

## **Entrepreneurship and Lean Manufacturing for Software Engineering**

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### **INTRODUCTION**

One of the goals of Engineering Education is the education of our students and job performance in the labor market. For that, we introduce several related aspects focused on Software Engineering. As usual, when we talk about "Software", we talk about an intangible product, so we'll try to give an approach of concepts like Canvas Model, or Value Stream Mapping, but for Software Engineers.

### **SITUATION, QUESTION, INTROSPECTION**

In a general and traditional way, engineering education has been a dense and complex task. Sometimes due to the various bases necessary for the integral formation of an engineer. The first courses have always been made up of mathematics, chemistry, physics, technical drawing...in the last years we added engineering projects skills combined with monitoring production standards and the orderly development of testing. Equally combined with proper documentation and planning, and basic design to achieve successful projects.

In some universities, and always in the first years of the degree, some company management concepts were introduced, but clearly insufficient for the formation of our Engineers. And do not forget, in addition to always work on a project basis, engineers, somehow or another, end up working in companies. Therefore, some additional preparation to their own business of engineering work is considered important.

This need is reinforced with the evolution of the markets prior to the crisis and accentuated during the crisis, the situation has increased the competitiveness of our students to get quality work. In this competition we find the need to "sell a product or service", and found engineering projects included within this global market of optimized development and cost and / or resources cuts.

All this complex situation suffers most in countries like Spain , where economic recovery is occurring more slowly than in the rest of Europe ( although at the time of writing this paper is important to stress that is occurring) .

One of the most successful activities being undertaken within the University of Cadiz, in southern Spain , is the promotion of self-employment and entrepreneurial skills within the Faculty of Engineering. Traditionally Engineering students are entrepreneurs but have never made the leap in business development, and one reason was that they always had to rely on ( and somehow forced to believe ) the guidelines of graduates in business administration. With consistent and natural problems and clashes in the way of thinking and the views of students of a Faculty or another.

This relationship is not broken or anything, but to help in communication, in certain subjects in the final year of Engineering are introducing successful business development skills . Which is greatly helping students to see closer and feasible development projects in technology-based entrepreneurs.

This whole approach is demonstrated in the introduction of development tools such as the "canvas model" and the "lean manufacturing". It is important to note at this point that many teachers somehow knew these methodologies, but it looked impractical to use in the field of Engineering. We offer the opposite view then both are perfectly usable but not only necessary to complete the circle of development projects.

## **ENGINEERING AND CANVAS MODEL**

A business model is nothing else than a representation of how an organization makes (or intends to make) money. Business models are used to describe and classify businesses, especially in an entrepreneurial setting, but they are also used by managers inside companies to explore possibilities for future development.

Business plans are decision-making tools. There is no fixed content for a business plan. Rather, the content and format of the business plan is determined by the goals and audience. A business plan represents all aspects of business planning process declaring vision and strategy alongside sub-plans to cover marketing, finance, operations, human resources as well as a legal plan, when required. A business plan is a summary of those disciplinary plans.

But don't forget we are handling with Engineering students, so let's be more accurate to them. Better to use Business Canvas Model.

The Business Model Canvas (BMC) offers a structured but lightweight tool for vetting a business model- it gives you the structure get from a business plan without the overhead and the flexibility and improvisation you have on a napkin without the lack of structure and comprehensiveness. We define a business model as consisting of 9 building blocks that constitute the business model canvas :

1. The value proposition of what is offered to the market;
2. The segment(s) of clients that are addressed by the value proposition;
3. The communication and distribution channels to reach clients and offer them the value proposition;
4. The relationships established with clients;
5. The key resources needed to make the business model possible;
6. The key activities necessary to implement the business model;
7. The key partners and their motivations to participate in the business model;
8. The revenue streams generated by the business model (constituting the revenue model);
9. The cost structure resulting from the business model.

And here some hints for the Engineering students in Cádiz:

1. Customer Segments: Who are the customers? What do they think? See? Feel? Do?
2. Value Propositions: What's compelling about the proposition? Why do customers buy, use?
3. Channels: How are these propositions promoted, sold and delivered? Why? Is it working?
4. Customer Relationships: How do you interact with the customer through their 'journey'?
5. Revenue Streams: How does the business earn revenue from the value propositions?
6. Key Activities: What uniquely strategic things does the business do to deliver its proposition?
7. Key Resources: What unique strategic assets must the business have to compete?
8. Key Partnerships: What can the company not do so it can focus on its Key Activities?
9. Cost Structure: What are the business' major cost drivers? How are they linked to revenue?

