Freshman Orienteering App
T-76.4115 Software Development Project, Autumn 2012
Group 11: Olkkonen, Harichandra, He, Huang, Saarelma, Udd, Vierros, Xiang

Project Plan

Team Freshmen

Version	Date	Author	Description
1.0	21.10.2012	Olkkonen	First draft
1.1.	26.10.2012	Olkkonen	Goals, tasks, and deliverables
1.2	26.10.2012	He	Risk log
1.3	28.10.2012	Olkkonen	Effort

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1. Introduction

F-Secure has a new cloud-based storage platform, F-Secure Content Cloud, that offers application developers a secure way to store customer data. The purpose of the application which will be developed during this project is to provide students an easy and secure way to share great moments during an orienteering course for fresmen students i.e. content created during the orientation will be stored and shared using services provided by the Content Cloud . An equally important goal is to build a sample application using F-Secures Content Cloud and to test the Content Cloud SDK.
The application itself will be hosted on a server and will be used with mobile clients. Content Cloud's services will be used for storing files, malware scanning and sharing and streaming uploaded content.

2. Stakeholders and staffing

The project group members and and main stakeholders are listed below.

Table 1: Stakeholders and staffing

Person/role	Email	Course type	Responsibilities
Project Manager	sanna.olkkonen@xerox.com	4115-5 cr	Documentation, customer and mentor contact, monitoring the project, requirements engineering, motivating the team
Sanna Olkkonen	+358405869795		
QA Manager	dexter.he@nokia.com	4115-6 cr	Plan and manage testing and quality assurance practises
Dexter He	+358504862431		
Architect	tuomo.vierros@aalto.fi	4115-5 cr	Architectural design, supervising developers, requirements engineering
Tuomo Vierros	+358407272244		
Developers			
Fuguo Huang (Ken)	fuguo.huang@aalto.fi	4115-6 cr	
Vidhuran Harichandra	vidhuran.harichandra.babu @aalto.fi	4115-6 cr	

Jukka Saarelma	jukka.saarelma@aalto.fi	4115-5 cr	Participates in requirements engineering
Raoul Udd	raoul.udd@aalto.fi	4115-8 cr	Documentation, participates in requirements engineering and QA management
TianShi Xiang	tianshi.xiang@aalto.fi	4115-5 cr	Participates in requirements engineering
Customer contact			
Mikko Pöri	mikko.pori@f-secure.com		
Mentor			
Juhana Yrjölä	juhana.yrjola@gmail.com		

The group's web pages can be found in http://freshmen.github.com/freshman-orienteering

3. Goals

3.1 Project goals

The main goals of the project are listed in table 2 and 3.

Table 2: Project goals in the priority order

Goal	Verification criteria
1. Develop a fun freshman orienteering application that uses the services of F-Secure's Content Cloud.	The application is functionally on a level that it can be presented to stakeholders.
2. Provide a sample application to the developer community.	The application is functionally on a level that it can be presented to stakeholders and clear and precise documentation has been provided to the client.
3. Test the SDK for the Content Cloud.	Solution implements the major features of the Content Cloud.
4. Communicate possible upcoming issues with the SDK to F-Secure.	Documentation on upcoming issues is provided to F-Secure.

Table 3: Project goals for the team

Goal	Verification criteria
1. Meeting the customer requirements	Delivering the customer a product that meets

	the requirements.
2.Obtaining the personal learning goals	All the team members can reach their personal learning goals related to different roles.
3. Good course grade	Receive a grade of 4 for the project.

