FINAL PROJECT REPORT

Project name: Solar economy calculator
Group number: 2
Date: 2016-01-12
Course: Software Engineering 2: Project Teamwork (DVA313)
Academy: Innovation, design and technology

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1. Background

This project has been made for our client named Bengt Stridh, from the Future Energy Center research specialization at Mälardalen University. The client and his colleagues had in a previous project, developed detailed models that are used to analyze investment decisions for photovoltaic plants in Sweden. Our task in this project was to develop a web-based tool to support different stakeholders, such as private persons and others (e.g. companies, property owners and cities), to determine what investments in solar energy that are suitable for them. This is based on a number of default input parameters that can be adjusted by the user. Even though the photovoltaic market has been growing strongly during the last years, the general knowledge of photovoltaic systems is still quite low among potential investors. For this reason, there was a strong need for a user-friendly tool to calculate the production cost and profitability for photovoltaic investments in Sweden.

If you wish to read more about the project organization (i.e. the project group, organization and communication, planned effort per group member for each week, deliverables, deadlines, milestones and quality assurance), description of the system to be developed (i.e. the high-level description of the domain and problem, description of existing systems, and high-level description of the desired functionality), and initial project backlog (i.e. the initial list of system features to be implemented), then you can take a look at the *project plan* document. Furthermore, if you wish to read more about the high-level description of the system to be developed, desired functionalities, system overview, software architecture, detailed design and graphical user interface, then you can take a look at the *design description* document.

2. Project results

Here you can read about the produced deliverables and the dates when they were finished, the key features of the final product, results of the acceptance test, missing functionalities, and possibilities for improvements and extensions to the product.

2.1 The produced deliverables and their finish dates

In Table 1 below, you can see the produced deliverables and their finish dates during the course.

Produced deliverable	Finish date
Project plan	November 17
Design description (first version)	December 1
Product (first version)	December 1
Design description (final version)	January 12
Product (final version)	January 12
Final project report	January 12

Table 1 – The produced deliverables and their respective finish date.

2.2 The key features of the final product

The key features of the final product are the following:

1. The possibility to choose between a private person and others (e.g. company, property owner and city), which will affect what default input values that are given to the user. Here, the user is presented with the two buttons "private person" and "company", on the website.

2. Guiding texts with recommended minimum and maximum values for each input textbox (i.e. through a "popup" that becomes visible when hovering over a button with your mouse on the website). This helps the user to know what to input in a particular input textbox.

3. Calculations of the production cost, profitability and cash flow. These calculated results are presented to the user as numbers in either textboxes, tables or diagrams on the website.

4. Diagrams (i.e. pie and line charts) that present results from the calculated cash flow on the website. Here, the user has to press a button on the website to make the diagrams become visible.

5. The possibility to download a PDF report file that contains both input (i.e. the user input) and output values (i.e. the calculated production cost, profitability and cash flow results). Here, the user has to press a button on the website to download the file.

6. The administrator can upload an Excel file (i.e. containing updated information) to the website, in order to update the default input values, guiding texts, recommended minimum and maximum values. Here, the administrator has to press a button on the website to make the upload, which becomes available when he/she is logged in as an administrator.

2.3 The results of the acceptance test

An acceptance test was conducted by using some test cases (see Appendix A) related to the actual implemented requirements, which both our project group and the client (i.e. we sent a link to the website) got to try out separately. By both doing the acceptance test we could increase the validity of the results (i.e. since we got more collected data to base our conclusion on). All we and the client had to do was to fulfil the pre-conditions, follow the test case's test steps, and then control if the expected result was correct. The final results from ours and the client's acceptance test, was that all of the test cases passed.

2.4 The missing functionalities and possible improvements to the product

Here follows a list of some missing functionalities and possible improvements/extensions to the product:

1. Compare the calculated results for two sets of input values.

2. Save used input values from one session to another session at a later time.

3. Switch between English and Swedish language on the website.

4. Possibility to create a user account.

3. Project work

Here you can read about changes to the organization and routines, total project effort and how it was distributed over different activities, worked hours per group member, distribution of work and responsibilities, positive experiences, and improvement possibilities.

3.1 Changes to the organization and routines

When it comes to the "project group" section that we have stated in the *project plan* document, we did some changes to the roles and responsibilities among the project members. These changes were made because a role or responsibility was more suitable for another project member, and when someone was sick or unreachable then another project member had to take his/her role or responsibility sometimes.

