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Chapter 1

Introduction

Chapter 2

Problem analysis in market gardening

In this chapter, we will talk about market gardening. It contains all pieces of information needed to understand the thesis, even without any knowledge of this field. We will also analyse this field and define different problems encountered during the management of a market gardening farm.

2.1 Some vocabulary about market gardening

First, it can be useful to define some common terms used in gardening.

Market gardening A market gardener is someone who produces fruit and vegetables on a relatively small area. The difference between a farmer and a market gardener is principally in the type of final product. Where a farmer will produce more cereals, a market gardener is specialized in fruits and vegetables. We will use the term *Truck farmers* for gardens that are cultivated with heavy machinery.

Bed A bed in a market garden is a surface of production, usually a line. It is used to divide the field in smaller cultivated areas. A representation of beds is shown on figure 2.1. Market gardener usually choose the width of their beds according to the width of the tools they are going to use.



Figure 2.1: Beds in a market garden

Crop rotation In order to preserve the soil from draining and to eliminate some diseases specific to some plant species, some market gardener rotate their cropping. If they plant one type of vegetable on a bed, the year after they will plant another type of vegetable on this bed. They will not plant two years in a row the same vegetable on the same bed.

2.2 Daily life scenario

Seasons Market gardeners live by the rhythm of the seasons: they have a peak of work during the Spring and the Summer. Harvests continue during Autumn but during Winter they usually have less things to do in the garden.

Planning Most gardeners plan their cropping during winter[4], when they have more time to think about what they want to grow this year. Planning the coming year has several advantages :

- Know in advance what amounts of seeds and fertilizers they will have to order
- Take the time to decide what to grow and in what quantities
- Look back at the previous year to see which vegetables were the most profitable and adjust cropping according to this experience.
- Gain time during the rush season by having clearly in mind what has to be done
- Organise the year to spread the work as most as possible (everything can not be seeded the same week)

While really useful, this planning part is not always done by market gardeners.

Adaptations Once the work season has started, this planning has to be adapted to the reality on the ground. The weather is the major factor of changes in the planning. Indeed, some seeding requires several days of dry weather followed by one day of rain for example. In the case of difficult weather (late frost, large humidity,...), whatever was the initial plan, the gardener will have to adapt his schedule to the weather. Others factors that disrupt the work set-up can be diseases in the crops, short staffing or hardware issues. One example scenario could be: We are the first week of July, the season is in full swing. Tim is a market gardener and had planned to plant endives this week. The weather conditions are perfect, so he could stick to his plan. Unfortunately, his tomatoes have mildew¹ and if he wants to save his tomatoes' crops, he has to treat them immediately.

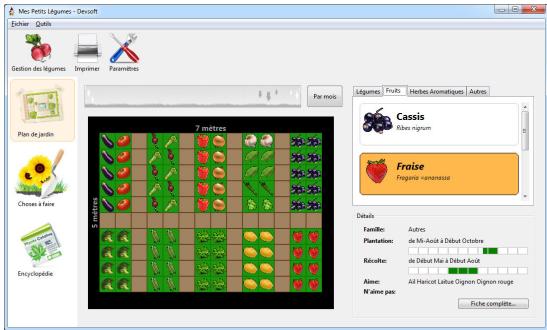
This example shows that some events have priority over the initial plan and confirm the idea that initial planning is meant to evolve.

It is essential for a market garden to be able to adapt its plans to a specific situation and to keep a clear head as we go along the season. Planning is already not an easy task, but adapting to changes is even harder.

2.3 Profitability of market gardens

Workforce Market gardeners don't count their hours as regular workers. They work all day in order to reach their objectives of the day. Most of them have no idea of how long each culture takes. It also means that they have no idea how profitable their cultures are. Moreover, they often need external workers to help them during the peak season. These external workers represent 50% of production costs [8]. Consequently, organizing the work to reduce the need of external workers can have a considerable impact on the garden's profitability.

¹an epidemic fungus <https://en.wikipedia.org/wiki/Mildew>



(a) Visual representation of a garden planning



(b) Intercropping advices

Figure 2.2: Screenshots of the software *Mes petits légumes*

Vegetables profitability Some vegetables are more profitable than others. For example, Jean-Martin Fortier [8] in his book gives data about the profitability of the vegetables he's growing. However, most farmer don't do this analysis on their production and have therefore, no idea of which cropping is the most profitable. Even in the table of Jean-Martin Fortier, we have no idea of the work time needed for each culture. And yet we have seen before that workforce represent a significant cost. Moreover, from one area to another it is reasonable to think that some crops will be more profitable than others. Depending on the clients' preferences or the soil type, some vegetables will be easier to sell or to crop. Gardeners are mostly not analysts and don't have the right tools to give them an idea of how profitable their business is and how they could be more efficient.

