A Heuristic Approach for Supporting Innovation in Requirements Engineering

Ricardo André Cavalcante de Souza[1], Gilberto Amado de Azevedo Cysneiros Filho[1], Glauber Henrique Camelo Batista[1]

[1] Federal Rural University of Pernambuco, Department of Statistics and Informatics, Pernambuco, Brazil
ricardo.andre@deinfo.com.br, {gilberto.cysneiros, glaubercamel}@gmail.com

Abstract. The first activity that most software development projects take is to elicit and document the project's requirements. Requirement elicitation is one of the most critical activities in the software development process. The ability to do it well is crucial to the project's success. The experience has shown that poor requirements frequently lead to rework, cost overruns and even project failure. Although several tools, processes, models, methods and frameworks have been developed to help with requirement elicitation, there is much less support for innovation through Requirement Engineering in software product development process. In this paper, we describe an approach to design innovative software. Innovative softwares are products that differ of the existing products and that aggregate value for customers or end users.

1 Introduction

Nowadays there is a lot of software available to most of market segments. Therefore, it is not enough only develop software with similar functionalities even when it is cheaper and it has functionalities improved. The software needs to differentiate from its competitors and to be innovative.

To survive in the business environment today it is increasingly important to allow creativity and innovation in the Requirement Engineering process to stay ahead of competition and to keep customers interested in your software products.

Traditionally, the metrics that a project's success is measured against include meeting the following key evaluation criteria: i) adherence to specified requirements; ii) compliance with initial budget estimations; iii) timelines of agreed delivery.

Nowadays, to be considered a successful project, a project must not only meet each of these three important criteria. It has also to create software that will "change the world", that transforms the company or how it conducts its business [5].

Traditional requirements elicitation techniques are ill equipped to deal with creativity and innovation. Traditional techniques only focus on identifying business and user requirements, but rarely lead to revolutionary ideas capable of changing paradigms and redirect a market [4].

This paper presents an approach to address this problem based on practices and tools from innovation-driven approaches [4,9,12,14]. The approach was mainly designed to support the software development by organizations categorized as Startup. In this paper, Startups are undertood as a company or a group of people, included in a public or private organization, who aim to develop innovative solutions based on software in a context of extreme uncertainty [14].

The main purpose of this work is to provide support for innovation through Requirement Engineering in the softwaredevelopment process. Therefore, the approach is not intended to be used when the requirements are well understood and based only on the explicit desires of users and clients.

The rest of the paper is organized as follows. Section 2 presents the conceptual background used as a reference for the elaboration of this work. Section 3 describes our approach. In the section 4, a case study is used to illustrate the approach. Finally, in the section 5 concluding remarks and directions for future work are outlined.

2 Background

Innovation plays an important role in corporative strategies and to support the search for innovation in different domains several approaches has been proposed in the literature. Examples of these approaches are: Design Thinking [4], Blue Ocean Strategy [9], and Lean Startup [14].

Innovation-driven approaches emphasize the humam perspective and provide methods for eliciting customer needs, rather than requirements. Human-centered innovation method, like Design Thinking, can be applied to ill-defined problems within a real-world context, which is characteristic of apps for mobile devices [16].

Design Thinking runs from the superposition of the following spaces: (i) "inspiration", which are identified in the circumstances (problem, opportunity, or both) that motivate the search for solutions; (ii) "ideation", which is the process of generating, development and testing of ideas that can lead to solutions; and (iii) "implementation", which is the path that leads the product/service to market.

Design Thinking search innovation from constraints imposed by criteria: i) "practicality", which is functionally possible in the near future; ii) "possibility", which will probably become part of a sustainable business model; iii) "perception", which makes sense to people.

Blue Ocean Strategy consist into discover a new niche market, offering customers something unique, unexplored in a given segment, producing a so-called value innovation that aligns innovation with: immediate utility, competitive price and costs reduction.

Lean startup is based on the build-measure-learn cycle. Build consists in turn ideas into a minimum viable product (MVP), which is a stripped-down version of the product used to get quick feedback from customers. Measure consists in to examine empirically the reaction of customers regarding the use of MVP and thus collect data to measure progress. Finally, learn consists in decide to maintain the current strategy or making any adjustments or route deviation.

