.
2. Calculating and selecting essential components.
3. 3D and 2D mechanical design.
4. Schematics and PCB design.
5. Pseudo code.
6. Module/Unit test plan.

Realisation

1. Mechanical – Making components and module assembling.
2. Electrical-Electronic – Making PCBs and module assembling.
3. Software – module/unit coding.

Module/Unit Test

Sub-system Test

1. Module integration.
2. Test.

Factory Acceptance Test

1. Sub-system integration.
2. System Test.

Site acceptance Test

Finalization project

1. Final report & Documentation.
2. Personal contribution document.
3. PowerPoint presentation.

4 Project Boundaries (scope and pre-conditions)

Start day: 11th of February 2022

End day: 26th of May 2022

Length of the project: 105 days

Budget: 50€ (Unless "ACEcar" convinces the stake holders to increase the budget)

The pre-conditions that must be met for the project to have a chance of success:

- Project members each need to be assigned a role that the members will be working on (design, programming, management, electronics, etc.)
- "ACEcar" needs to decide on what technical approach will be chosen
- The preliminary design of the vehicle needs to be thought out for the prototype
- A prototype of the product needs to be made for testing purposes
- All important documents must be filled in and submitted
- The parts list must include the required parts price and links to the parts

What doesn't belong in this project:

- A website promoting our company and product
- personnel other than the ACEcar team working on the project.

Project Schedule/Timetable:

SCHEDULE PROJECT SYSTEM 2021-2022 QUARTER 3 AND 4

Week 3.1	Week 3.2	Week 3.3	Week 3.4	Week 3.5	Week 3.6	Week 3.7	Week 3.8	Week 4.1	Week 4.2	Week 4.3	Week 4.4	Week 4.5	Week 4.6
- Project Kick Off - Group Formation - 5 Members - Research - Group Meeting - Project Plan Gant Chart (Planning) - Risk analysis (Excel Sheet) Book Grit - Logo - Roles - V-Model - Scrum	- Research - Group Meeting - Project Plan Gant Chart (Planning) - Risk analysis (Excel Sheet) Book Grit	- Functional Design - Functional Blocs - 3 Functional Design Concepts - Block Diagram - High level flow chart - Testing requirements -	- Working out 1 Functional Concept - Platform - Shields - Sensors - Power Supply - Propulsion - Drawings - Schematics - 3-D Model View - Cover	- Low level design (flow chart) - Test cases - Protocols - Standards - Platform - Shields - Sensors - Power Supply - Propulsion - Drawings - Schematics - 3-D Model View - Cover	- Providing The platform and other items - Calculation Results - Simulation Results - PCB Design (Shields + ..) - Measurements Primarily Results - Test Results - Components/part list - Safety	- Calculation Results - Simulation Results - PCB Design (Shields + ..) - Measurements Primarily Results - Test Results - Components/part list	Assembling And Sub Systems Testing	Assembling And Systems Testing	Assembling And Systems Testing	- The Car has To Work 30 Minutes According Functional Design! - If Ok Then On Presentation Schedule		- Each Group Member Talks About His Part Of The Design (Defence) If Not Present - 1 Point Off In The Grade	- No Race No Mark
- Investigation Phase - research	- Project Plan Phase	- Functional Design Phase	- Technical Design Phase	- Technical Design Phase	- Technical Design Phase	- Test and Implementation Phase	- Test and Implementation Phase	- Realisation Phase - Test Phase	- Realisation Phase - Test Phase	- Performance Test	- Fine Tuning	- User Acceptance Test	- Individual Student Performance Check
	Monday 21th February 23:59 H Submitting Project Plan On Blackboard Individual	Monday 7th March 23:59 H Submitting Functional Design On Blackboard Individual	Go – No Go Meetings	Monday 21th March 23:59 H Submitting Technical Design On Blackboard Individual	- Order list - Midterm Presentation	-	-	-	-	- Prototype Demonstration	Friday 27th May 23:59 H Submitting Final Report On Blackboard Individual	Presentations + Demo 30 Minutes	Race + Evaluation + Peer Assessments + - Logbooks
													Week 4.7 Retake

5 Results

After the phases and activities are fulfilled, see chapter 3. These below will be the intermediate results for the project.

Project setup

- Project plan.

System Requirements

- A document containing the Functional and Technical requirements with the corresponding System Test plan.