3.2 Personal learning goals

Table 4: Personal learning goals

Member	**Personal learning goal**
Sanna Olkkonen (Project manager)	I want to learn about software development process as a whole and about coordinating such projects. An important goal is to obtain a successful result of the project - i.e. the client gets an application and other information which he has hoped for when deciding to participate in the course. I also consider it a as goal, that the team members would enjoy working with the project.
Dexter He (QA Manager)	My personal learning goals are to learn about a software development process, about testing methods and quality assurance practices with a real project.
Tuomo Vierros (Architect)	I want to learn about software development process as a whole and about coordinating such projects. An important goal is to obtain a successful result of the project - i.e. the client gets an application and other information which he has hoped for when deciding to participate in the course. I also consider it a as goal, that the team members would enjoy working with the project.
Fuguo Huang (Developer)	1. Learn new things from teammates and customers with a lot of different background. 2. Improving software development skills. News things could be terminology lists, programming style, preferences, development suites, testing technology, web services and F-Secures new Cloud Service etc.
Vidhuran Harichandra Babu (Developer)	The primary motive for me to take up this project was that it is based on Android and HTML5 development. This would help in improving my skills as a software developer. The project is also centered around a very new platform from F-Secure named "Content Anywhere Network". The challenge to learn a new platform and to learn about mechanisms to test it is also another motivating factor. The drive from the initial stages towards a full-fledged app will help me in understanding the nuances of the software development life cycle.
Jukka Saarelma (Developer)	My personal learning goals consist of two things: 1. Get hands-on experience with software development process as a whole in a real world context. Especially observe how the teams decisions early on reflect to the end product and see which methods used in requirement stage are actually helping in the iteration stage. 2. Improve my skills as a developer in both technical and teamwork sense.
Raoul Udd (Developer)	I have two main learning goals for this course. Firstly and mainly I'd like to gain experience in the software engineering methods, processes and techniques involved in a real-life project. Secondly, I'd like to improve my coding skills, which this project

	gives me great opportunities for as we will be using several different platforms and languages. Improving my technical abilities is a supporting activity for my main interest (software engineering) and producing high quality code and refining my coding habits is something I'd like to improve.
Tianshi Xiang (Developer)	My Personal learning goals are: 1. To develop a real software with team members together 2. Practise Javascript 3. Get familiar with FSIO SDK

4. Resources

4.1 Personnel

The estimate of working hours for each member of the team and each iteration is presented in table 5.

Table 5: Resource allocation/iteration

Member	**Credits**	**Allocated hours**	**Allocated hours**	***Realized hours***	**Allocated hours**	**Allocated hours**
		Total	**PP Iteration**	***PP Iteration***	**I1**	**I2**
Dexter	6	147	15	*27*	60	72
Jukka	5	120	20	*19*	50	50
Ken	6	147	10	*15*	70	67
Raoul	8	201	20	*19*	100	81
Sanna	5	120	65	*58*	25	30
Tianshi	5	120	10	*14*	60	50
Tuomo	5	120	50	*20*	40	30
Vid	6	147	10	*23*	70	67
		1122	200	*195*	475	447

After the week 43 the cumulative between allocated and realized working hours was quite close to budget. One weekly working session will be done before the end of this iteration, so the hours will be slightly over budget.

4.2 Materials

The hardware, software and other material resources used in project are listed in table 6.

Table 6: Materials

Hardware/software/ programming	Version	Intended use
Amazon EC2	Ubuntu 12.04.1 LTS (GNU/ Linux 3.2.0-31-virtual x86_64)	Hosting application files, database, Continuous integration tool (Jenkins)
JavaScript SDK for F-Secure Content Anywhere Network	Version 0.1	Hosting of Shared Media Files: Images, Videos, Audios and Documents
Node.js (with Express)	v0.6.12 (v3.0.0)	Serves files on the ec2 instance
Mocha	1.6.0	JavaScript test framework
Jenkins	ver. 1.424.6	Continuous Integration
Github		Version control, issue tracking

5. Work practices and tools

5.1 Practices

The project consists of three iterations, i.e. the project planning phase and two agile development iterations. The SE trio's (project manager, architect and quality assurance expert) workload is heavier during the first iteration while the developers' workload is concentrated on the last two iterations.
The project manager sees to it that communication works between the group and the client as well as the mentor, documents are delivered in time, and that the work proceeds as expected. The architect is responsible for establishing the development environment as well as assigning tasks to the developers and supporting the developers when needed. The quality assurance manager plans testing and sees to it that the system under development full fills the requirements of the customer. Requirements elicitation has been allocated to a subgroup consisting of the SE trio and three developers.

The group has two weekly meetings, on Tuesday and Thursday afternoons. It has not been necessary that all the members are present in all the meetings. The topics of the meetings are communicated to the team beforehand. The meetings during the first iteration have been about requirements elicitation and getting to know the Content Cloud SDK, as well as setting up the development environment. During the development iterations the SE trio will meet the developers during the weekly meetings to see to it that everyone has a meaningful task to do and to follow up on the work, to help in possible problems etc. The meeting time will be also used for coding and the developers can naturally choose other working times which are suitable to them.