3 Our Approach

The proposed approach consists of a set of tasks grouped in Business Modelling and Requirements phases based in agile paradigm. Business Modeling helps to identify the company's goals that can give rise to system requirements. The implementation of the requirements satisfies the company's goals.

The proposed approach consists in the following tasks (see Fig. 1): i) Identify Innovation Opportunities; ii) Evaluate Competitors; iii) Specify Competing Factors; iv) Ideation; v) Design Business Model; vi) Develop Vision; vii) Define Product Backlog. The tasks of Business Modelling phase summarize some of the main activities of the innovation-driven approaches [4,9,12,14] used as reference for this work. The tasks of Requirements phase are based in the initial steps of the agile process SCRUM [15]. We consider that the tasks should be executed jointly by an interdisciplinary team with shared responsibility.
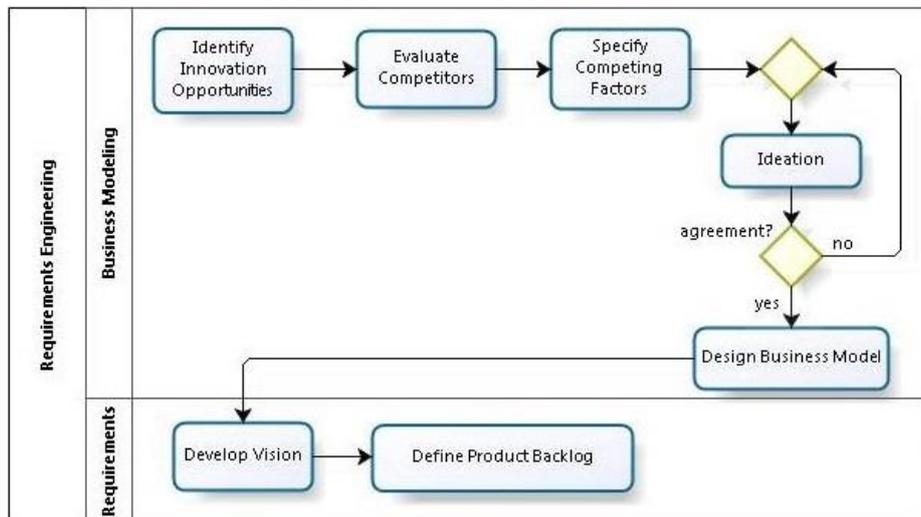

Fig 1. Process to Support Innovation in RE

3.1   Identify Innovation Opportunities

The process starts with the observation and study of a segment of market to identify opportunities for products and services that meet the needs undeclared (latent) of people and turn them into possible demands.

The ideas are freely conceived and discussed by the team through brainstorming sessions. The brainstorming sessions must follow the rules: defer judgment, defer criticism, encourage different ideas, stay focused on the topic, and ideas based on other ideas. The ideas presented should be attached to a viable business strategy to create value for customers, but also represents the possibility of gains.

3.2 Evaluate Competitors

In this task, solutions related in the existing target market are evaluated to avoid creating something already existing. The evaluation is based on objective criteria such as reputation (i.e. user feedback) and popularity (i.e. number of downloads).

The evaluation of competing solutions is mapped into Strategy Canvas [9] describing the factors that govern the current competition in the market, and the offering level of evaluated solutions to these attributes.

The Fig. 2 [3] presents a reference model to Strategy Canvas. The horizontal axis defines the competing factors used in the comparison between the average of the approaches found in the market (industry value curve) and the proposed approach (blue ocean strategic moves).

