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DOCTORAL THESIS

SUMMARY

QUALITY TOOLS EMBEDDED IN I.T. STARTUP PROJECT MANAGEMENT

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Introduction

The goal of the doctoral thesis is to identify and provide a literature review analysis in the field of startups, with the purpose of highlighting the factors which lead to startup success, the management practices implemented by these types of businesses, and to propose a methodological framework for constructing a project management platform dedicated to I.T startups requirements, taking into account not only their particularities and needs but also aspects and elements from the field of quality management, project management and risk management.

The thesis has been structured in 6 chapters in order to conduct the research on startups, the ways in which they succedd and the practices they implement in their daily activities. Each chapter follows a structure as follows: introduction and research objectives, research methodology, chapter content and the description of the conducted research, results and conclusions.

Chapter 1 describes the state of the art regarding startups and the management practices implemented by these. Four research objectives have been established for the chapter, as follows: 1. Identifying the types of companies that are considered to be startups, and their particularities; 2. Identifying the project management tools and practices that are being implemented by startups, and the degree to which these meet startup requirements; 3. Identifying the role of quality management tools and practices for startups; 4. Identifying the means and practices used by startups to help diminish the risks that these businesses are faced with.

In order to gather the necessary information, the author of the thesis reviewed 147 bibliographic resources made up of journal articles, books and websites, blogs and furthermore, analyzed real life I.T. startups.

The term startup was used as a term for describing a budding company in a Forbes magazine in 1976 for the first time but has gained popularity after the “dot-com bubble” of 2000 during which a lot of startups have been born.

An important aspect to take into account when defining startups is acknowledging the fact that they are not simply smaller versions of bigger companies, nor newly founded businesses. Unlike companies, which regardless of their size, have a clear vision of their problems, customers and means of achieving what the customers want, startups operate in a constant state of uncertainty looking for ways to achieve a profitable and scalable business model.

In the context of the current research and taking into account the opinion of experts, startups have been defined as being those businesses which are no older than four years and which, in this time frame have succeeded in obtaining a scalable and repeatable business model with a minimum development team and resources.

As for the reason behind startup failures, the opinions are divided between those who consider that the main causes of startup failure are: lack of market, running out of cash or not having the right team; and others who argue that the main reasons are: not having a viable business model, not having enough traction, encountering market problems, founders shortcoming and running out of cash or failure to find an unresolved customer pain

The results of the literature analysis have highlighted the main aspects that define and differentiate startup businesses, allowing therefore the construction of a startup business profile which can be then used as a starting base for further research in the field.

An important aspect identified in the analysis of startups refers to their project management practices. Although inadequate project management practices have been identified as one of the main reasons behind startup failure, in practice, it has been demonstrated that startups manifest a lack of rigor when implementing or using project management practices.

Regarding the project management practices currently used by startup, the following have been identified: product based startups use the classical or traditional project management approach preponderantly; I.T. startups use the Agile development approach preponderantly; and a small number of product based and I.T. startups use the Lean Startup and/or Leagility development approaches.

In order to determine which project management approach best fits the requirements of the startups, the author of the thesis identified the particularities of the development approaches most used by startup businesses, respectively the classical project management approach and the Agile approach. The results showed that the Agile development approach is more flexible in implementation, allows iterative product development and can be easily adapted to meet the needs of startup businesses.

Moreover, when analyzing the issue of how startups obtain validation from customers, and how they manage to deliver the desired products, a similarity between the practices used by them and the Agile development approach was noted. These action refer to aspects such as: customer involvement in the development process and making adjustments to the final product based on customer feedback.

The author of the thesis also addressed the problem of how the project management tools are adapted for each stage of the development life cycle and from this, identifying the correspondences between the project management tools used and the quality management tools adapted for each stage of the development life cycle.

In order to achieve customer validation and to ensure that they are developing what customers are willing to buy, startups use prototypes called Minimum Viable Product (MVP). These prototypes contain the minimum set of functionalities that a product must have for it to be considered useful and to be purchased by the customer.