So the Business Model Canvas is a strategic management and entrepreneurial tool. It allows you to describe, design, challenge, invent, and pivot your business model. The Business Model Canvas can be printed out on a large surface so groups of people can jointly start sketching and discussing business model elements with post-it note notes or board markers. It is a hands-on tool that fosters understanding, discussion, creativity, and analysis. (See fig. 1)

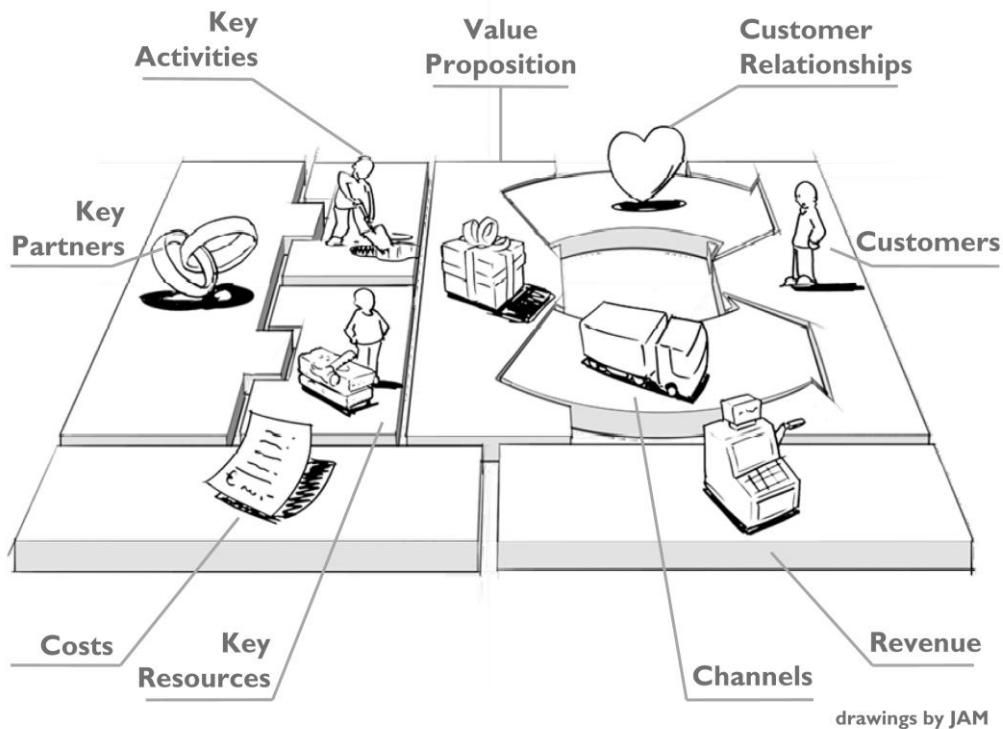


Fig 1. Basic Canvas Model

Basis and introduction were shared with students, some of them understood at once, but for the majority were necessary some hints. Here in fig 2.

<p><b>KEY PARTNERS</b></p> <p>Who are our key partners? Who are our key suppliers? Which key resources are we acquiring from our partners? Which key activities do partners perform?</p>	<p><b>KEY ACTIVITIES</b></p> <p>What key activities do our value propositions require? Our distribution channels? Customer relationships? Revenue streams?</p>	<p><b>VALUE PROPOSITIONS</b></p> <p>What value do we deliver to the customer? Which one of our customers' problems are we helping to solve? What bundles of products and services are we offering to each segment? Which customer needs are we satisfying? What is the minimum viable product?</p>	<p><b>CUSTOMER RELATIONSHIPS</b></p> <p>How do we get, keep, and grow customers? Which customer relationships have we established? How are they integrated with the rest of our business model? How costly are they?</p>	<p><b>CUSTOMER SEGMENTS</b></p> <p>For whom are we creating value? Who are our most important customers? What are the customer archetypes?</p>
<p><b>COST STRUCTURE</b></p> <p>What are the most important costs inherent to our business model? Which key resources are most expensive? Which key activities are most expensive?</p>	<p><b>KEY RESOURCES</b></p> <p>What key resources do our value propositions require? Our distribution channels? Customer relationships? Revenue streams?</p>		<p><b>CHANNELS</b></p> <p>Through which channels do our customer segments want to be reached? How do other companies reach them now? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?</p>	
<p><b>COST STRUCTURE</b></p> <p>What are the most important costs inherent to our business model? Which key resources are most expensive? Which key activities are most expensive?</p>		<p><b>REVENUE STREAMS</b></p> <p>For what value are our customers really willing to pay? For what do they currently pay? What is the revenue model? What are the pricing tactics?</p>		