The proposed approach generally adds new attributes not met by the market. The vertical axis of the matrix identifies the offering level for each competing factor (represented by dots) by the compared approaches on a scale of lo (low) to hi (high).
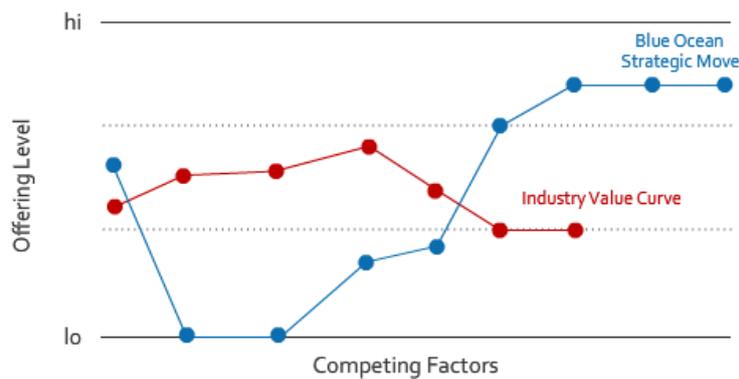

Fig 2. Strategy Canvas.

3.3 Specify Competing Factors

The next task is to define which competing factors should be eliminated, reduced and increased in relation to the industry standard, and which factors not offered by the industry should be created. Four Actions Framework [9] is used for this purpose.

3.4 Ideation

In this task, the team goes in search of insights through Experience Scenarios [4] and Direct Observation [4]. The insights gained by the team assist in create a new Strategy Canvas to describe the new value curve in order to differentiate the proposed solution compared to the market average.

The next step is to discuss, evaluate and rule out alternative solutions to reach a consensus on what should be offered. The prototyping technique is essential to give life to the alternative solutions and help in decision making.

The prototypes range from simple sketches on paper, to design user interfaces (UI) aided by computer tools, and functional software. The objective is to evaluate different alternatives before reaching a solution "optimal", and hit from mistakes.

Another technique is to produce storytelling which consists of possible scenarios of future use of the proposed solution described through stories illustrated by pictures, text, and fictional characters.

The Ideation task is repeatedly executed until an agreement has been reached between the team and clients that the proposed solution is the best alternative.

3.5 Design Business Model

At the end of the Business Modeling phase is produced a business model through Canvas Business Model [12]. The building blocks of the Business Model Canvas are the following: Customer segments (CS) - to identify those who want to create value; Value Propositions (VP) - to identify which value is delivered to the customer segments; Channels (CH) - describe how an organization communicates with and reaches its customer segments to deliver its VP; Customer Relationships (CR) - aim to establish and maintain each customer segment; Revenue Streams (RS) - represent how revenues will be generated by each customer segment; Key Resources (KR) - describes the main features that are required to make the business model work; Key Activities (KA) - describes the most important actions that an organization must take to operate successfully; Key Partners (KP) - describes the main partners and providers that are necessary for the business model work; and Cost Structure (CS) - describes the most important costs inherent in the operation of the business model.

3.6 Develop Vision

The Vision describes a view of the solution to be developed and it should reflect the stakeholders' needs and features that are proposed to address those needs. It usually defines markets, customer segments, and user needs to be satisfied, and provides a contextual overview of the system that is to be developed. It provides the goals of the system against User Stories are based.

The objective of this task is to produce the Vision of the solution based on the work products created in Business Modeling phase.

3.7 Define Product Backlog

The objective of this task is to buid the Product Backlog from Vision. The product backlog is "an ordered list of everything that might be needed in the product and is the single source of requirements for any changes to be made to the product" [15].

Vision Board can be used to map stakeholders' needs (Vision) in user stories (Product Backlog). The Vision Board is a visual tool that helps agile teams found to answers the following questions before stocking the product backlog: (1) Who are the users and customers?; (2) Why would they use and buy the product?; (3) What makes the product special? What are its key features?; (4) What are the business goals the product should deliver and how are they met? [13].

4 Case Study

The experimentation of the proposed approach was performed through a case study executed by the LabI9 research group from Federal Rural University of Pernambuco.

Identify Innovation Opportunities

In the traditional Requirement Engineering, the market segment to be explored is defined by the needs of a particular customer. In this particular case study, the first step was to identify a market segment that offers more opportunities for innovation. To choose the market segment, the team conducted some brainstorming sessions and concluded that the tourism business had characteristics that made it attractive.

Although there is various software products that satisfy some needs of this market segment, our study shows that still exist latent demand in the trip planning.