The important role that quality plays in achieving success by startups derives from their particularities, and the reasons that lead to their failure. In this respect, it is necessary to consider the implementation of some quality management practices in the startup development life cycle, with the role of helping startups meet customer requirements. The recommendations are aimed at implementing specific actions in the daily activities of startups, such as:

- Defining a strategic goal
- Development team training
- Focusing on customer requirements
- Identifying the factors by which startup success will be measured
- Focusing on how decisions are made and documenting them
- Developing a risk-based thinking
- Integration of quality assurance methods in product development

Another contribution of the author was the analysis of the ways in which quality is achieved and ensured within the classical project management approach and the Agile approach. In this regard, a number of elements have been identified that differentiate the ways in which quality management practices are applied in the context of the classic project management approach from the Agile approach. Therefore, if in the case of the classical project management approach, the emphasis is placed on providing a reactive response to changes, elaborating complex solutions to problems, placing the responsibility and decision-making power on the team leader, monitoring progress

through reports and periodic meetings, and demanding extensive documentation, in the case of the Agile approach, the following characteristics are highlighted: adopting a proactive approach to change, providing simple and flexible solutions, encouraging and supporting multifunctional and self-disciplined teams, emphasizing the necessity of having functional products rather than comprehensive documentation and monitoring progress with the help of daily meetings.

Another aspect analyzed in the course of the chapter was the way in which quality is obtained and ensured in startup businesses and the possibility of implementing a quality management system within them to facilitate their efforts regarding the quality of their products and processes. To this end, an analysis of the conjunctive and disjunctive aspects between their practices and the ISO 9001: 2015 quality management standard was performed with the role of determining the extent to which the implementation of a quality management system would provide a methodological support system for startup businesses.

The main conjunctive aspects identified were related to the central focus that both manifest in regard to customer requirements and satisfaction, the strong emphasis on leadership and top management engagement, test driven development in the context of preventive actions taken for unconformities, the risk based thinking and the possibility of integrating a PDCA approach for processes.

As for the disjunctive aspects, the most significant ones were related to aspects such as: most startups not having a strategic goal given their iterative, customer oriented development style; startups lacking enough personnel and often certified personnel for certain activities; a general lack of resources for the case of startups and a lack of management layer in the case of startups.

The review of literature in the field of startups risk management is scarce and incorporates mainly the suggestions given by startup owners. A risk management approach for startups focuses on identifying the risks to which they are exposed and evaluating them using a Likert scale with the role of developing action plans to address the major risks. Another approach suggests that startups should embrace smart risks, such as: developing a product that will solve a pressing customer problem, developing a whole range of products that will satisfy a necessity, implementation of a viable business model, identification of a suitable business partner and building an adequate development team, etc.

Chapter 2 highlights the set of methodological tools that the author of the thesis used, and its course, from identifying the research issues and establishing the research objectives, and until obtaining results and drawing conclusions.

In chapter 1, the research objectives were achieved with the help of two methodological tools, namely documentation and observation. The results constituted starting points for chapter 3.

The objectives of chapter 3, respectively: the identification of the project management platforms that are appropriate for the requirements of startup businesses, and the identification of quality tools suitable for each stage of the development life cycle, were achieved with the help of five methodological tools (Experimentation, Comparative analysis of project management platforms, Statistical Interpretation, PDCA cycle methodology, Project management methodologies - Classical, Agile, Lean Startup), and the results constituted entry elements within chapter 6.

The main objective of chapter 4, namely the identification of the possibility of implementing the QFD (Quality Function Deployment) method in the field of quality management for the context of project management and risk management in the case of startups, was achieved with the help of three methodological tools (Documentation, Scrum methodology, Risk management models), and the results provided input elements in Chapter 6.

The main objective of chapter 5, namely testing the implementation of the previously proposed model within I.T. startups was realized with the help of four methodological tools (Observation, Experimentation, Case study, Optimal task division algorithm), and the results were used to adjust the model proposed in chapter 4, and subsequently, constituting elements of entry in chapter 6.

The objective of chapter 6, to provide a methodological framework for the construction of a project management platform adapted to startup needs, was achieved with the help of a main methodological tool (the QFD model that integrates fuzzy logic).