When it comes to the "organization and communication" section that we have stated in the *project plan* document, we stuck to the following things: Having a project meeting with the external steering group every Monday during the course (i.e. except for the non-mandatory project meeting on 19th December), a small internal project meeting before all of the meetings with the external steering group on Mondays (i.e. to prepare the material that was going to be presented for the external steering group), at least one internal project meeting per week (i.e. to for example discuss each other's progress and issues) which mostly was over the communication service called Slack, a client meeting or communication with the client every week (i.e. except for some weeks during the Christmas holidays). Using the collaboration tool called Trello to follow the progress of the current week's activities and plan activities for the upcoming week, a GitHub repository to both share and store an Excel file containing each project member's worked hours per week (i.e. each project member made their own report in a specific Excel file), documentation and code.

When it comes to the "planned effort per member for each week in the project" section, that we have stated in the *project plan* document, we can mention that each project member did not end up with a total effort of approximately 160 hours. This was because of reasons such as illness among the project members, other courses that took up more time than expected etcetera.

When it comes to the "quality assurance" section that we have stated in the *project plan* document, we stuck to the following things: Having a least one project member reviewing the documentation (e.g. the project plan, design description and final project report) to avoid errors before reporting them to the teachers. Doing unit testing (i.e. to ensure that separate units/functionalities work as expected) and then moving on to integration testing (i.e. to ensure that units/functionalities work together as expected). Allowing the client and other external people (e.g. the client's colleagues, family and friends) to do a user test of the product (i.e. both the first and final product version) to see if the system works as expected in a real life scenario and get important valuable feedback.

3.2 Total project effort and how it was distributed over different activities

In Table 2 below, you can see the total project effort (i.e. in approximate person-hours) and how it was distributed over different activities.

Activity	Approximate worked hours (for all of the group members together)
External meetings with the steering group	15
Client meetings and contact	25
Internal meetings within the project group	150
Presentation preparation (material for all the external steering group meetings)	10
Presentation preparation (project plan and requirements)	10
Presentation preparation (design and implementation)	16
Presentation preparation (final)	20
Presentation (project plan and requirements)	16,5
Presentation (design and implementation)	16,5
Presentation (final)	16,5
Project plan	32
Design description (1st version)	25
Product (1st version)	[40 – included in other implementation activities]
Design description (final version)	30
Product (final version)	[180 – included in other implementation activities]
Final project report	45
Review (project plan)	3
Review (1st design description)	4
Review/User test (1st product)	3,5
Review (final design description)	4
Review/User test (final product)	8
Review (final project report)	6
Create a basic layout for the website	12

Improved layout (i.e. includes choosing between private person and others, viewing guiding texts etc.)	30
Create a login	7
Update the default input values etc. through an Excel file	5
Calculate production cost	12
Calculate profitability	20
Calculate cash flow	25
Make diagrams show the results	10
Create a downloadable PDF file	18
Email function	3
Database & Server (i.e. includes being able to download a backup Excel file for the admin)	20
Integration of units	20
Testing	35
Others (e.g. create accounts for Trello and GitHub, learn how to use Trello, GitHub and different web technologies, understand the given Excel files)	70
Total worked hours (approximation):	**746**

Table 2 – The total project effort and how it was distributed over different activities.

3.3 Worked hours per group member

In Table 3 below, you can see the total worked hours per group member.

Group member	**Total worked hours**
Lukas Hamacek	104
Aliya Hussain	103
Charlie Höglund	156
Jonathan Larsson	144
Sebastian Lindgren	139
Avalika Podduturu Reddy	100

Table 3 – The total worked hours per group member.

3.4 Distribution of work and responsibilities

In Table 4 below, you can see the distribution of work and responsibilities.