Evaluate Competitors

The software products evaluated were selected from research on specialized articles [6,7,11] indicated that those who stood out in supporting some stage of the trip. Furthermore, we observed the level of popularity of each software product in terms of amount of downloads and the position of these applications in a ranking of a statistical analyzer applications [2].

To support the planning of trips were evaluated tripit.com and worldmate.com. To support the execution of trips, we evaluated tripadvisor.com and guidepal.com.

Specify Competing Factors

After assessing the competitors were identified competing factors on to support planning and executing trips. The Competing Factors that govern market are the following: (A) Multiplatform - availability of the software product on web platforms and mobile devices; (B) Social Media Integration - use and post of information for platforms such as Facebook and FourSquare; (C) Georeferencing - use of information from GPS to provide guidance services; (D) Geographic Search - means for search based on geographic attributes; (E) Offline Content - store information on the local device; (F) Internationalization - support different languages; (G) Multimedia Content - video, text, image; (H) Search/Assistance Services - support services such as hotel

reservations and flights, and the search for suppliers and establishments related to the tourism business; and (I) Pricing - way of charging: paid, free, and mixed.

Fig. 3 shows the Strategy Canvas for evaluated softwares that assist trip planning. Fig. 4 shows the Strategy Canvas for evaluated softwares that assist trip execution.
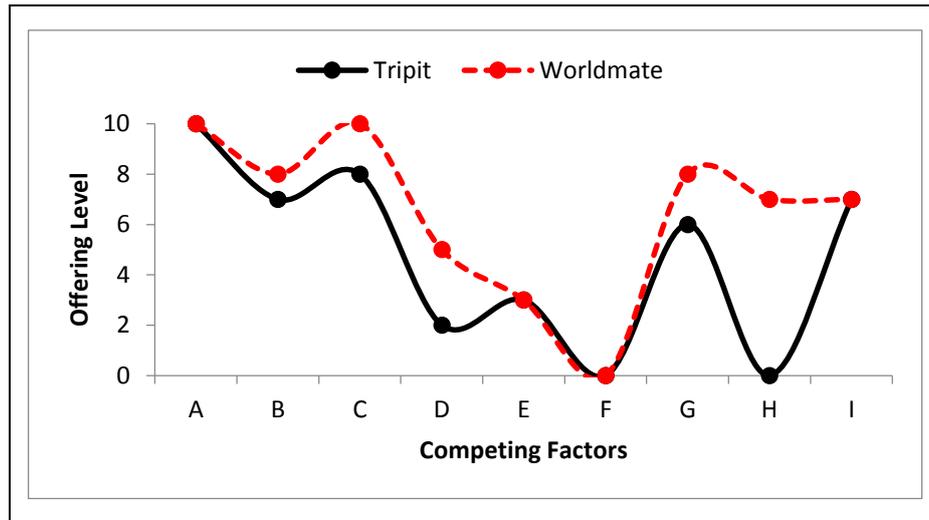

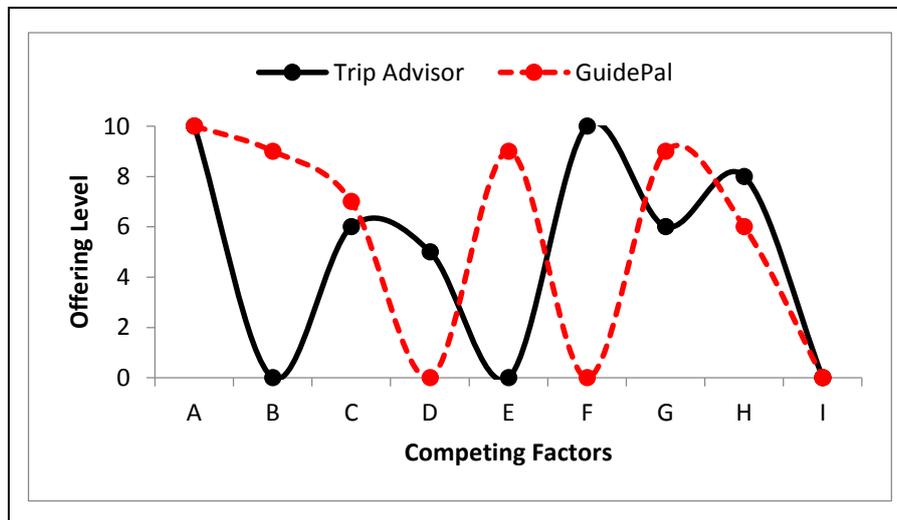
Fig 1. Strategy Canvas of software to planning travel.

