Capstone checklist for standards, sustainability, health & safety and legal.

Student name: Nevzatcan Çırpıcıoğlu	Student id:1806538	Course: xxx4992
Project Title: Estimation of Real and Predicted Plane of Array Radiation	Project code: 1010283	Date: 05/06/2022

Provide a brief overview of your project

> For this project; firstly, it is planned that the related proper mathematical models will be compared such as Liu Jordan, HDKR, Reindl, Badescu, Bugler. Results will be observed and the most precise one will be chosen to estimate Plane of Array Radiation related with the Global Horizontal Irradiation. Gathered estimation will be closely compared with the real values which will be obtained from the companies or literature. If the final results are still very apart from each other, new development and approaches is going to be integrated into the model. The determined model will be transformed into a web application that customers can access from anywhere with internet access. It will be a modular solution for their businesses, where they can benefit from these models and facilitate their decision making.

Part A - Overview

1. What are the main functional and performance requirements of your product or sub-system?

> The crucial functional and performance requirement for the product is creating an estimation method which gives the most possible precise POA values compared with the actual data.
> Our basic functional requirements as a sub-system are as follows, the user will enter the system, they will be able to select the location information, information about the process will be sent. The performance requirements of the subsystem are as follows; The result will be shown to the user within 10 minutes. Correct information will be delivered to the user.

2. What are the dominant design constraints for your product or sub-system?

> One of the biggest constraints is; insufficient resources to build custom experiment. Custom experiment could facilitate the comparison process.
> As a sub-system, the design constraints determined the requirements expected from us by the lead department in the project. They conveyed the needs of the users to us, and we made the design and development decisions accordingly.

3. Who will be the users of your product?

> Mainly, PV module users, PV system companies but especially investor candidates.

4. What realistic operating conditions have you assumed your product will be exposed to?

> Required operating conditions mostly lie on Global Horizontal Irradiation, it is the leading factor that affects POA.
> The product we developed as the sub-system is digital, we have worked on it being safe and accessible on the internet.

Part B - Standards

1. What safety standards apply to your product or sub-system? For example, ISO.

Standards and recommendations on information technology and application security from the documents published by IEEE (Institute of Electrical and Electronics Engineers) Computer Society and ISO (International Organization for Standardization) institutions will be taken into consideration.

2. Are there any basic standards (legal metrology) that apply to your product or sub-system?

There are no legal restrictions that set a basic development standard.

3. Are there any performance standards that apply to your product or sub-system?

The results in the article Defining Standards for Web Page Performance in Business Applications will set a performance standard for us.

4. Are there any codes (government laws) that apply to your product or sub-system

KVKK (Law on the Protection of Personal Data) and BDDK (Banking Regulation and Supervision Agency) have regulations and laws on personal data and digital payment.

5. Other.

Your answer...

Part C - Economic impacts

1. Explain how you minimized the cost of your prototype, and how production costs could be reduced if the prototype were to be mass produced?

The only cost that might appear is building a custom experiment. If custom experiment is conducted, minimal amount of tools and modules will be used. Otherwise there is no cost that can be avoided in terms money.

2. Compared to other similar products that are on the market, how does your design lead to cost savings for the user?

It is offered to the users that: First, the significant cost-saving effect will be higher energy production with the same number of modules, resulting in a reduced payback period. Instead of similar computer-based software programs, users can be offered a web application. This solution will save time for users as it is more flexible. In addition, web programs can be accessed from anywhere with an internet connection and the user does not need to invest in hardware.

3. Would there be any *tax incentives* to be considered towards final product cost. For example, renewable energy and energy-efficient products tax incentives, carbon footprint reduction, etc.

Application will lead increasing the efficiency of PV modules. Meaning that same amount of energy will be able to generated with less PV modules. Therefore, the demand for PV module related with the same amount of energy will decrease. In terms of carbon footprint, less production will directly cause less carbon emission.

4. Are there any environmental aspects, such as availability of resources that may affect the product cost and therefore price and market vulnerability?

> There is an expected outcome which can be estimated as that: If the profit increase occurs with efficiency increase through the application, PV module prices may increase suddenly until the saturated availability of PV modules. However, all of these would result in a growth of renewable based energy generation. Meaning less conventional based energy production.

Part D - Environmental impact

1. Are there any greenhouse gas emissions related to the production or use of your product, what aspects of your design attempts to reduce those emissions?

> For the whole process of the project, completely non zero greenhouse gas emission is offered since this is a software application project.

2. Does your product require usage of environmentally sensitive resources such as water, energy, wood, etc. and how does your design encourage efficient use of such resources?