Functional Design (High level design)

- A document containing different initial concepts and the final concept with the corresponding Sub-system test plan

Technical design (Detailed design)

- A document containing the technical design for mechanical, electrical/electronic and software with the corresponding module/unit test plan.

Realisation

- A document containing all the information and progress on the realisation on the mechanical – Making components and module assembling. Electrical-Electronic – Making PCBs and module assembling. Software – module/unit coding.

Module/Unit Test

- Documentation on the results of the individual parts which are the combined from the mechanical/ Electrical-Electronic/Software parts.

Sub-system Test

- Documentation on how and what was integrated into multiple modules and the Integration test results.

Factory Acceptance Test

- Documentation on how the different modules were integrated in one whole system and the System test results.

Site acceptance Test

- Documentation on the comparison of the end product, the system requirements and User requirements with the conclusion.

Finalization project

- Creation and handing in of the final report & documentation, personal contribution document and PowerPoint presentation.

6 Quality assurance

The desired quality will follow the project objectives mentioned in chapter 2:

1. Ride autonomously.
2. Work for at least 30 minutes.
3. fit in a box of 400mm x 250mm x 200mm.
4. Follow the white line (20mm).
5. Stop at the end of the track.
6. Avoiding obstacles.
7. Finding the white line.
8. have a body (3D printed separate parts).

The sponsor will assess the quality by testing the product on a track of a white line. That way 5 of the 8 objectives for the quality of the product will be assessed. The 2nd one will be done by riding in on a treadmill with a white line, the 3rd objective will be tested by measuring tape. And the 8th objective will be tested by sight and/or touch.

Before the production of the product, an order list, project plan, a functional and technical design must be created and submitted for feedback. Either to improve or change the conceptualization of the product.

The quality of the product will be tested by phase tests known as, Module/Unit Test, Sub-system Test, Factory Acceptance Test and Site acceptance Test.

External advice might be requested from other parties or experts to evaluate the intermediate product/results.

Some tools that might be used are:

- CLion.
- Visual studio code.
- Arduino IDE.
- Draw.io.
- Multisim/Uliboard/Altium.
- TinkerCad.
- SOLIDWORKS.
- Word.
- Teams.
- Excel.
- OpenCV + extra modules

7 Project organization

7.1 Organisation

Chief Financial Officer	Test engineer	Jurijs Zuravlovs	440882	+31647617551
Chief Information Officer	Software engineer	Dmytro Taras	516824	+31627251241
Chief Operating Officer	Mechanical engineer	Miguel Pérez Hernández	524262	+34620561978
Chief Executive Officer	Electrical engineer	Tarik Mandic	523830	+31639759355
Chief Technology Officer	Electronics engineer	Karolis Juozapaitis	517546	+31612636101

Test engineer - responsible for the testing part. Finding bugs and fixing them, Software, and hardware implementation testing
Software engineer - responsible for the software part of the project prototype and testing.
Mechanical engineer - responsible for testing and mechanical part of the project
Electrical engineer - responsible for the hardware part of the project prototype and testing.
Electronical engineer - hardware part of the project. Implementation testing and software

7.2 Information

Andre Fiselier, Ali Yuksel, Yanin Kasemsinsup are the stakeholders for this project. Communication with the stakeholders presented via meetings one time per week. During these meetings stakeholders can be reached to solve any issues and feedback on a project. The group itself also meets at this time but the group also can include meetings according to project model (SCRUM for example). For the stakeholder around 3 hours per week is defined while for the team meetings more hours expected. Project leader must handle reports to a stakeholder if it asked so. All the reports and working templates can be found on a cloud drive.