Fig 4. Strategy Canvas of software to trip execution travel.

Ideation

The steps of Ideation task are following: (a) Get insights; (b) Specify value curve; and (c) Storytelling.

The techniques used to obtain insights by the team project were: experience scenarios, direct observation, and prototyping. The application of these techniques has encouraged the formulation of ideas discussed in brainstorming.

The brainstorming sessions were planned to discuss all aspects surrounding a tourist trip: planning, survival guide, departure/arrival at destination, transportation, lodging, tour, shopping, food, leisure, and return to the place of origin. Each brainstorming session focused on a specific aspect.

The experiments of experience scenarios consisted of planning a vacation trip, for three members' team to an unknown destination to them, and the location and nature of the voyage were defined by draw.

The first participant fell planning a leisure trip with a group of friends of the same age to Botswana. The second participant performed planning a trip also leisure with family (father, mother and a child of five years) to Romania. The third participant was responsible for planning a lonely business trip to Dubai.

This activity was valuable because it allowed us to see the difficulties in obtaining information about tourist attractions and local customs, in addition to revealing the difficult task of planning the temporality of the everyday events of the trip. The lessons learned in this activity were very useful for the redirection of some preconceived ideas about the process of trip planning.

The next step was to specify a value curve for the software product that the proposed differentiate with respect to the market, from the insights gained by the project team.

Thus, the Four Actions Framework was used to guide the project team to define the competing factors that should be eliminated, reduced and high relative to the market average, and what value attributes not offered by market should be created. The competing factors should be kept as they are currently on the market are not considered in this model. The ERRC grid of software product proposed was then filled, as shown by Table 1.

Table 1. ERRC Grid of Software Product Proposed.

Eliminate	Raise
Search/assistance services (H)	Integration with social media internationalization (B) Geographic search (D) Offline content (E) Internacionalization (F) Princing (I)
Reduce	**Create**
Multiplatform (A) Multimedia content (G)	Interaction between provider and tourist (J) Personalized recommendations (K)

The competing factors were created: (J) interaction between provider and tourist and (K) personalized recommendations. The first is to enable the interaction between service providers and tourists as the events of the journey unfold, linking demand/supply. The second is to analyze personal information, preferences and affinities of tourists contained in social networks to define a profile and then customize the recommendation of products/services, programs and events.

Finally, a Strategy Canvas (Fig. 5) was developed to enable a comparison between the value curve of the proposed software product and the average of the software products evaluated (market).
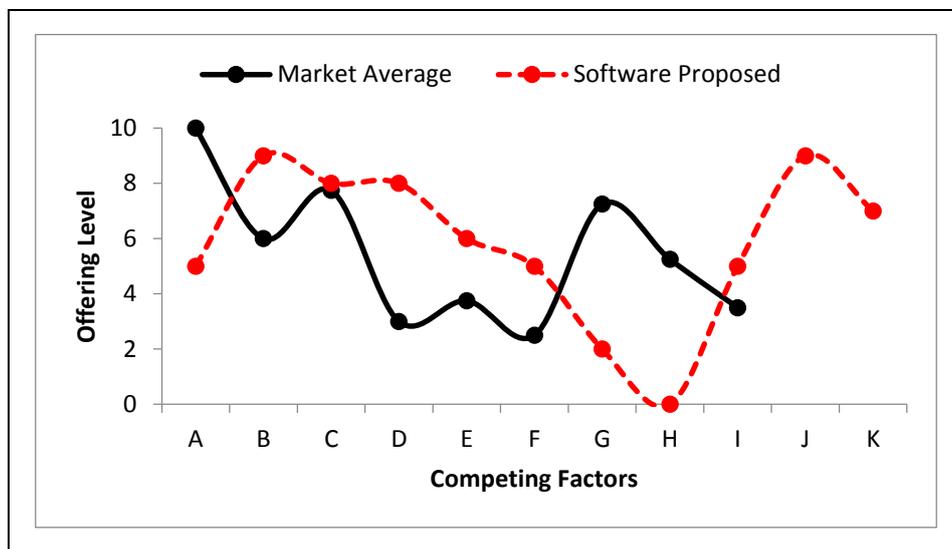

Fig 2. Value Curve of the software proposed in relation to the market average.