The issue of project management tools used by startup businesses, and the possibility of implementing quality management tools and practices in the project management of startups was addressed in **Chapter 3**.

The starting point consisted in defining the particularities and needs of startup businesses and analyzing the main development methodologies used within them, along with the advantages and disadvantages of these methodologies. As a result of identifying the possibility of adapting the Agile development approach to better meet the requirements of startups, the author of the thesis proposed and described a development model adapted to the particularities of these businesses and based on the methodologies encompassed by the Agile development approach.

The development model based on the Agile approach was called "Particular Startup Agile System Development Life cycle" and comprises four stages of the development process, noting that the fourth stage is not predetermined but results from the requirements of the startup, and can take three forms.

Thus, the first stage, called "Initiation", is the stage where the development team undertakes activities such as: identifying the customers, understanding the problems the customers have and the ways in which these can be solved with the help of one or more products; obtaining funds and building a development team; determining estimated delivery times and outlining the requirements of a prototype.

The second stage, called "Construction" includes the directly productive activities that lead to the desired products, along with activities concerned with continuous improvement, inspection and quality control. In the third stage, called "Delivery", the development team delivers the product to the customer and gathers the feedback with the role of making an informed decision in the next step.

Based on the customer response, the development team may decide to choose one of the following development stages:

- Pivoting - changing direction by either bringing major changes to the product or changing the product altogether. If the team decides to pivot, the cycle is repeated starting with the Initiation phase.
- Maintenance – in this case the development team maintains the product as it is at the time and continues producing volumes of it and distributing it on the market, while small upgrades and developments may take place.
- Closure – the third alternative refers to either the decision of selling out the product and /or startup to bigger companies in case the development team doesn’t want to further develop the startup or ceasing operation altogether if the product market fit was not achieved and the team doesn’t have the necessary funds or doesn’t want to further invest in the idea/product.

The next step was to carry out an analysis of the online project management platforms currently used to determine the extent to which they allow and support the implementation of the three project management approaches, and to identify those platforms that respond to the needs of startup businesses. The analyzed platforms were selected by taking into account their popularity among European and US businesses, the number of users worldwide, and prioritizing the platforms used by startups.

Based on the results, a set of 20 online project management platforms were selected for analysis, as follows: Freedcamp, Slack, Microsoft Project, Wrike, Jira, Basecamp, Podio, Asana, Trello, Teamwork projects, Smartsheet, Project Manager, VersionOne, Monday, ProofHub, Meistertask, Bitrix24, Workfront, Mavenlink, Redbooth.

In terms of their capabilities, they were grouped into three categories: General features, Task management and Team management.

The features identified in the first category were: the possibility of accessing the product from a desktop and mobile platform, having and overview dashboard, the ability to manage multiple projects, having a calendar display for important information, the possibility of creating a Gantt chart, the existence of a global filter search system, the existence of a notification system, the ability to make video and voice calls, having an interactive screen sharing, the possibility of sharing files between team members, having and issue tracker, allowing 3rd party integrations and the possibility of managing events and milestones.

The features identified in the second category were: the ability of creating, editing and deleting tasks, the ability to create, edit and delete subtasks and task groups, the possibility of prioritizing tasks, the possibility of visualizing the task progress, the possibility of assigning a task to multiple users, displaying a Kanban view of tasks and attaching files to tasks.

The features identified in the third category were: the possibility of adding, editing and deleting team members, the possibility of managing teams and creating global teams for projects and having clearance levels for team members.

In order to eliminate the subjectivity of the analysis, an algorithm was designed to help determine the extent to which an online project management platform meets the requirements of the three project management approaches, for each stage of the development life cycle.

The steps taken for this were: identifying the most important features needed for each stage of the life cycle and prioritizing them; creating a database that included, on the one hand, the list of all online project management platforms with their features, and on the other, the list of features required in each stage of the life cycle; testing the project management software against the set of required features for each stage of the life cycle and calculating their match as follows: the must have features for a stage have top priority and are at the top of the list. When returning results, in order to achieve the best fit, the system checked to see which project management software had all the required features exactly in the required order. If it found one or more tools then it returned these tools with a 100% match, and if not, it ran the same test but this time checking if the software tools have all the required features minus the last one, in the required order and returned a percentile value based on the calculated weight of the features. After it found a match, it iterated through this step until only the top feature remained.