Others profitability factors

- Retail strategy: different retail strategies will give different revenues, the more intermediaries there are between the producer and the client, the less the producer will gain.
- Pricing strategy: of course, the selling price of vegetables will affect the profitability of this vegetables. Depending on which retail strategy is chosen, prices will be more or less flexible.

Antoinette Dumont has dedicated her doctoral thesis on the subject of market gardens' profitability.[7]

2.4 Researches in gardening

2.5 Existing tools

From our researches, there are not lots of software to help farmers of all kind in their daily life. Most of them are not open source.

First, we found softwares like *Mes petits légumes*[3] intended for non-professional market gardeners, with a great library of data about lots of vegetables. The software can be bought once for 19 € or one can use the free incomplete version. Two screenshots of this application are shown on image 2.2

Then, we have softwares like *LEA*[2] more focused on the management of the business and intended for big farms. It can generate bill from tractor work. It helps managing stocks and uses of fertilizers. Once again, the software is not open source and a subscription is required to use it.

Finally, we have found a software that seems to have a purpose and a target audience similar to this project. *Tend*[6] is a software developed in the USA by a Startup. It has lots of features,

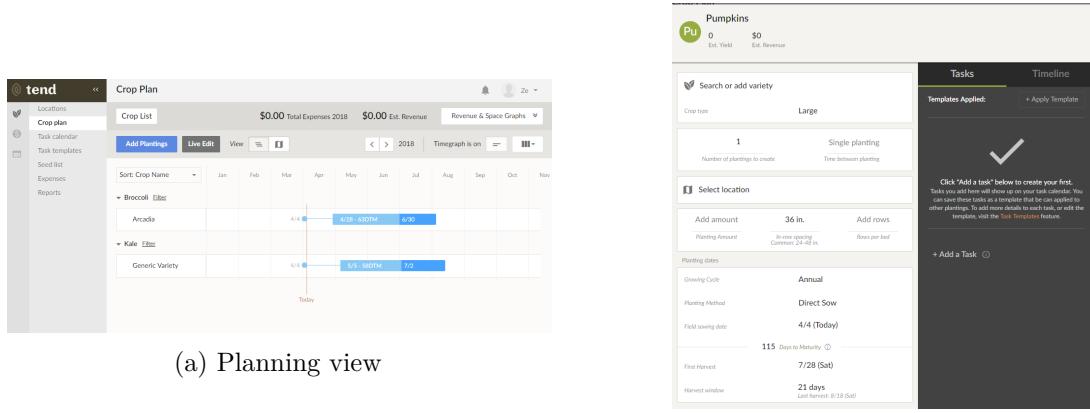


Figure 2.3: Screenshots of the software *Mes petits légumes*

including a databases of vegetables, a task calendar and an expenses section. The main feature (constitute a crop plan by adding plantings) is shown on figure 2.3.

These software show that farmers are in need of tools to help them in their planning and management. The poorness of software really adapted to their needs show that this field has been forgotten by technology.

2.6 Conclusion

From this analysis of the field of market gardening,

+ say that this is where this thesis comes in Give more informations on each software.
Screenshots.

Chapter 3

Problem analysis in software engineering

For each thing you explain also say why you explain it, what role will it play later in this thesis

pq web, pq Python et donc Django? Pq en français?

3.1 Clients and their needs

3.1.1 UCL

3.1.2 Market gardeners

Meetings

3.2 Vocabulary in software engineering

In this section, we define some concepts specific to software engineering. These concepts will be used in the following sections. This section can be skipped by experts of the subject.

Agile Methodology The Agile methodology is a set of techniques and principles for conducting a development project. The main principle is to iterate over short periods (called sprints) divided in subphases in order to build the final product in an incremental way. A sprint lasts between one and two weeks and is divided as follows:

- At the start of each iteration, we plan with the client what we are going to do this iteration.
- Next step is to think about how to build a good design to achieve the objective
- Then, we develop the features
- After, we test these features. If we switch these last two steps, we apply what is called Test-Driven Development. With this methodology, a team write tests before developing the corresponding features, ensuring that the tests will cover all the cases
- At the end of each sprint, we meet the client again to validate the changes and new features, collect his feedback about the project's progress and to define together the future work.

A visual representation of this iterative approach is shown on figure 3.1

A good summary of the Agile methodology is the agile manifesto[5], that states the main principles of this methodology.