After specifying the value curve was established as the software product proposed offer the following competing factors: Multiplatform - available only on the Web and mobile platform Android; Integration with social media - sharing experiences and travel plans; Georeferencing - guidance through GPS; Geographic search - explore geographical attributes to allow more targeted searches; Offline content - allow use without total dependence on data network; Internationalization - adaptation to portuguese, english and spanish languages; Multimedia content - restrict the display of images and videos; Search/assistance services - not provide any aid to services such as booking hotels and flights; Pricing - use freemium/premium model; Interaction between provider and tourist - may allow players to anticipate and provide services in accordance with demands of tourists contained in the travel plan; Personalized recommendations - suggest scheduling based on the user profile defined from information extracted from social networks.

Storytelling describes fictional scenarios that illustrate the context of use of the software product through interaction with imaginary characters.

These usage scenarios facilitate and align the team understanding about what is expected of the software product. They can also be used as a tool for presentation and dissemination of the software product to the target audience. The storytelling is presented below using only the text feature, but is not limited to this.

"John is a 25 year old American backpacker traveling around the world to know different cultures. Ana is a fashion designer who travels regularly for inspiration and materials for their collections. These people so different visit Pernambuco in Brazil for the first time in the same period, and from suggestions from friends, use the application developed by LabI9 to facilitate the planning and execution of the trip.

John reused part of the travel plan of one of his friends who had previously visited Pernambuco. Ana already enlisted the services of a concierge (player) that anticipated demand, identified through the application, and offered to build a travel plan freely.

The flight of John and Anna arrived at the airport of Recife (capital of Pernambuco) in the same time interval, on a day of great movement. Once performed the check-in logging the event of arrival, the city, the application identified the inn Ana and hostel of John were in Olinda city and suggested apportionment taxi, which was accepted by both.

John took the feature virtual tour guide application that features audio in English with information about tourist attractions, as well as guides the visitor through a compass GPS.

Ana followed the plane trip and visited several workshops and craft shops, performing check-in at each point. On the last night, Ana received via the app, offering a regional dinner by a chef whose business is to receive customers at home for culinary experimentation. Ana loved the dinner and shared the experience with friends through Facebook.

At the end of the trip, John and Anna shared with friends as the trip was performed by means of check-ins, itinerary and comments about the places visited."

Design Business Model

The Canvas Business Model is presented in Fig. 6 that summarizes the results obtained in the previous steps. Each block of business model is described bellow.

Customer segments: providers are physical persons or companies that offer services that are around the tourist trip; tourists are individuals traveling for leisure or business seeking offers and personalized recommendations.

Value Propositions: to the supplier would be the discovery of demands early or real-time for your business, to the tourist would be peer interaction for sharing experiences, personalized recommendations, and offer products and services directed at their consumption profile.

Customer Relationships: to the supplier would be a self-service system which presents demands updated in real time directed to the profile of your business, to the

tourist would be a self-service system which presents offers updated in real time to your targeted consumer profile and community for the exchange of information.

Channels: to the supplier would be web-based application; to the client would be application for mobile devices.

Revenue Streams: related to provider would freemium (basic) and premium (advanced) versions, related to tourist would always be free.

Key Activities: maintaining and managing the software platform to link supply and demand, optimize the recommendation engine (algorithm) of targeted offers to the tourist profile.

Key Resources: business reputation to attract and retain users; recommendation engine based on information collected from tourists on social networks, and IT system with the necessary infrastructure (hardware, software, people) to implement the business model.

Key Partners: marketing agencies, responsible for dissemination of the software product to attract customers, and government agencies responsible for promoting tourism for the disclosure of the software product through official channels.