8 Planning

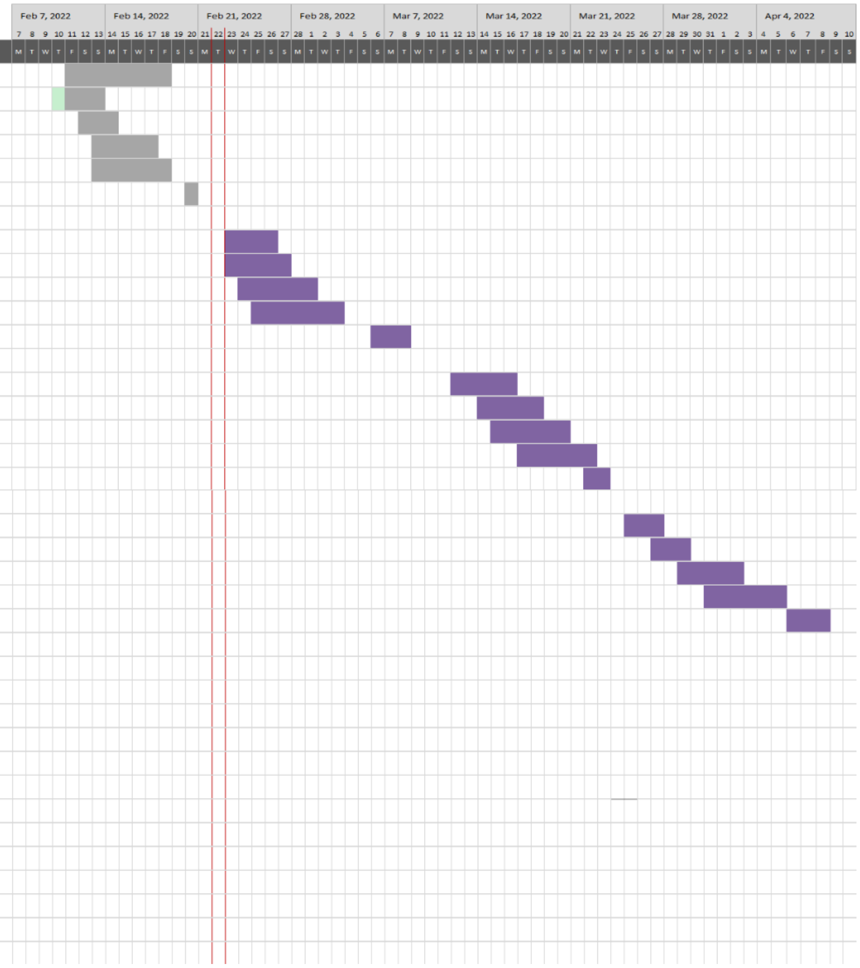
Project System

Company Name: ACECar
Project Lead: Jurijs Z

Project Start: 18/11/2021

Display Week: 1

TASK	ASSIGNED TO	PROGRESS
Requirement analysis		100%
Team collaboration	All team	100%
Workload planinig	All team	100%
MoSCoW method	All team	100%
Project plan	All team	100%
Reporting	All team	100%
High level design		
Integration tests	Tarik M.	10%
Architecture	Miguel P.	10%
Requirement and technology	Karolis J.	10%
Basic design	Jurijs Z., Dmytro T.	10%
Reporting	All team	
Detailed design		
Detailed specifications	Jurijs Z.,Miguel P.	
Low level flowchart	Dmytro T.	
Hardware design	Karolis J.	
Unit test plan	Tarik M.	
Reporting	All team	
Implementation		
Actual coding	Dmytro T., Jurijs Z.	
Module assembling	Miguel P.	
Building PCB	Karolis J., Tarik M.	
Component preparation	Miguel P.	
Reporting	All team	
Unit testing		
Inverse testing	Tarik M., Miguel P.	
Debugging	Jurijs Z., Dmytro T.	
Performing unit testing	Karolis J., Tarik M.	
Reporting	All team	
Integration testing		
System function testing	Jurijs Z., Dmytro T.	
Component testing	Karolis J., Tarik M., Miguel P	
Team report	All team	
System testing		
Performance testing	All team	
Regression testing	All team	
Acceptance testing	All team	
Main system report	All team	



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9 Costs and benefits

Project costs:

- Man-hours, 140 hours per person.

Project benefits:

- Reflect on the specific Body of Knowledge and Skills of ACS and EEE
- Understand the Arduino and several Shields and Modules for data processing and control
- Do calculations, simulations and designing circuits for this Project
- Do electrical and mechanical measurements and software coding
- Do electrical and mechanical test measurement
- Implementing several electronic modules
- Building autonomous driving electrical Racing Car
- Work in a structured way to become a solution for a defined problem
- Experience Teamwork with individual responsibilities and work in a structured way
- Organize a scheduled group and supervisor meeting
- Report technical information with specific software tools
- Do an Oral presentation with PowerPoint for a select Audience
- Perform respectively as a chairman and as a secretary in the group meetings
- Convince the Graders of your individual knowledge and skills improvement (reflection)

10 Risk analysis

Conclusion

After gathering all the information, our team scored a pretty good score in risk analysis, meaning we can successfully continue our work. There are also many more risks that we take care of, and our management team analyses all of them to try to better succeed. To summarize, all risk assessment methods are considered the foundation for all operational risk assessment methods. Our strength of effectiveness is based on our teams' simplicity and ease of use, acting as quickly as possible on the numerous risks that need to be assessed.