> Project has been built conveniently on the environmental friendly vision. It will lead the sensitive usage of the natural resources, while the solar energy is going to be utilized more efficiently.

3. Does your product rely on materials or resources that scarce (such as rare elements)? Has your design been adapted to make use of materials that are more abundant?

> The design for the project uses completely abundant resources since it is software based application.

4. Does your product introduce or encourage different usage or behaviors that are more environmentally friendly?

> The application will encourage and serve the ones that are willing to contribute environment, the ones who would like generate their own energy, the ones that are about to join the solar energy users but want to see the realistic data and the most possible outcomes. It will show how profitable solar energy is when it is installed relevant with custom based locations.

Part E - Social impact

1. In what way can your product impact people's lives (positively and negatively)? What design decisions have you made to maximize positive impact and minimize negative impact.

> Some of the major facilities that will be brought within the applications may follow as: Increasing trend for the availability of the PV systems so the increase on relative job opportunities. Self-energy generation concept will gain popularity among society. All of these above will result in less conventional based energy demand which may actually pose a downsize trend on that sector. However; diminish for the conventional market could be covered with the increasing trend on solar energy market related with job opportunities.

2. Does your product address any social needs?

> Project is determined to be assigned as a realistic-based option which offers people being able to gain energy independency for those who are not satisfied with the current regulations and tariffs they involve in.

3. Who will benefit from this product?

Application is going to be advantageous mostly for those who currently own an installed PV system, since the optimization they will benefit from the application will only increase their profit. However; anyone that has the facility to generate energy from the sun can also monitor the various amount of possible advantages which can be obtained.

4. If your product were to be mass-produced, would it create new jobs, or destroy jobs?

It definitely can be stated that, success of this project will outcome as great broaden for the Solar energy sector since accessibility and availability for the solar systems which are one of the most available renewable energy resources, will increase in the long term period. These will pose a reduction of job opportunities for the non-renewable based energy sectors. However; new job opportunities will be supplied with the broaden usage of solar systems.

Part F - Health and safety

1. What relevant health and safety laws or standards does your product or sub-system comply with?

It is a project that utilizes equipment that does not pose any harm to health and safety laws.
It complies with the laws of KVKK (Law on the Protection of Personal Data) and BDDK (Banking Regulation and Supervision Agency) to protect your data and payment information. It will be a project that implements the digital security criteria of the ISO (International Organization for Standardization) institution. Users will be using an application that complies with security standards on the web.

2. What practices did you adopt during the development of your prototype to protect your own health and safety and the health and safety of those around you?

No precaution needed to be taken since this is a literature review and software based project.

3. What design decisions did you make to increase the safety of your product or sub-system?

While creating the software architecture, we separated the basic functions of the application and implemented a layered architectural solution. We have established a modern software architecture recommended in current sources, thus reducing the risks.

4. Can your product be used in any way that can impact the health and safety of the user or others?

Project is built on environmental friendly vision. Therefore, contribute to a more renewable based energy for the future, will be achieved through the facilities that application will offer. With less greenhouse gas emission, the effect of one of the biggest concern which impact human`s health will be diminished.

Part G - Legal

1. What laws or regulations apply to your product?

We must apply the regulations and laws determined by KVKK (Law on the Protection of Personal Data) and BDDK (Banking Regulation and Supervision Agency). There are regulations regarding the storage conditions and security of users' data. These regulations tell us under what conditions the information of our users can be kept.

2. The manufacturer of a product is liable for any damage or harm that results because of a defect. What harmful defects could occur during mass production of your product, and how could they be minimized?

> Our product is a virtual product and will not be a mass production process. One of the biggest risks in your app is losing the website. The precaution we take is to back up the website at regular intervals.

3. Have you violated any licenses or patents in the development of your prototype? Would there be any such violations if the product were mass produced? How have you mitigated such issues?

> The software languages and applications we use in our application are open-source projects. Since they are developed and supported by the Communities, no fee is paid for their use and a license fee cannot be requested. It is a very popular and common approach in the software world.

4. What security and privacy laws are relevant to your product or sub-system, and what aspects of your design ensure that these laws are adhered to?

> A software license is a document that protects the rights of the copyright holder (software manufacturer). Copyright owners' rights are also protected by law. It expressly declares that people cannot copy software without permission. In addition, we will not keep user information, which is mandatory to be kept within the country within the scope of KVKK (Law on the Protection of Personal Data), unless necessary conditions are met.

5. Other

> Your answer:

Part H - Others

Do you have any other relevant information to share related to your design experience regarding *standards*, *sustainability*, *health & safety* and *legal* aspects of your capstone project?

> The project aims to be titled as one of the contributors for the non- zero emission world. It will be designed and conducted relatively in order to achieve this.