The results indicated the following: the stage called "closure" was the only one in which there was a degree of fulfillment with a value of 100%, achieved by the following online project management

platforms: Basecamp, Bitrix24, Freedcamp and Proofhub. In the stage called "delivery" the highest degree of fulfillment of the requirements, with a value of 52% was reached by Bitrix24, Redbooth and Slack. The "maintainance" stage registered the highest value of 45% for the VersionOne online platform. The "pivoting" stage registered the highest degree of match with a value of 45% for the following platforms: Britrix24, Redbooth and Slack. The stage called "construction" registered the highest degree of matching with a value of 40% by VersionOne and the stage of "initiation" recorded the highest value of 35% for the Redbooth platform.

The algorithm was then adapted with the role of identifying the most appropriate quality tools to be implemented at each stage of the life cycle, in the case of the three project management approaches.

In choosing the quality management tools that are most recommended to be used in each stage of the life cycle, the author took into account recommendations noted in the literature and by experts in the field such as the American Society for Quality (ASQ) and the Project Management Institute (PMI).

Thus, the quality instruments selected to be analyzed were: Check sheet, Control chart, Graph, Histogram, Pareto Diagram, Cause-Effect diagram, Scatter diagram, Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Arrow diagram, Process Decision Program Chart (PDPC), Benchmarking, Brainstorming, “5 Whys?”, Flowchart, Analysis of Failure Modes and Their Effects (FMEA), PDCA Cycle, QFD.

The results of the analysis indicated the following: in the "initiation" stage, the highest value of 34% was recorded by the following quality tools: Brainstorming, Cause-effect diagram, "5 whys?", Relationship diagram, PDPC and Affinity Diagram. In the stage called "construction" the highest value, of 75% was recorded by the following tools: Flowchart, Graph, PDCA cycle and Arrow diagram. In the "delivery" phase, the value of 100% was recorded by two quality tools, namely: The Cause-effect diagram and the Control chart. In the stage called "pivoting" the highest value, 60% was recorded by the Affinity Diagram, and in the "maintenance" phase the highest value, 75% was recorded by the PDCA Cycle. In the last stage, called the "closing" the highest value, 100% was recorded by the following quality instruments: Cause-effect diagram, Check sheet, Control chart, Analysis of failure modes and their effects (FMEA), Flowchart, Graph, Histogram, Pareto diagram, Relationship diagram, Scatter diagram, Affinity diagram, Matrix diagram and Tree diagram.

Another contribution of the author of the thesis was the synthesis of the obtained results and their representation in an easy to visualize PDCA cycle based model, with the role of providing the development team a methodological framework for the implementation of quality tools in each stage of the development life cycle.

Still, in the course of the chapter, based on the results obtained from the conducted analysis, the possibility of integrating the QFD quality tool with the role of assisting the development team in its efforts to identify and satisfy customer requirements was identified.

In **Chapter 4**, the author of the thesis proposed and described a model based on the Quality Function Deployment (QFD) method from the field of quality management, with the role of providing a methodological support that allows the identification and conversion of the customer requirements in technical requirements in order to build a product that the customer wants.

The proposed model addresses the possibility of implementing fuzzy logic within the QFD method and project management practices in the form of a new approach which encompasses all three elements.

The model allows the calculation of an indicator called Offset and with its help, the possibility of quantifying the degree of customer requirements fulfillment by taking into account multiple aspects

such as: the degree of importance for each customer requirement, the degree of difficulty of each technical specification, the extent to which a technical specification contributes to meeting a customer requirement.

The Offset indicator is calculated based on the following inputs: the matrix representing the task status (AT) and which records values of 0 (for unfulfilled tasks) and 1 (for completed tasks); the correlation matrix, which represents the relations of interdependence between the tasks (TT); the influence matrix (IUT) that reflects the weight that a task has within a customer requirement; the degree of difficulty of the tasks (T) and the degree of importance for the customer requirements (US).