Some members could be slacking off.

Split the work evenly and democratically. group meetings to learn about problems and solve them together. If some team members refuse to work together or refuse to participate in any type of work, the team has no choice but to vote them out of the team and project.

Not enough manpower or time to fulfil all the client's expectations.

In order to ensure that all the client's expectations are met, it is important to thoroughly plan out the workload between group members - if something seems too taxing to be implemented then the client is alerted beforehand, so as not to deliver a subpar product.

A mistake in the hardware or software.

By having everyone from the group check both the software and hardware portions of the project, we can ensure a high standard of value is upheld. Although this would take some more time, it ensures that everything the group does is done correctly, and as Linus's law dictates: "given enough eyeballs, all bugs are shallow (Raymond and Torvalds, n.d.)".

Failure of Components.

To avoid future errors in the system or mis failure of components, we would like to have some extra pairs of sensors, wires, LEDs, and parts to guarantee the quality of our product.

Poor management.

A project's success is dependent on good management. A good leader is supposed to have good communication and interaction with the team. Therefore, high standards are always set for the project manager.

Poor productivity.

To avoid low productivity among team members, the team leader should exercise strict control. In addition, there could also be a spread of the workload between the other members to avoid this risk.

Technical risks.

There may be a technical issue like a device that is not working, and this will be a risk as one of the members is out of the project unofficially. A way to solve this problem is to borrow this member a device or he himself finds one.

Bad timing.

To avoid this software development risk, apply agile methodologies, ensure the maximum involvement of all team members in planning and estimating, receive feedback at all stages, starting from the earliest ones, and involve the owner or stakeholders.

Bibliography

Grit, R. (2010). *Project managment.* Noordhoff Uitgevers.

Appendix A Gantt chart

Project System

Company Name: ACECar
Project Lead: Jurijs Z

Project Start: 18/11/2021

Display Week: 1

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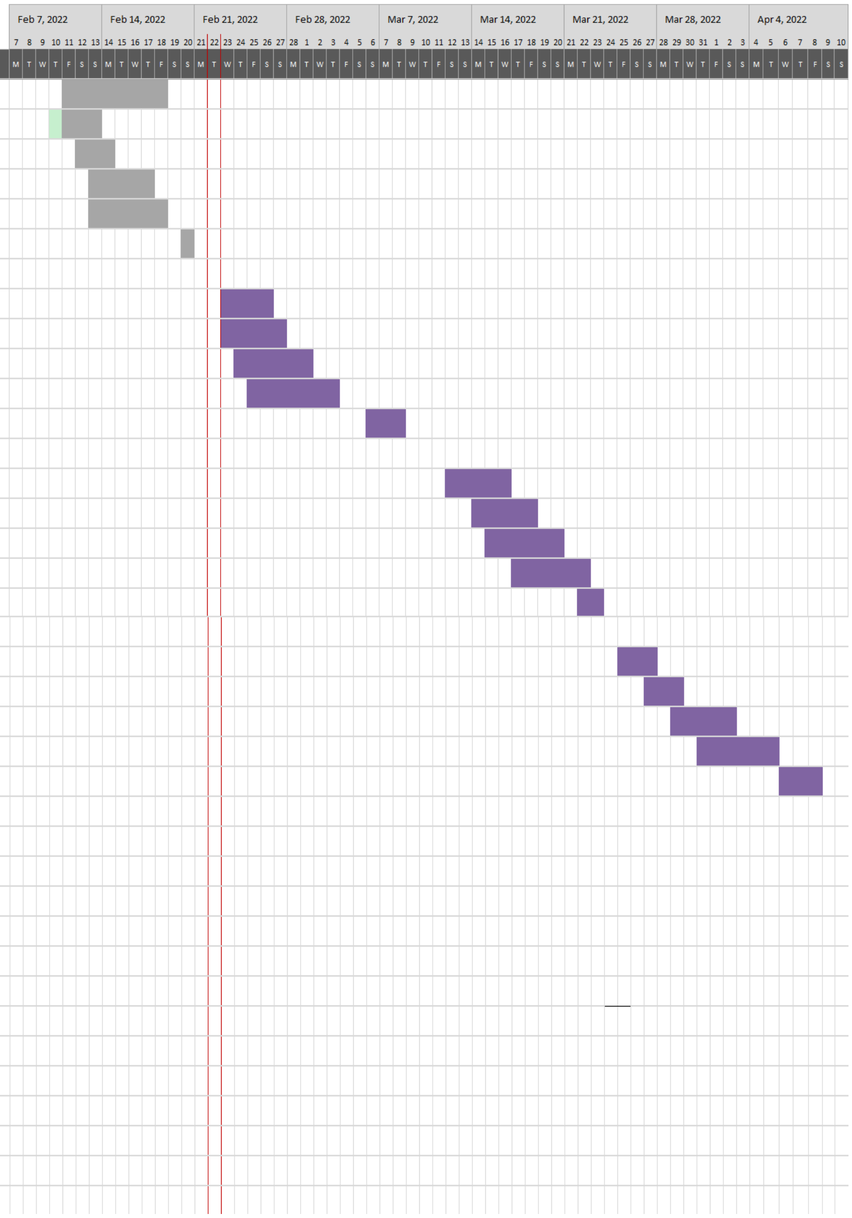