5.1.1 Iterative development

The development iterations will be divided into smaller sprints, which will last from two to three weeks. When planning the sprints it has to be taken into consideration that almost all of the group members are working alongside with their studies. The group will also use other agile development methods such as pair programming and early testing with as much automation as possible.
For each sprint it needs to be planned what is to be accomplished during that sprint. The sprint planning is based on the user stories defined in the planning phase of the project, but will be revised during the iterations if necessary. In the end of the sprint a demo will be arranged with the customer where increments are presented and prioritising requirements for the following sprints will be made.

5.1.2 Iteration planning

Iteration planning starts two weeks before the iteration plan needs to be delivered. The iteration planning is done by the SE trio. The current status of the project and system is covered, with consideration on the effort used and the effort left for the project. The iteration plan is discussed in the weekly meeting in the beginning of the iteration with the team members.
The practical work is done in sprints described in the previous chapter.

5.1.3 Documenting

The SE trio produces documentation which is delivered to the course staff. A developer will be responsible for producing documentation for the customer on the system, i.e. user manual and technical document. Document drafts are shared in Google Docs with all the stakeholders. Final delivery of the documents is the responsibility of the project manager, however so that project manager is mainly responsible for general planning and management documents as well as requirements engineering documents and architect for the technical documentation. Quality Assurance expert is responsible for documenting quality assurance processes.
All deliverable documents will have a version management table in the beginning of the document.The documents will be revised during the iterations.

5.1.4 Risk management

The risks, actions to prevent risks and corrective actions are defined by discussing with the group.Risks are checked during sprint planning. The risks are monitored by the quality assurance expert and project manager. They are responsible for taking corrective actions when needed. Risks are also presented in the iteration demos.

5.1.5 Time tracking

Google spreadsheet is used for time tracking. The team members are responsible for updating the working hours to the spreadsheet during the Project Planning iteration on weekly basis and during the development iteration on daily basis with task definitions. Time allocation and control is done after every sprint during the development iterations (Iteration 1 and 2).

5.1.6 Communication

The group communicates in the weekly meetings, through email and Skype. The project manager communicates in the beginning of every week the meeting agendas for the following week,as well as other issues and customer meetings etc. by email to all group members. The group also has a shared calendar, where all the meetings, deadlines etc. are marked. The SE trio has arranged Skype meetings in the project planning iteration due to remote working. Communication with the customer happens in meetings with the customer and through email. A memo has been made on all the customer meetings so that those who were not able to participate are aware of what has been discussed and decided. The memos also include tasks which need to be done for the project to proceed (for instance related to SDK). A skype chat group is established to allow instant communication with the client and group members. Communication with the mentor is done mainly in meetings and by email. All the material which has been generated for the project is available to all stakeholders in Google docs.

5.1.7 Defect tracking

We will use a dedicated feature of our code repository to manage defects. Github.com provides us, with *GitHub issues*, an issue management tool that allows stakeholders to create bug reports and feature requests. Defects can be tagged according to their priority.

5.1.8 Version control

For version control, we use Git and we host the source code on Github.com (https://github.com/Freshmen/freshman-orienteering). All developers have created an account on github and have cloned the repository on their local machine.
We aim to develop in the master branch and keep the number of branches to a bare minimum. Commits to the repository should be made as often as possible, so that the number of conflicts will be small.

5.1.9 Process improvement

The group follows the guidelines given by the course on process improvement. Process improvement is discussed with the group in a group meeting during each iteration. During the process improvement discussion of the project planning iteration, it was stated that the

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group has learned about requirements engineering from a practical perspective and what kind of information requirements elicitation should provide to a software development project. Communication was a subject of improvement. Skype chat groups will be established to ease communication with the client and the team.

5.1.10 Requirements engineering

The requirements elicitation started in the first meeting with the client. The group formed a requirements engineering ”subgroup” consisting of five members of the group. A use case diagram was drawn to clarify the ideas presented in the first customer meeting. A new meeting was arranged with the customer quite soon after the first meeting, where the requirements were specified in a more detailed manner. This was a very helpful approach, and especially using the use case diagram helped in clarifying the requirements with the customer.
Due to customer requirement, the requirements are presented in a ”Definition of ready”-format. The definition of ready is as follows:

In this context "Ready" means that a Feature is mature enough that a team can start grooming it and splitting into to stories, eventually turning it into working software.