The model also integrates Fuzzy logic, in the form of a fuzzy logic system, with the role of estimating the development team's risk level, taking into account its experience and the extent to which the team responds to dynamic customer requirements.

Fuzzy logic, in the context of the proposed model, is used to obtain an estimated value of the risk to which the startup is exposed to, in each stage of the development cycle and takes into account aspects such as: the development team's experience, capabilities and history. The resulting value is used to update the Offset indicator, so that it reflects the possibility of achieving a degree of fulfillment for the customer requirements by taking into account the development team's risk level.

The usage of fuzzy logic to help estimate the development team's risk level was necessary due to the subjectivism of the factors involved in the development process.

Estimating the risk level with the help of fuzzy logic and the proposed model, requires the implementation of some aspects of the Agile development approach, such as: assigning roles to the development team, delivering working fractions of the product at short and regular time intervals called "sprints".

Thus: The Product Owner (PO) is the interface between the development team and the customer, and has the role of indicating the general direction of development of the startup and the offered products. The Scrum Master (SM) is the interface person between the development team and the PO, having the role of facilitating the meeting sessions, of encouraging the development team and at the same time supporting it. The Development Team (DT) is represented by the team responsible for carrying out the tasks, and it usually consists of 3 to 9 members

A PO can have three attributes (Major, Medium, Minor) indicating the type of changes he can make during the development life cycle; an SM can have three attributes (NonEfficient, Average, Efficient) indicating his capabilities of managing the development team and achieving the established goals; and DT can have 5 attributes (Very weak, Weak, Medium, Strong, Very strong) representing team cohesion and its ability to meet the requirements

From the intersection of the attributes of the three actors, and estimated team risk level can be achieved, taking values from G0 to G4 (where G0 represents the lowest degree of risk and G4 the highest degree of risk).

The attributes of the three actors constitute inputs to the fuzzy logic system, with which, based on the established rules, an estimated risk value is obtained. The resulting value is used to update the Offset indicator so that it reflects the possibility of achieving a degree of customer requirements fulfillment taking into account the development team's degree of risk.

Chapter 5 contains the results of the implementation of the proposed model within three I.T. startups. The analysis of the model implementation was carried out in the form of case studies, the results of which were used to adapt the model and validate it.

The three startup businesses in which the proposed model was implemented varied both in terms of the type of offered products and the stage of the development life cycle. Thus, the model was implemented as part of a product based startup, a service based startup and a startup offering a mix of products and services.

In order to be able to implement the proposed model, the development team had to first implement the Startup particular Agile SDLC development approach. As a result, the development team was divided into 3 segments: PO, SM and DT.

The second step consisted in gathering the customer requirements (expressed in the form of User Stories - US) and determining the tasks required to be completed in order to meet the requirements. In capturing the requirements, the degree of importance of each requirement was taken into account; in establishing the tasks required to be completed, a degree of difficulty was assigned to each task (estimated by the SM) and the interdependence between tasks has also been noted.

In order to estimate the measure of the product obtained at the end of each development period, a target value of the Offset indicator was established for each sprint.

The third step was to estimate the extent to which a tasks contributes to the fulfillment of a customer's requirement, in a percentile form.

The fourth step consisted in the division and assignation of tasks into sprints, while taking into account the sequence of completion, the degree of complexity for each tasks, the degree of importance for each US and the development team's experience. The process of sprint planning and tasks related to each one was carried out by the MS after consulting the DT.

At the end of each sprint, the Offset indicator was calculated to check whether the development team reached the target functionality level.

In the case of the first analyzed startup - Check4Green, a number of 5 US and 26 tasks (of which 16 tasks with interdependence relations) were selected to be completed, in the course of 3 sprints, each sprint with a target value of the Offset indicator of 33%.

For the first sprint, a number of 8 tasks were selected to be completed, with an Offset indicator value of 32%. For the second sprint, a total of 11 tasks were selected to be completed cumulating an Offset indicator value of 40%. The third sprint required the completion of 7 tasks with an Offset indicator value of 28%.