Appendix B Risk analysis

Risk	Value	Factor	Weight	Total risk
1. Estimated duration of the project?	0–3 months 0 3–6 months 4 - 6+ months	0 1 2	X4	0
2. Does the project have a definite deadline?	No Flexible Yes	0 2 4	x4	16
3. Is there sufficient time to complete the project within the set period?	more than enough enough not enough	0 1 3	x4	4
Complexity of the project				
4. The number of functional subsectors involved?	1 2 3+	0 1 3	x4	12
5. The number of functional subsectors that will make use of the outcomes?	1 2-3 4	0 1 2	x2	4
6. Is it a new project or one that has been adapted?	minor adaptions major adaptions new project	0 2 3	x5	15
7. To what extent do the present authorisations have to be adjusted?	Not minor extent medium extent major extent	0 1 2 3	x5	5
8 Are other projects dependent on this one?	No yes, though the deadlines are not tight yes, and the deadlines are tight	0 1 3	x5	15
9. What sort of reception are the users likely to give it?	Enthusiastic noncommittal interested	0 1 2	x5	5
10. Has the project been divided up into phases and is progress dependent on the coordination between them?	No a little strongly	1 2 3	x3	15
Project group				

11. Where do the project workers come from?	mainly internally partly internally mainly externally	0 1 3	x4	4
12. Where is the project located?	1 location 1 to 3 locations more than 3 locations	0 1 2	x2	0
13. The number of projects taking up more than 80% of peak hours?	1–5 5–10 5 – 10+	0 2 4	x5	10
14. The balance between subject experts and project experts?	Good Average unfavourable	0 2 4	x5	0
15. Are the users involved in the project?	to a large extent to a reasonable extent to a limited extent	0 1 3	x3	9
The project management				
16. Does the project management team have any knowledge of the subject?	a lot a reasonable amount little	0 2 4	x3	6
17. Does the project management have any knowledge of how to plan a project?	a lot a reasonable amount little	0 2 4	x3	6
18. How much experience does the project manager have with projects like this?	a lot a reasonable amount little	0 1 3	x3	3
19. Do the advisers have any knowledge of the field of research?	a lot a reasonable amount little	0 1 3	x5	0
20. Do the subject experts have much knowledge of the field?	a lot a reasonable amount little	0 1 3	x5	0
21. How involved in the project are the managers responsible for it?	Very	0	x5	10

	reasonably involved only slightly	2 5		
22. Is there any chance that the project team will change during the project?	little chance some chance big chance	0 2 5	x5	0
23. Is the project group using existing methods or creating its own methods?	only existing methods some existing methods no existing methods	0 2 4	x4	0
Project definition				
24. Are the project members sufficiently aware of the problems and objectives?	yes, everybody most of them not all of them	0 1 5	x5	0
25. Is the field of research sufficiently demarcated?	yes reasonably not clearly	0 2 5	x5	10
26. Is there sufficient demarcation between this project and other projects?	considerable reasonable insufficient	0 1 3	x4	0
27. Has enough time been reserved for coordination and decision-making?	considerable reasonable insufficient	0 1 3	x4	0
28. Are the boundaries clearly demarcated?	Yes in general most of them are not	0 1 3	x4	0
29 Are the boundaries limiting enough?	Yes moderately no	0 2 5	x5	10

Risk percentage $=\frac{total}{\max score}$x100% = 35%