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Adapting P2M Framework for Innovation Program Management Through a Lean-Agile Approach

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ABSTRACT

The commonly adopted project management approach is the stage-gate model, which is not always the convenient approach to innovation projects. The paper objective is to present a qualitative analysis of existing project management approaches and to propose a new hybrid model for effective management of innovation programs based on traditional project management approaches, agile methods to involve the customer, and then lean approach to eliminate waste. The results were illustrated by a new model based on the Japanese P2M (program and project management for enterprise innovation) guide, then combine it with Agile Industrial Scrum method and the agile 3S (scheme, system, and service) model of P2M, and finally with some lean tools and techniques oriented towards the innovation and project management context. Finally, an application case was illustrated where the researchers present the planning of the application of the proposed model on an innovation program in medical waste management field.

KEYWORDS

Agility, COVID-19, Hybrid Project Management, Kanban Board, Lean Start Up, Project Management, Scrum, Trello Board

INTRODUCTION

Project innovation is generally defined as the implementation of new products, new services, new markets, or realizing new organizations (Xiang & Wu 2012). This approach becomes an obligation for all companies seeking competitiveness in the era of globalisation (Sommer et al. 2015), also is considered as a crucial factor in a very challenging environment (high development costs, ever-changing customer demands, condensed product life cycles) (Müller et al. – 2012). Different project

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management methodologies, guides, and methods exist to deal with this kind of project, namely; traditional, agile, and hybrid ones. For the traditional ones, there is the Project Management Body of Knowledge (PMBOK), Projects IN Controlled Environment Version 2 (PRINCE2), P2M (Program and Project Management for Enterprise Innovation), ISO21500 … they all use the stage-gate model proposed by Cooper in 1990 (Lartey, 2020). Their applicability was limited due to the customer involvement in the development of products (Bonner, 2010) and they present a rigid life cycle (Bushuiev & Kozyr, 2020). On the other hand, the agile project management methods have found gradually their way in the development of complex services & business models (Ghezzi & Cavallo 2018) with their flexible life cycle (Bushuiev & Kozyr, 2020). Additionally, in the same context of innovation and development of new products, the researchers found the hybrid approaches that combine stage-gate models with agile methods at the execution level (Conforto & Amaral 2010), (Bindera et al 2014), (Sommer et al. 2015), (Cooper & Sommer 2016), (Mousaei & Javdani 2018), (Lalmi et al 2021). The choice of the appropriate methodology is an important factor to avoid the failure of innovative projects (Matovic, 2020). Therefore, the project management tools and techniques must be examined carefully to identify the best ones ensuring the effectiveness of the projects (Lalmi et al 2021). This paper explores the traditional, agile, hybrid models and lean start-up methods in order to build a new hybrid management model suitable for innovation programs, while program management is defined as the management of several projects combined organically with a holistic mission (Ohara, 2005). After a deep analysis, this study was based essentially on the Japanese P2M guidebook as well as on the agile Scrum method.

The paper is structured as follows: in the next section, the researchers present the appropriate literature for the development of the hybrid management conceptual model for innovation programs. This is followed by the illustration of the result of their research and their proposed model. In the last section, they present the planning of an innovative program in the medical wastes field, where they detail each step of the proposed framework. Thereafter, possible future research avenues are suggested.

LITERATURE REVIEW

As introduced before, several project management methods, tools, and techniques exist in the literature that treat the innovation projects, this section is divided into 4 categories: traditional project management, agile project management, hybrid project management, and Lean management tools.

Traditional Project Management

Traditional project management methods follow the waterfall model, in which product development occurs in a cascade. It is suitable for projects with less complexity (Chaudhari, et al 2018). They usually start with requirements gathering, then design implementation, testing and verification phases, and finally the deployment phase. Especially in this model, the planning phase is time-consuming and this is considered as one of its drawbacks. In addition to this, the product testing starts very late and any change requires a redesign of the component which may impact the project schedule (Lartey, 2020).