In the case of the second analyzed startup - Vitraly, a number of 4 US and 13 tasks (of which 10 tasks with interdependence relations) were selected to be completed, during 3 sprints, each sprint accumulating a target value of the Offset indicator of 33%.

A number of 5 tasks have been completed during the course of the first sprint, cumulating an Offset indicator value of 29.8%. Four tasks have been completed during the course of the second sprint, cumulating an Offset indicator value of 30.1%. The third sprint required the completion of 4 tasks and cumulated an Offset indicator value of 40.1%.

In the case of the third analyzed startup - Lemur, due to the small number of human resources, a number of 3 US and 8 tasks (of which 5 tasks with interdependence relations) were selected to be completed, during 2 sprints, each sprint accumulating a target value of the Offset indicator of 50%.

The first sprint, accumulated a number of 2 tasks for fulfillment, with an Offset indicator value of 49.99%. The second sprint accumulated a total of 6 tasks to to be completed, and an Offset indicator value of 50.01%.

After delivering the products to the customers, and based on the feedback obtained from them, the development team decided to pivot thus changing the direction of the product development and starting a new development cycle that aimed at achieving a single US with 5 tasks (of which 2 tasks with interdependence relationships) during the course of two sprints, with a target value of the Offset indicator of 50% / sprint.

The first sprint, cumulated a number of 2 tasks for fulfillment, and a value of Offset indicator of 48%. The second sprint, accumulated a number of 3 tasks for fulfillment, and an Offset indicator value of 52%.

The proposed model helped the development teams of the three analyzed startups to organize their activities and resources in a way that would maximize customer satisfaction and optimize the use of available resources.

Chapter 6 summarizes the conclusions of the results obtained in the previous chapters with the role of proposing a methodological framework for the construction of a project management platform dedicated to the needs of startup businesses, which incorporates elements from the quality management and risk management areas, thus offering a holistic approach in terms of managing these types of business.

In order to sketch the project management platform dedicated to the requirements of startup businesses, it was necessary to first analyze a profile of the startup type of business, highlighting their particularities and needs, and also analyze the project management, quality management and risk management practices which could help meet startup requirements in each stage of the development life cycle. The construction and development of the proposed platform can become the object of an I.T. startup.

Within the chapter, the operating principles of the proposed platform were described and a representative sketch was made with the role of providing a methodological framework for the construction of a project management platform dedicated to startup businesses requirements.

Thus, the user will have access to the dashboard of the platform that will indicate the most significant information such as: the status of the projects in which the user participates, the summary of his activity and global notifications, the status of the last messages in which the user was involved.

The US related to a project, together with their degree of importance, and the related tasks, with the degree of difficulty of each task, can be accessed from the project page. Still from here, the user will be able to access the page detailing the tasks that need to be performed and those that have been carried out, along with those tasks that are waiting to be assigned to one or more members of the development team.

Creating a new task or editing an existing one requires the completion of a form that registers information such as: the task name and description, the priority degree and its deadline, the person or

group of persons responsible for the completion of the tasks, and it allows files to be attached to the task.

The PO and the SM will have access to a special page that will allow the input of data into the QFD model described above, with the role of providing them with the value of the Offset indicator correlated with the risk level of the development team.

The Calendar section will open a page that will display the current month's calendar, and will allow events to be marked within certain days with specific symbols. When selecting a day, the platform will display the schedule for the day, with the notes that the user created.

The quality module highlights the quality tools that are recommended to be used at each stage of the life cycle, integrated and represented with the help of the PDCA cycle. When selecting an instrument, the platform will display a page containing basic information about the tool, the steps that need to be followed in order to apply the selected tool, and a model for applying it with the role of exemplification.

Conclusions

The important role that startup businesses play in the current economic context has been emphasized on many occasions by researchers concerned not only with the financial contribution they bring to the economy, but also with the innovative environment that surrounds them and which often leads to technological progress.

Although the number of startups which are born annually has increased after the "dot-com boom", a significant number of them fail each year, with 50% of startups surviving after a period of four years.