In order to be Ready, a Feature in the backlog Must include and should be:

- Concise, short and clear description of what the Feature is about. This can be achieved for example by by using User Story format, use cases or something else. Should be on a high, but understandable level.
- At least draft level Acceptance Criteria, the exact is to be agreed upon with the team.
- Test plan for the Feature
- List of required documents that need to be updated or created
- An idea what to demo once this feature is done. How does the work done meet the AC? What do the stakeholders want to see in the demo? If applicable, due to the technical nature of some features.
- Architectural guidance and acceptance: What is there to consider architecturally and technically on implementing this feature: architectural decisions, API specifications, other technical guidance. An architect’s acceptance to start work on this feature and that the feature is implementable.
- a list of things that need clarification.

The requirements are presented in a User Story format on a relatively high level. The requirements listed include basic requirements which are to be fulfilled during the project. Many other user stories were listed as well, but are considered as extended functions. It will depend on the velocity of the team how many of those requirements are fulfilled during the project. Acceptance criteria, test plan and architectural issues as well as documentation are presented for each user story. In addition to presenting the requirements in the above format mock ups related to the stories were made. This was considered to be quite helpful, especially as the user stories were required to be on a quite high level.
During the sprints the requirements will be revised with the client and possible extended requirements will be chosen from the user stories.

5.1.11 Design

Architectural design is follows standard conventions of web application development. The code base is structured according to a Model-View-Controller design principle. A skeleton for the application structure is provided by Express.js, a web application framework built on top of Node.js. The database layer of the web application is abstracted to work through a RESTful API.

5.2 Quality assurance plan

The quality assurance plan will be included in the project plan during the first development iteration (I1).

5.3 Tools

5.3.1 Project management tools

Communication

- Skype
- Skype chat
- email
- Google docs (comments)

Time management

- Google spreadsheet
- Google calendar

Documentation

- Google Docs
- Github for web pages

5.3.2 Development environment

File and database hosting

- Amazon EC2

Continuous integration

- Jenkins (hosted on Amazon EC2)

Version control and issue tracking

- Github, Github issue tracker

Testing framework

- Mocha

6. Phasing

6.1 Schedule

Project plan iteration **(25.09.2012 - 31.10.2012, 5 weeks)**

---------- passed milestones ----------

Friday 21.09.2012	Internal	First meet-up with the group
Monday 24.09.2012	Internal	Kick-off meeting with the customer

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Wednesday 26.09.2012	Internal	Planning session with the group
Wednesday 03.10.2012	Internal	Technical overview of the F-Secure platform
Friday 05.10.2012	Internal	Meeting with our mentor, planning user stories
Monday 08.10.2012	Course	Iteration Plan DL
Tuesday 16.10.2012	Course	EES[1]: Project Managers 14-16, QA Managers 16-18
Thursday 25.10.2012	Internal	Meeting with the client on user requirements
Thursday 25.10.2012	Internal	Group meeting – process improvement discussion
Week 42	Internal	Weekly group meetings – going through the SDK and development environment, trying out the map APIs
Monday 29.10.2012	Course	Delivery of all documents

---------- future milestones ----------

Wednesday 31.10.2012	Course	Iteration demo 15:00

Implementation phase 1 **(01.11.2012 - 13.12.2012, 6 weeks)**

Monday 05.11.2012	Course	Iteration Plan and QA plan DL
Tuesday 06.11.2012	Course	EES: Architects/Developers 14-16, QA mngr 16-18
Tuesday 13.11.2012	Course	EES: Project Managers 16-18
Tuesday 11.12.2012	Course	Delivery of all documents
Thursday 13.12.2012	Course	Iteration demo 15:00
Week 44	Internal	Sprint 1, sprint planning
Week 47	Internal	Sprint 1, sprint demo & retrospective
Thursday 22.11.2012	Internal	Sprint demo with the customer
Week 47	Internal	Sprint 2, sprint planning
Week 50	Internal	Sprint 2, sprint demo & retrospective