Among the traditional standards and guides of project management in the context of innovation, there is P2M (Project and Program Management for Enterprise Innovation), developed in 2001 by Professor Shigenobu Ohara (Ohara, S, 2006). The program management technique in P2M allows a division of one complex task into multiple projects, manage each project, and then integrate them to optimize the overall task. P2M is considered the world's first program management of its kind (Japan International Cooperation Agency Social Development Department, 2006). It is considered in Japan the equivalent of the PMBOK guide. It was developed specifically to address and improve innovation in Japanese companies in order to ensure the success of their projects (Drob & Zichil, 2013).

P2M proposes a framework based on (Bredillet & Ohara, 2007):

- Mission-Driven Approach
- Addressing complex, ambiguous and uncertain situations
- Value creation
- Modeling throughout a lifecycle integrating three models: Scheme, system and services models

In other words, P2M Methodology is based on mission-oriented and goal-oriented businesses and not on product or process orientation. It uses a strategy to deliver innovative projects and programs that ensure the success of the company project activity (Seek & Danchenko, 2019)

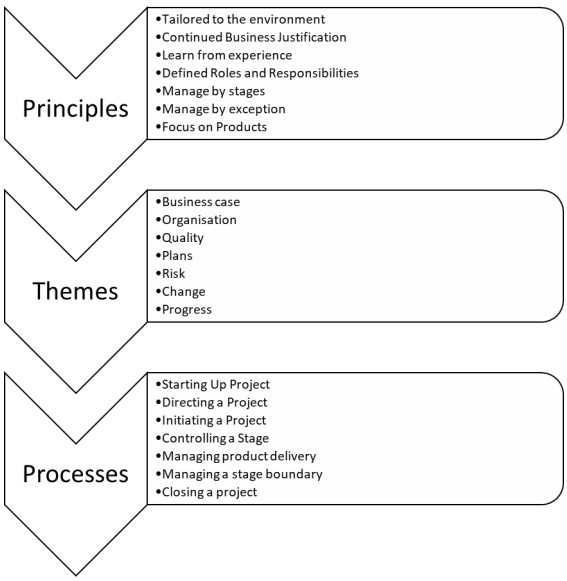
Basically, we can sum up that P2M represents a value creation for companies and a coherent chain beginning from a mission, then the strategies to achieve the mission, then the program(s) to implement these strategies, and finally the projects that make up the program(s) (Project Management Professionals Certification Centre (PMCC) of Japan, 2002).

Prince2 (Projects in Controlled Environments 2) is a standard of project management published in 1996 in the UK by APMG used in the private sector (Mousaei & Javdani 2018). It is a methodology applicable to any type of project, scale, organization, geography, or culture (Matos & Lopes, 2013). Prince2 creates an iterative process that helps to manage daily operations, change control and quality assurance (Wang, J.-J, et al, 2020). It is based on four pillars; i.e. Principles, Themes, Processes, and its adaptation to a particular environment (Vaníčková, 2017).

First, The Prince2 introduces seven guiding obligations (principles) that determine whether a project has used Prince2 or not (Siegelaub, 2004). Then, it is built on seven themes. And, finally, Prince 2 also has seven processes defined as a "structured set of activities designed to accomplish a specific objective" (Karaman & Kurt 2015), figure 1 regroups all of these elements:

PMBOK (Project Management Body of Knowledge) is a traditional project management methodology developed by PMI (Project management institute). Their last version (seventh version) was published in 2021 and is a very prevalent guide in Asia, Africa, and the United States (Alwaly & Alawi, 2020). This guidebook describes the methods and processes needed to generate the required output within the agreed time, cost, and quality standard (Abd Elhameed AT, 2017). It presents project management core concepts, such as the project lifecycle, as well as an exhaustive

Figure 1. Principles, themes and processes of Prince2



list of processes together with possible inputs, outputs, and tools and techniques to be used in each process. The processes group identified in this guide are Initiating, Planning, Executing, Monitoring and Controlling, and Closing. It present ten knowledge areas: Integration, Scope, Schedule, Cost, Quality, Resource, Communications, Risk, Procurement, and Stakeholder (Takagi & Varajão, 2020).