The literature review highlighted the following main causes of failure among startup businesses: inefficient management practices, inability to deliver a product desired by the customer, and lack of an adequate team.

Starting from these, the author of the thesis sought to identify how startup businesses respond to these problems to ensure their success.

The results of the analysis highlighted the following:

- Although most startup founders are aware of the important role that project management plays, a small number of them implement and use project management practices and /or tools.
- Startup founders are somewhat aware of risk management practices but rarely implement them in their activities.
- Startup founders have little knowledge of quality management practices and tools but are willing to implement them within the daily activities of their business
- Startup founders know to some extent how to obtain customer validation but often fail to achieve their goals.

Based on the obtained results, the author sought to identify the project management platforms available and used by startups and found that although there is a significant number of project management platforms available currently, there are no platforms which address the startup needs, but there are platforms dedicated to projects and companies that use Agile development methodologies. In addition, all of the analyzed platforms presented only project management tools, without integrating tools from the field of quality management or risk management.

Regarding the ways in which startups meet customer requirements, a lack of methodological support has been noted, startups relying mainly on customer feedback for validation, which in some cases may be misleading due to lack of previous market research.

The research also highlighted the positive corellation between the implementation of quality tools in project management for the classical project management approach and the Agile development approach, both in identifying and satisfying customer expectations and reducing /mitigating the risk that startup businesses are exposed to.

Based on this information, the author proposed a model based on the QFD method from the field of quality management and which integrates fuzzy logic, and then applied the model within 3 startup businesses working in the I.T. field.

The results obtained throughout the research were synthesized and used to propose a methodological framework for the construction of a project management platform, dedicated to the needs of startup businesses, which integrates elements of project management, quality management and risk management.

Theoretical contributions

- Conducting a thorough literature review on startups, addressing a gap in the overall body of knowledge which at the time lacks comprehensive literature reviews on the matter
- Helping define a startup profile which can then be used to better understand startup requirements, particularities and their environment
- Conducting a research which helped identify the success and failure factors for startups
- Conducting a thorough analysis on the most popular and widely used project management platforms, in terms of offered features and their match to startup requirements
- Analyzing the project management approach that can benefit startups the most by looking at classical project management, Agile development and the startup specific Agile development practices.
- Proposing a project management life cycle fit for startups requirements.
- Providing a thorough analysis on the means in which quality is achieved in classical project management and Agile development.
- Analyzing the conjunctive and disjunctive aspects between the ISO 9001:2015 and startups practices in order to determine if the implementation of a Quality management system could benefit startups
- Conducting a literature review regarding the implementation of Fuzzy logic in the quality management tool called Quality Function Deployment.

Methodological contributions

- Designed an algorithm as a methodological research tool, to calculate the level of fitness for all of the analyzed development approaches in each stage of the development process.
- Designed an algorithm to help determine the quality management tools that are best fit for each stage of the development process, for the three analyzed development approaches.
- Designed a development process dedicated to startups requirements
- Designed a quality management framework based on the PDCA cycle to help startups identify the stage of the development process they are in and use the appropriate quality management tools for it.
- Proposed the implementation of a model for risk management in startups
- Designed an algorithm for automatic task prioritization and task division into sprints

Practical contributions

- Applied the proposed risk management model in case of three startups
- Applied the Startup specific Agile system development life cycle in the case of three startups
- Applied the proposed PDCA cycle in the case of three startups
- Designed a framework for a project management software tool which is fit for startups requirements, and which integrates both quality management and risk management practices.
- Applied the algorithm for automatic task prioritization and division into sprints for the case of the three analyzed startups

Research limitations

The research has potential limitations regarding the analysis of startup financial capabilities and best practices, along with limitations regarding the analysis of personnel training in the case of startups and limitations caused by lack of previous research studies in the field.

Further enhancements

- The integration of a methodological framework to help startups manage their financial resources better
- The integration of a module to help startups shape a business model and identify their target customers before building the product, with the possibility of providing a framework for conducting marketing studies
- The integration of a training module for the development team