Activity	Main contributors	Assisting contributors
External meetings with the steering group	Everyone	-
Client meetings and contact	Sebastian & Charlie	Jonathan, Lukas, Aliya & Avalika
Internal meetings within the project group	Everyone	-
Presentation preparation (material for all the external steering group meetings)	Charlie	Sebastian, Jonathan, Lukas, Aliya & Avalika
Presentation preparation (project plan and requirements)	Charlie, Sebastian & Avalika	Jonathan, Lukas & Aliya
Presentation preparation (design and implementation)	Charlie	Jonathan, Lukas & Sebastian
Presentation preparation (final)	Charlie	Jonathan, Sebastian & Avalika
Presentation (project plan and requirements)	Everyone	-
Presentation (design and implementation)	Everyone	-
Presentation (final)	Everyone	-
Project plan	Charlie & Sebastian	Jonathan, Lukas, Avalika & Aliya
Design description (1st version)	Charlie & Sebastian	Jonathan, Lukas, Avalika & Aliya
Product (1st version)	Jonathan, Lukas & Aliya	Charlie, Sebastian & Avalika
Design description (final version)	Sebastian & Charlie	-
Product (final version)	Jonathan	Charlie, Sebastian, Lukas, Aliya & Avalika
Final project report	Charlie & Sebastian	Jonathan, Avalika & Aliya
Review (project plan)	Charlie & Sebastian	Jonathan, Lukas, Avalika & Aliya
Review (1st design description)	Charlie & Sebastian	Jonathan, Lukas, Avalika & Aliya
Review/User test (1st product)	Everyone	-
Review (final design description)	Sebastian & Charlie	-
Review/User test (final product)	Jonathan & Charlie	Sebastian, Lukas, Avalika & Aliya
Review (final project report)	Charlie & Sebastian	Jonathan, Lukas, Avalika & Aliya
Create a basic layout for the website	Lukas & Aliya	-
Improved layout (i.e. includes choosing between private person and others, viewing guiding texts etc.)	Jonathan & Lukas	Charlie

Create a login	Lukas	Jonathan
Update the default input values etc. through an Excel file	Jonathan	-
Calculate production cost	Charlie	-
Calculate profitability	Jonathan & Aliya	-
Calculate cash flow	Everyone	-
Make diagrams show the results	Jonathan & Charlie	Lukas
Create a downloadable PDF file	Jonathan & Lukas	Charlie
Email function	Everyone	-
Database & Server (i.e. includes being able to download a backup Excel file for the admin)	Jonathan	-
Integration of units	Jonathan	-
Testing	Everyone	-
Others (e.g. create accounts for Trello and GitHub, learn how to use Trello, GitHub and different web technologies, understand the given Excel files)	Everyone	-

Table 4 - The distribution of work and responsibilities.

3.5 Positive experiences

This project has given us a number of positive experiences that we can use later on in our careers. Firstly, having worked with a real client and software project (i.e. a project that is actually going to be used by the client when it is done), has learnt us how a software project could really look like and work in a real life scenario. Furthermore, when working with a client it is also very important to have continuous discussion with him or her about the project's progress, so that you are actually working in the right direction (i.e. fulfilling the client's actual requirements). Secondly, it is always good to let external people (e.g. the client, friends and family) test the software product and then share valuable feedback. This is because the programmer might take for granted that the user should know how to do/use something, since he or she knows exactly how it works and it therefore seems so obvious etcetera. Thirdly, being several people in the group made it easier to divide all of the tasks, which in turn made it easier to finish the tasks before their deadlines. Each person also brought different knowledges and ways of looking at things to the project, and we could therefore learn from each other. Besides this, each person had a different agenda, and that gave us the experience on how to synchronize with others as well. Moreover, it was also a good experience to work with people who speak different languages and have different cultures, since that is usually how it looks like in real life. Lastly, the GitHub repository has been a great way of sharing and storing files (e.g. the code and documentation) which all permitted people can access.

3.6 Improvement possibilities

This project was quite large, consisting of both requirements that were a must and not a must. Our initial plan from the start, was to finish both the requirements that were a must and not a must. However, in the end we only finished the requirements that were a must. This was because of reasons such as the following: The provided Excel files (i.e. which we based most of our implementations on) by the client was in Swedish, and therefore it took more time for the English speaking group members to understand them. The calculations of the cash flow tables were quite vast and time consuming, since they contained a lot of columns with different calculations that needed to be calculated. It also took a lot of time to for example test all of the columns' calculations in the cash flow tables (i.e. each column consisted of approximately 51 cells that needed to be tested). This made us change our initial plan to instead focusing on implementing the requirements that were a must as good as possible, since it is better to have all of the "minimum" functionalities than just some of them. In a similar future scenario, we would probably know approximately how much time some tasks will take, and could therefore plan our time better. A good strategy to finish tasks in time, is also to set an internal deadline a few days before the actual deadline, since some tasks usually take more time than you would expect.