Agile Project Management Model

Agile project management is an efficient, incremental and iterative management framework designed to reduce the risk of change in any project. Often, each iteration lasts from one to four weeks. This can be considered a miniature of the final project (Hidalgo, 2019). In 2001, 17 practitioners of these methods produced the Agile Manifesto with their 4 values (Beck et al. 2001):

- People and their interactions more than processes and tools;
- Operational software rather than exhaustive documentation
- Collaboration with customers more than contractual negotiation;
- Adapting to change rather than following a plan.

There are several agile process models in the literature, including Scrum, XP (Extreme Programming), DSDM (Dynamic systems development method), FDD (Feature Driven Development), Crystal methods, etc. In contrast, only the Scrum model is considered suitable for project management (Abrahamsson et al. 2003), (Sommer et al. 2015), (Anwer et al., 2017). It is one of the most popular agile methods and is considered as project management process model because it specifies a process which is executed iteratively until the output complete (Rush, D. E & Connolly, A. J, 2020)

Many other agile models provide only a few tools to support some individual aspects of project management (Abrahamsson et al. 2003), (Sommer et al. 2015).

The Scrum model works on a series of development cycles called “sprints” that last from 2 to 4 weeks (Mousaei & Javdani 2018), and at the end of each sprint, the deliverables must be presented during a “sprint review” meeting (Collignon & Schöpfel, 2016). This model is used in a variety of contexts and domains in addition to IT development and is also used as a basis to support innovation projects (Sommer et al. 2015). Usually, the overall Scrum process begins with the definition of the Product Backlog. This includes a list of features that will be included in the final product, followed by the step of prioritizing this list into a certain number of sprints and therefore into a certain number of sprint backlogs (Cooper & Sommer 2016).

Hybrid Project Management Model

The usage of each approach depends on the type and the requirements of each project. When the project is large with stable requirements, the traditional approach is more adequate; and when the project is small and involves changing requirements, agile methods are more convenient. But when the project is large with dynamic user requirements, the hybrid model was born (Batra et al, 2010), it is a balanced combination of the two approaches to ensure the success of the project. And in order to show the precise definition of hybrid project management, (Janine, R & Dennis,S, 2022) found in the literature that there are two different flows, at first-hand they define it as a mix of agile approach at the operational level and traditional approach at the decision level. In the other hand, the second flow describes hybrid project management as resulting from an integration of an agile approach into existing traditional project management methodologies.

In addition, based on systematic literature review of (Janine, R & Dennis, S, 2022), there are 4 hybrid methodologies (Table 1):

Sommer et al. (2015) and Cooper & Sommer (2016) proposed a hybrid model that combines the application of Scrum at the execution level and the stage-gate at the strategic level in the context of innovation and the creation of a new product in the production area;

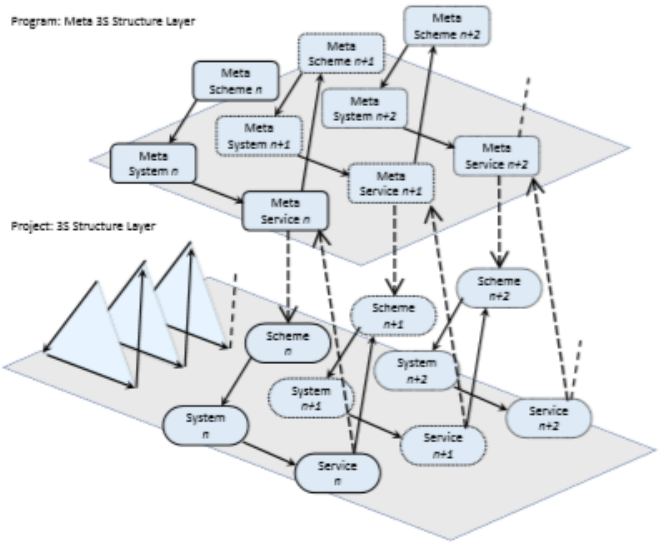
Table 1. Hybrid methodologies, adapted from SLR of (Janine,R & Dennis.S,2022)