Figure 3.1: Iterations using Agile methodology

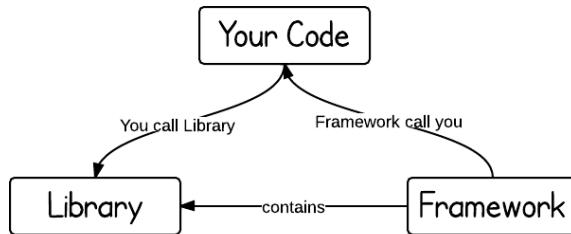


Figure 3.2: Framework versus library



Agile Manifesto [5]

Individuals and interactions over processes and tools.

Working software over comprehensive documentation.

Customer collaboration over contract negotiation.

Responding to change over following a plan.

That is, while there is value in the items on the right, we value the items on the left more.

The main advantages of this methodology are to have flexibility and regular feedback on the product delivered.

Software framework A framework is a set of tools that provides features that can be reused in multiple applications. A framework is different from a library in the sense that when using a library, we call the methods of the library while when using a framework, our code is called by the framework. The difference is shown on figure 3.2. Frameworks help to build reusable and maintainable applications

give some examples of frameworks + why you talk about it, integrate Django with it?

Continuous Integration Continuous integration (often referred as CI) is a software engineering practice to help development teams working on a set repository. When using CI, we automate a set of checks at each push request on a repository and developers should merge to this repository regularly. With continuous integration, we will detect bugs faster and more easily. We can also add tests to our continuous integration tool, these tests will then be run at each push request and we will receive a notification if they fail. Thanks to that, we can see exactly which commit implied a failure in the tests. If we do small regular commits, it will be really easy to find where the failure comes from.

3.3 Which platform?

web pour que ce soit accessible de tous les devices, aussi bien pour les maraîchers sur leurs smartphone que pour les chercheurs sur leur ordinateur.

3.4 Which licence

open source car par une volonté de rentabiliser le logiciel. L'intérêt étant d'avoir le plus de maraîchers possibles pour récolter le plus de données possible du côté des chercheurs.

3.5 Which methodology

agile parce que le problème n'était pas défini dans son intégralité au début du projet, il a été redéfini au fil des semaines, a pris de nouvelles orientations. Feedback régulier des maraîchers

3.6 Which languages?

3.6.1 Programming language

un langage facile d'utilisation, orienté objet, compréhensible. Enseigné aux étudiants de l'université.

Python Python is a programming language used in many fields. Its main advantage is great readability.

Talk more about python? Creator, specificity's, interpreted language, speed, community, TIOBE Index...? <https://www.tiobe.com/tiobe-index/> Mainly explain why you chose it and what its main features/specificities you will rely upon

3.6.2 Web framework

un framework facile d'utilisation, stable et fiable avec une bonne documentation et une bonne communauté. Assez de fonctionnalités, on ne veut pas tout réimplémenter. Quels sont les différents choix? Django, Flask, web.py, autres? Trouver avantages et inconvénients.

Django Django is a web framework to develop web applications in Python.

Develop, why django, what others, what features of Djangos do you rely upon (ORM, authentication, what plugins, and so on

3.6.3 Database language

Postgresql

3.7 Maintenance

Why you explain this, what CI you use, what CI features and tools you use; why you use these

Chapter 4

Solution

Chapter 5

Architecture

Chapter 6

Implementation

Chapter 7

Validation

Chapter 8

Conclusion and future work

Bibliography

- [1] Continuous integration. <https://www.thoughtworks.com/continuous-integration>. [Consulted 26-March-2018].
- [2] LEA. <https://www.lea-agri.com/>. [Consulted 10-January-2018].
- [3] Mes petits légumes. <http://mespetitslegumes.com/>. [Consulted 15-August-2017].
- [4] Planification des cultures : méthodologie. <https://fermesdavenir.org/fermes-davenir/outils/planification-cultures-methodologie>.
- [5] Manifesto for Agile Software Development. <http://agilemanifesto.org/>, 2001. [Consulted 22-March-2018].
- [6] Tend. <https://www.tend.ag/>, 2016-2018. [Consulted 26-March-2018].
- [7] Antoinette Dumont. *Analyse systémique des conditions de travail et d'emploi dans la production de légumes pour le marché du frais en Région wallonne (Belgique), dans une perspective de transition agroécologique*. PhD thesis, Université Catholique de Louvain, 2017.
- [8] Jean-Martin Fortier. *Le jardinier-maraîcher : manuel d'agriculture biologique sur petite surface*. Ecosociete Eds, 2016.
- [9] Mireille Navarrete and Marianne Le Bail. Saladplan: a model of the decision-making process in lettuce and endive cropping. *Agronomy for sustainable development*, 27(3):209–221, 2007.

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