Cost Structure: human resources necessary for the development, maintenance and administration of the business; hosting system IT datacenter processing power.

Develop Vision

Briefing describes the vision of software product and serves to align the team understanding of what is expected to be developed. The software product should be a platform to support the steps of planning and executing travel tourism and supporting business opportunities that are around these steps.

The niche market, to be explored would be the interaction between tourists and small (and out of the map) suppliers (players) services, such as rental of sports equipment, recreational vehicles and lower cost; hosting residences and hostel rooms, shared transportation, translators, tour guides autonomous, concierge, etc.

The software product should allow the sharing of experiences, information and recommendations among users. Furthermore, it should support the process of decision making as the events of the trip are conducted through personalized recommendations, proactively and not reactive to a question from the user, and according to the consumption profile and with context.

Finally, the software product should always seek to provide a good user experience, and be as simple as possible, should be mobile, developed in Java platform/ANDROID, based on geolocation and integrated with social media as well as following the freemium/premiuim pricing model so that most users use the application freely, funded by a minority with more specific needs for your business.

Define Product Backlog

The product backlog initial (list of demands) of project was defined with the following items: (1) travel plan to schedule daily events planned; (2) check list to control actions that must be performed before the trip (reservations, passport, vaccinations, etc.); (3) survival guide for registering local customs and other relevant

information; (4) check in to record the events held; (5) virtual tour guide to guide itinerary of tourist attractions; (6) assistance platform to connect supply and demand/convenience targeting the interaction between players and travelers; and (7) integration with social media authentication and to allow access to user information from Facebook.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer segments
Marketing agencies	Management meeting platform between supply and demand	Discover demands early in real-time	Self-service system with demands updated in real time	Provider
Government tourism agencies	Optimization recommendation engine	Peer interaction	Self-service system offers updated in real time	Tourist
		Personalized recommendations	Community	
		Offer services and products targeted to profile		
	Key Resources		**Channels**	
	Reputation		Web Application	
	Recommendation engine		Application for mobile devices	
	IT system			
Cost Structure		**Revenue Streams**		
Human resources		Freemium	Premium	
IT system hosting		Free		

Fig 6. Canvas Business Model

5 Conclusion

Traditionally, requirement elicitation activity is done for building software products that are based on client requirements. To develop software products that aim to redirect a market and/or discover a latent demand, it is necessary to go further and "we must learn what customers really want, not what they say they want or what we think we should want" [14].

The main contribution of this work was to demonstrate that tools and techniques provided by innovation-driven approaches [4,9,12,14], usually applied in the creation of products manufactured or services of traditional markets, can be used in the Requirements Engineering process. In particular, the paper focus on the Business Modeling phase to develop a software product that differentiates in relation to the status quo.

Our approach begins with the observation of a market segment to identify problems and/or opportunities that motivate the search for innovative solutions.

The next stage is the evaluation of software products correlated ("competitors") to prevent recurrent practice generally offers more of the same. Therefore, we identify the competing factors that govern market competition and what offering level these competing factors for software products evaluated.

The team then leaves in search of insights through practices that consist primarily of live experience putting hisself in the customer's shoes and see how the customer interacts with a context/real scenario.

The specification of a value curve is required to show graphically that the proposed software product is differentiated in relation to the market. Therefore, it is necessary to define the value attributes that should be eliminated, reduced and elevated in comparison to the industry average, as well as the value attributes that must be created, based on the insights obtained by team.

To aid the understanding of the team and other stakeholders on usage scenarios of the software product and a vision of what should be done, are designed storytelling.

At the end of Business Modeling phase is produced Business Model, based on artifacts ever produced, which describes in a concise manner the main elements for an economic sustainable business and customer oriented.

Our approach was evaluated with a case study to develop a planning and executing trip application. The emphasis of this case study is in providing a platform to enable business innovation that is around a tourist trip. The main idea is to allow suppliers to obtain demands in advance and during the trip and offer services and products convenient and tailored to tourists.

Currently, we are extending the approach to include other innovation-oriented methods, such as disruptive innovation [1] and personas [8]. We are also evaluating the approach in other cases studies.

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