Phases	Methodologies/Approach			
	Water-Scrum-Fall	**Waterfall-Agile**	**Hybrid V-model**	**Agile-Stage-Gate (Scrum-Stage-Gate)**
Initial Phase	Waterfall -Requirements analysis -Planning	Waterfall -Requirements analysis -Planning	V-model -User requirements -System requirements -Planning	Stage-Gate for administrative and strategic activities Scrum for operative activities -Discovery -Idea generation -Scoping
Development phase	Scrum -Design -Development -Implementation	Agile approach -Design -Development -Implementation	Scrum -Design -Implementation -Unit testing	Stage-Gate for administrative and strategic activities Scrum for operative activities -Development -Implementation
Final phase	Waterfall -Integration -Testing	Agile approach -Testing	V-model -Integration -System testing	Stage-Gate for administrative and strategic activities Scrum for operative activities -Testing -Validation -Launch

Conforto & Amaral (2010) have also proposed a hybrid method called iterative and visual project management method (IVPM2) combining the agile practices within 7 stages of the innovative projects.

Kato (2019) proposed the hybrid model "Agile P2M", which aims to build a management system for the manufacturing industry to respond flexibly to changes in the environment (change in mission). In his paper, he made two contributions. One is to present the Agile 3S model as a management framework that allows the development of objectives as the environment changes (figure 2), and the other is to refer to the Teal organization which is considered flexible to changes with its three characteristics (the goal of evolution, self-management, and fullness).

Figure 2. The P2M agile 3S model; source: Agile P2M for Development Enterprise (Kato, 2019)



Mousaei & Javdani (2018) provide a hybrid risk management model using the Prince2 project management framework and the Scrum methodology. In addition, 52 Agile experts from six different countries participated in this work. The main objective of this model is to improve the risk management on software projects in order to ameliorate the quality of the product as well as the quality parameters such as usability, flexibility, efficiency and reliability. The scrum methodology was introduced essentially on the step of product delivery. They also presented an evaluation of their proposed model in the end.

Some of the important findings of their work include that their model is responsible for: covering of risk management at 67.4%, increasing project success to about 75.4%, the ability to provide a quality product at 75%, and the reliability to identify, analyse, and control the risks at 85.71%.

Lalmi et al (2021) have proposed in their article a hybrid project management model for construction projects based on lean, agile and traditional approaches. They tried to extract the best practises from these approaches in order to increase the success rate of projects by reducing costs, shortening project schedules, optimizing results, eliminating waste and increasing project satisfaction.

Žužek et al (2020) have proposed a conceptual framework for an Agile Concurrent hybrid product development, where they integrated Scrum in the execution of day-to-day work and remained the initial framework for concurrent development unchanged; the stages overlap and the track-and-loop approach is preserved. Their objective through this framework is to integrate the customer in each iteration, mainly when the customer reviews the results in each iteration of an entire loop, not just of one stage, which enables a large understanding of the progress.

Hassani et al (2018) proposed a new hybrid methodology diagram of digital projects, it combines the waterfall and the agile methodology. It aims to help digital companies in conducting and succeeding their digital projects. This method focuses on an initial requirement gathering and analytics, then the design of the global system, and finally a handful of stages will be repeated over and over before deployment. This work explained that it's necessary to go through multiple versions for big and complex projects in order to reduce risks of the era of digital transformation.