SOURCE [WWW.BUSINESSMODELGENERATION.COM/CANVAS](http://WWW.BUSINESSMODELGENERATION.COM/CANVAS). CANVAS CONCEPT DEVELOPED BY ALEXANDER OSTERWALDER AND YVES PIGNEUR.

Fig 2. Questions for Canvas Model

In this point we received some questions about the application of this management tool for engineering. As a good answer we develop Canvas Model for Software Engineering (understanding Software Engineering as the most intangible and not concrete Engineering)

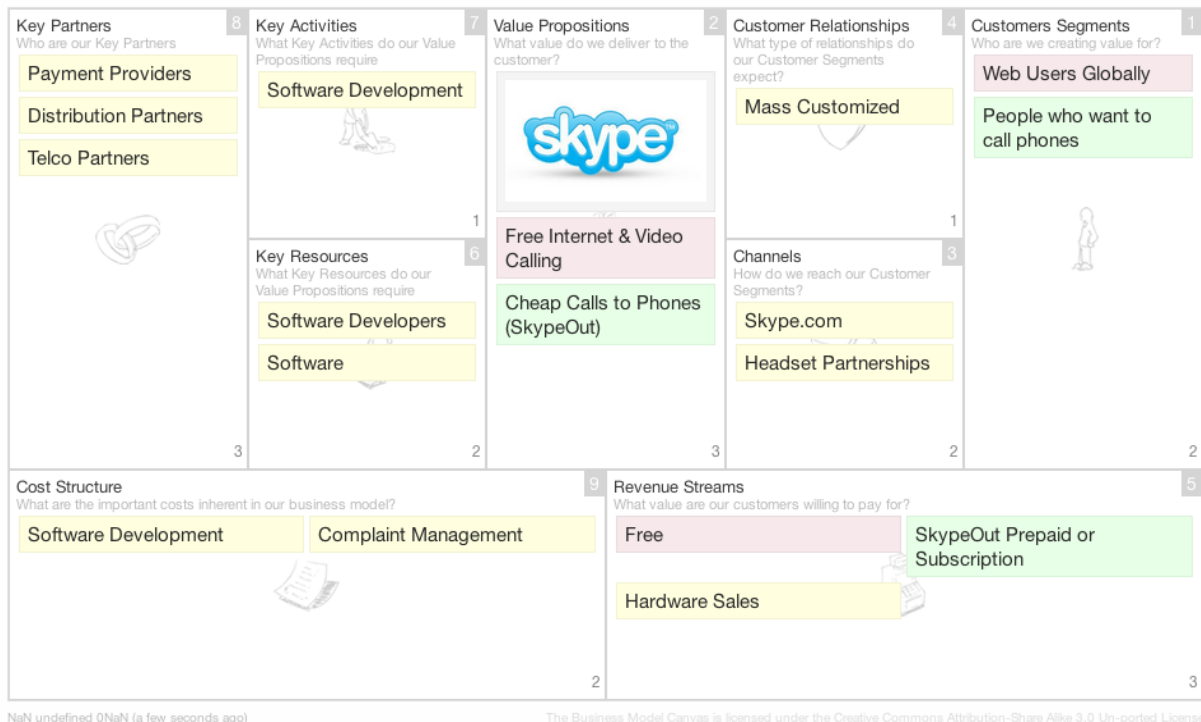


Fig 3. Canvas Model for Skype

Concerning the Canvas Model and Software Engineering, one of the most common problem for the students was the Customer Segments. Is important to distinguish between customers and users. If you have multiple user roles in your product, identify customers.