Christmas vacation **(14.12.2012 - 13.01.2013, 4 weeks)**

Week 50 or 51	Internal	Informal meet-up

Implementation phase 2 **(14.01.2013 - 21.02.2013, 6 weeks)**

Week 2	Internal	Sprint 3, sprint planning
Tuesday 15.01.2013	Course	Iteration Plan and QA plan DL
Week 5	Internal	Sprint 3, sprint demo & retrospective
Week 5	Internal	Sprint 4, sprint planning
Tuesday 12.02.2013	Course	EES: Architects/Developers 14-16, QA mngr 16-18
Wednesday 13.02.2013	Course	EES: Project Managers 16-18
Thursday 14.02.2013	Course	Delivery of the peer testing results to the peer group
Week 7 or 8	Internal	Sprint 4, sprint demo & retrospective
Tuesday 19.02.2013	Course	Delivery of all documents
Wednesday 20.02.2013	Course	Iteration demos
Thursday 21.02.2013	Course	Iteration demos
Tuesday 26.02.2013	Course	Quality award and course closing ceremony

6.2 Project Planning

Goals

Goals - Project Planning:

Goal	**Status, 28.10.2012**
Goal #001: Construct a roadmap for the project as a whole, including the schedule and time allocation of the tasks over the iterations	Roadmap of iterations and time allocation is done, but needs to be revised during the iterations
Goal #002: Schedule weekly working times for the group	Done. Weekly working times are Tuesday and Thursday afternoons
Goal #003: Develop and implement working practices for the team	Done. Communication channels, tools, roles and responsibilities are clarified
Goal #004: Get familiar with project management tools and methods	Done. Tools have been chosen.

Goals - Understanding the domain

Goal	**Status, 28.10.2012**
Goal #005: Clarify the purpose and function of the product under development for both the client and the end user	Done
Goal #006: Gain an understanding of the identified stakeholders	Done
Goal #007: Clarify decided technologies, getting familiar with them when needed	Ongoing. Technologies have been defined and part of them have been covered together with the group. Responsibilities of learning certain technological entities have been allocated to team members.

Goals - Requirements Elicitation

Goal	**Status, 28.10.2012**
Goal #008: Cooperating with the client in requirements elicitation, prioritising	Done

requirements	
Goal #009: Building user stories based on requirements	Done
Goal #010: Identifying nonfunctional requirements and constraints	Done

Goals - System design

Goal	**Status, 28.10.2012**
Goal #011: High level architectural outlines are decided upon	Done
Goal #012: Provide a sufficiently well designed architecture which enables the development to start towards the end of this iteration	Ongoing. Development environment will be finalised during week 44

Goals - Technology

Goal	**Status, 28.10.2012**
Goal #013: Set up the development environment and supporting infrastructure (server, version control solution, register with APIs)	Ongoing. Will be finalised in during week 44.

Goals - Testing

Goal	**Status, 28.10.2012**
Goal #014: Plan testing methods, research test automation for HTML5/JavaScript-based applications	Ongoing. Will be finalised in Iteration 1.

Goals - Documentation

Goal	**Status, 28.10.2012**
Goal #015: Plan the documentation which will be delivered to the customer as a result of the project	Done

Goal #016: Deliver clear reports which allow all the stakeholders to get a clear understanding of the project and the progress of the project	Done

Deliverables

Deliverable	**Responsible**
Iteration plan	Sanna and Tuomo
Project Plan	Sanna, Tuomo and Dex
User Stories according to F-Secure definition of ready	Sanna, Tuomo, Dex, Raoul, Jukka, Tianshi
Requirements Document	Dex, Sanna
Progress report	Sanna, Dex

Tasks

Goal	**Task/allocated people/ allocated hours**	**Status**
Project Planning Tasks		
Goal #001	Discuss requirements with the customer / All team members / 30 hours	Achieved as planned
	Create high level user stories / 4 team members / 24 hours	More team members participated, more hours were used (approx. 32 h)
	Validate user stories with the customer / Project manager / 4 hours	The group took part in the meeting with the customer, thus more hours were used (approx. 12 h)
	Prioritize user stories (customer input required) / Management team / 4 hours	The group took part in the prioritising meeting with the with the client

Goal #002	Set up a *Doodle*[2] with possible times for co- located worktimes / Project manager / 1 hour	Achieved as planned
	Find premises for the group sessions / Project manager / 3 hours	Achieved as planned
	Reserve workroom for sessions for the fall / Project manager / 2 hours	Achieved as planned
Goal #003	Make questionnaire and check results / Architect / 1 hour	Achieved as planned
	Hand out a task and assist in possible questions or problems / All team members / 5 hours	Achieved as planned
Goal #004	Try out and set up a project management tool for the team / Project Manager, Architect / 2 hours	Achieved as planned
	Set up a solution for time tracking / Project Manager / 1 hour	Achieved as planned
Goal #005	Discussion with the client / All team members / 1 hours	Achieved as planned
	Capture the message with a message map / PM, Architect / 2 hours	Message map wasn't used
Goal #006	Discussion with the client / All team members / 1 hour	Achieved as planned
Goal #007	Study the documentation / All team members / 5 hours	Achieved as planned