The project often required tasks to be divided amongst the group members, and sometimes it took too long for a person to finish their task etcetera. Therefore, it is very important for that person to inform the others if he or she needs help at an early stage to not waste precious time. Furthermore, the earlier you decide what clearly needs to be done and by whom, the better it is. In addition to this it is good if each group member takes their own initiative and choose what tasks to do, instead of having the rest of the group pointing out what he or she could do. Having self-assigning of tasks and then just notifying the rest of the group what you are going to do, could improve the production rate. Finally, it is also important to try to divide the workload equally (e.g. three people do the documentation and three people do the implementation) to be even more productive on several fronts at the same time.

Appendix

Here you can see all of the test cases that have been used in the acceptance test.

Appendix A

These are tables containing the different test cases used in the acceptance test.

ID	1
Title	Choose between private person and other user
Pre-conditions	You are on the website
Test steps	1. Click on any of the three tabs "indata", "grundläggande antaganden" or "resultat" 2. Click on either the "privat person" or "företag" button
Expected results	The default input values should be affected and appropriate based on your decision

ID	2
Title	View guiding texts, recommended minimum and maximum input values
Pre-conditions	You are on the website
Test steps	1. Click on either the "indata" or "grundläggande antaganden" tab 2. Click on any of the accordions (e.g. "anläggning") to make it drop down 3. Click or hover over the yellow button furthest to the right of any input textbox
Expected results	You should now see a "popup" that shows the guiding texts, recommended minimum and maximum input values

ID	3
Title	Calculate production cost, profitability and cash flow
Pre-conditions	You are on the website
Test steps	1. Enter all your input values in the input textboxes inside the two tabs "indata" and "grundläggande antaganden" (or just use the default input values) 2. Also, if you need to calculate the "internränta (IRR)" for profitability, then go to the "resultat" tab, click the "beräknad lönsamhet" accordion, and finally click the "räkna ut" buttons
Expected results	Now everything should be calculated. To view the calculated results, you have to go to the "resultat" tab. Here you can see the production cost (beräknad produktionskostnad (LCOE)), profitability (beräknad lönsamhet), and cash flow diagrams (click the "diagram" button), downloadable pdf file containing input and output values (click the "ladda ner pdf" button)

ID	4
Title	Generate diagrams
Pre-conditions	You are on the website
Test steps	1. Enter all your necessary input values in the "indata" and "grundläggande antaganden" tabs (or just use the default input values) 2. Go to the "resultat" tab 3. Click on the "diagram" button to view the diagrams
Expected results	Now you should see the diagrams (i.e. pie and line charts) that present the calculated cash flow

ID	5
Title	Download a PDF file containing both input and output values
Pre-conditions	You are on the website
Test steps	4. Enter all your necessary input values in the "indata" and "grundläggande antaganden" tabs (or just use the default input values) 1. Go to the "resultat" tab 2. Click on the "ladda ner pdf" button to download the PDF file
Expected results	A PDF file containing all of the input and output values is downloaded to your computer

ID	6
Title	Admin login
Pre-conditions	The website is in "login mode" (i.e. it is done by adding "?admin=true" to the URL)
Test steps	1. Click the "logga in" button in the navigation bar 2. Enter the username and password inside the modal window 3. Press the "logga in" button inside the modal window
Expected result	You should now have been forwarded to the admin version of the page, in which you have admin controls available (i.e. upload excel file, download excel template and current excel file).

ID	7
Title	Upload an Excel file to update the default input values, guiding texts, recommended minimum and maximum values
Pre-conditions	1. An Excel file is prepared with the suitable updated data 2. You have logged in as admin (test case ID = 6)
Test steps	1. Click on the "ändra standardvärden" button in the navigation bar 2. Click on the "välj fil" button and choose your prepared Excel file 3. Click on the "ladda upp standardvärden" button
Expected results	The database's data-tables should now be updated with the new information. This in turn updates the whole website (i.e. the default input values, guiding texts, recommended minimum and maximum values) when it is refreshed.

ID	8
Title	Download a previously uploaded Excel file or Excel file template
Pre-conditions	You have logged in as admin (test case ID = 6)
Test steps	1. Click on the "ändra standardvärden" button in the navigation bar 2. If you want to download the currently used Excel file, then click on the "ladda ner nuvarande excel fil" button 3. If you want to download the Excel file template, then click on "ladda ner mall" button
Expected results	Either the currently used Excel file or Excel file template is downloaded to your computer