A customer is a someone that pays for your product

Split broad customer segments into smaller ones. While you might be aiming to build a mainstream product, you need to start with a specific customer in mind. Even Facebook, with it's now 500 million+ users started with a specific user in mind (Harvard college students).

## ENGINEERING AND CANVAS MODEL & LEAN MANUFACTURING

Now that our students have some skills about Canvas Model, we mix it with Lean Manufacturing. In this, the expenditure of resources for any goal other than the creation of value for the end customer is wasteful, and thus a target for elimination.

Preserving value with less work. Lean manufacturing is a management philosophy derived mostly from the Toyota Production System

The Lean Canvas is the perfect format for brainstorming possible business models, prioritizing where to start, and tracking ongoing learning.

Ok, but talking about Software Engineering, what do you mean by waste? what you consider a waste is? in terms of software development, a waste would be:

- unnecessary code and functionality (If some activity could be bypassed or the result could be achieved without it)
- delay in the software development process
- unclear requirements(Extra processes and features not often used by customers are waste)
- insufficient testing (leading to avoidable process repetition)
- bureaucracy
- slow internal communication

Lean development can be summarized by seven principles, very close in concept to lean manufacturing principles:

1. Eliminate waste
2. Amplify learning
3. Decide as late as possible
4. Deliver as fast as possible
5. Empower the team
6. Build integrity in
7. See the whole

We have already seen about detect and eliminate waste, but what about the rest? We can solve point 2 increasing feedback via short feedback sessions with customers helps when determining the current phase of development and adjusting

efforts for future improvements. During those short sessions both customer representatives and the development team learn more about the domain problem and figure out possible solutions for further development.

For point 3, Decide as late as possible, as software development is always associated with some uncertainty, better results should be achieved with an options-based approach, delaying decisions as much as possible until they can be made based on facts and not on uncertain assumptions and predictions. The more complex a system is, the more capacity for change should be built into it, thus enabling the delay of important and crucial commitments.

Number 4, Deliver as fast as possible: the just-in-time production ideology could be applied to software development, recognizing its specific requirements and environment. This is achieved by presenting the needed result and letting the team organize itself and divide the tasks for accomplishing the needed result for a specific iteration. This requires transparency of the process, which is also beneficial for team communication.

Empower the team: another mistaken belief has been the consideration of people as resources. People might be resources from the point of view of a statistical data sheet, but in software development, as well as any organizational business, people do need something more than just the list of tasks and the assurance that they will not be disturbed during the completion of the tasks. People need motivation and a higher purpose to work for the purpose within the reachable reality, with the assurance that the team might choose its own commitments. The developers should be given access to the customer; the team leader should provide support and help in difficult situations, as well as ensure that scepticism does not ruin the team's spirit.

Last two points, Build integrity in

: conceptual integrity means that the system's separate components work well together as a whole with balance between flexibility, maintainability, efficiency, and responsiveness. This could be achieved by understanding the problem domain and solving it at the same time, not sequentially.

(Notice that you can apply this and some more points to all fields of Engineering).

And last one, See the whole: Lean thinking has to be understood well by all members of a project, before implementing in a concrete, real-life situation.

*"Think big, act small, fail fast; learn rapidly"*, these slogans summarize the importance of understanding the field and the suitability of implementing lean principles along the whole software development process. Only when all of the lean principles are implemented together, combined with strong "common sense" with respect to the working environment, is there a basis for success in software development.

## **IN A NUTSHELL**

Although statistics employability of our students are favorable , it is important , given the current crisis , every effort to improve their employability skills.

Were shown some key concepts and entrepreneurial business development and engineering student aid. The technology-based companies need this knowledge for their development and well founded especially to avoid unnecessary costs to the same high standards.

As application example we have worked to Software Engineering , but also can perform Model Canvas for any type of Engineering.

Already there are several groups of engineering students at the University of Cádiz , which , using these new capabilities are developing I have already developed successful entrepreneurial ventures .

In short, the introduction of these small capacities in the education of our students can convey a lot of security and open new doors in business and entrepreneurial development in an era in which innovation and autonomy are considered essential.