	Gather online resources / Architect / 2 hours	Achieved as planned
Goal #008	Discussion with the client / All team members / 3 hours	Achieved as planned
Requirements Elicitation Tasks		Achieved as planned
Goal #009	Define user stories / RE team (Jukka, Vid, Raoul, Tuomo, Dex, Sanna) / 10 hours	Achieved as planned
	Discuss with the client and make corrections / All team members / 10 hours	Achieved as planned
Goal #010	Discuss the non functional requirements with the client / All team members / 1 hour	Achieved as planned
	Define validation criteria / RE team / 1 hour	Achieved as planned
System Design Tasks		
Goal #011	Read documentation for F-Secure Content Cloud / All developers / 12 hours	Achieved as planned
	Experiment with F-Secure Content Cloud / All developers / 12 hours Create a first draft system architecture / Architect / 2 hours	Achieved as planned
Goal #012	Discuss possible tools libraries within the team / All developers / 6 hours	Achieved as planned

	Research libraries that team came up with / Architect / 4 hours	Achieved as planned
	Write down pros and cons on each tool or library / Any developer / 4 hours	Achieved as planned
Technology Tasks		
Goal #013	Register with Github.com / All developers / 2 hours	Achieved as planned
	Install Git on local machine / All developers / 2 hours	Achieved as planned
	Pull the master branch, Edit a file, Commit changes / All developers / 8 hours	Achieved as planned
	Research and decide on a map APIs / Any developer + Architect / 6 hours	Achieved as planned
	Research and propose a server set-up to the customer / Architect / 4 hours	Achieved as planned
	Create users to server for developers / Architect / 2 hours	Achieved as planned
	Send your Facebook username to the customer for API access / All developers / 2 hours	Achieved as planned
Testing Tasks		
Goal #014	Research Selenium as a testing tool for GUI testing / Any developer / 2 hours	Ongoing, will continue in Iteration 1

	Research Mocha as a JavaScript Unit test framework / Any developer / 2 hours	Ongoing, will continue in Iteration 1
	Research Jasmine as a JavaScript Unit test framework / Any developer / 2 hours	Ongoing, will continue in Iteration 1
	Research other tools for JavaScript Unit testing / Any developer / 2 hours	Ongoing, will continue in Iteration 1
	Create a first draft testing plan for HTML5 + JavaScript / Architect / 2 hours	Ongoing, will continue in Iteration 1
Documentation Tasks		
Goal #015	Go through course requirements for documentation / Any team member / 1 hour	Achieved as planned
	Create document templates in Google Docs / Any team member / 1 hour	Achieved as planned
	Discuss documentation requirements with the customer / Project manager / 2 hours	Discussed with the whole team
	Update user stories to include related documents / Project manager / 2 hours	Achieved as planned
Goal #016	Create a time tracking form for the project / Project manager / 1 hour	Achieved as planned

	Create a burndown chart on hours budgeted vs hours used / Project manager / 2 hours	Achieved as planned
	Include communications strategy to project plan / QA manager / 1 hour	Achieved as planned
	Make issue tracking and time tracking available to stakeholders / Architect / 1 hour	Achieved as planned

6.3 Implementation 1

The plan for the first iteration will be included in later versions of the project plan.

6.4 Implementation 2

See above.

7. Risk log

Table 7: Risk log (Probability 1=lowest, 3=highest, Severity 1= lowers, 3=highest).

ID	Risk	Prob.	Sev.	Effects	Controlling actions	Responsible
1	A developer quits in the middle of the project.	3	3	Crucial knowledge is lost. Project scope must be decreased.	Taking care of good team spirit. (avoiding) The development work of critical parts is done using pair programming. (minimizing effect)	Project manager
2	Leakage of API keys	3	3		Remind all team members not to disclose API keys. Use local config-files. Add config files to .gitignore file	Architect

3	Underestimating task time requirements	2	2	Project scope must be decreased	Follow up on time tracking and communicating changes with the client	Project manager
4	Client unable to provide CAN	1	3	The geolocation information we get from mobile phone won't be accurate enough	Ensure client to provide CAN	Architect