Lean Tools & Techniques:

The start-ups remain among the companies that handle innovation projects. This is defined as a company created to bring a new product to market (Eisenmann et al, 2011). Furthermore, this type of company has no past experience and has difficulty using traditional business planning (Bortolini, et al 2018). In this context, and based on the lean manufacturing concepts Ries has developed the lean start-up method (LSM) in 2011, it represents a business model specifically designed for product development and innovation (Yordanova, 2017), it advocates an iterative and adaptive product development and testing approach to innovation(Onesun Steve, et al, 2021). Its goal is to reduce waste by creating minimum prototypes of functionalities in products and seeking customer feedback to evolve (Bortolini,et al 2018) and also reducing the development costs of new products by ensuring the functionality desired by customers (Boufleur, et al 2016).

Yordanova (2017) introduces 13 LSM tools and techniques that can help for managing innovation projects. Namely: Minimum viable product, Build-measure-learn process, Validation process/ validated learning, Decision-based design, Problem-solution, and product-market approaches, Measurements, Tests and experiments, Pivoting, Customer alignment, Customer Feedback, Continuous deployment, Innovation accounting, Split testing. According to his research, the three main tools and techniques that have a positive impact and are mostly used in project management are measurements, tests and experiments, problem-solution approach, and product-market technique. He defines these main three tools as:

1-Measurement: This tool collects key metrics that can be used to measure actions with reference to the main objectives and results.

2-Problem-solution and product-market approaches: This tool allows to work directly with the customers to identify their needs and the appropriate means to meet them.

3-Tests and experiments: This technique regroups all of the means, to directly test the potential customer.

Understanding the evolution, failure and good practice of each approach helps to exploit them in order to realise the paper's goal. As introduced before, the goal of this study was to establish a new hybrid model for innovation programs, based on this objective and the analysis of this literature review, the researchers attempted to extract the best practices from the three approaches; the benefits that flow from structure and complexity resolution of the traditional guide P2M (Program and project management for enterprise innovation), adaptability and continuous improvement from agile model and lean start-up method. In the P2M framework, the application and execution of projects are done in a traditional and waterfall way, which does give a limitation in retroactivity during the project phases. In contrast, the Industrial Scrum method has succeeded in providing agility to innovative projects. Furthermore, the agile 3S model allows the continuous improvement and the development of the program's goals as the environment changes.

Therefore, we thought of combining all these models to bridge the gap between them. They thought to propose a model, more agile, a model that guarantees continuous improvement and manages the entire innovation program.

The model is divided into a program life cycle consisting of five essential phases: initiation phase, design & planning phase, implementation phase, monitoring phase, and the closing phase. Each phase includes some tools and techniques recommended for better management.

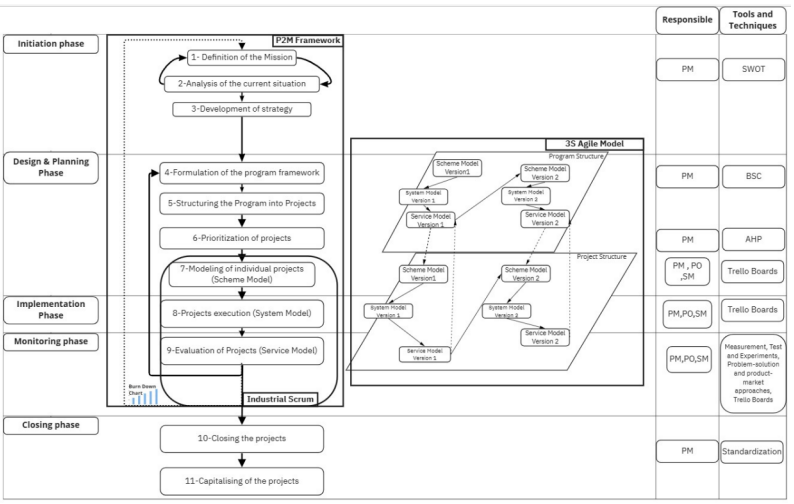
THE PROPOSED MODEL

The proposed model is shown in Figure 3, it is a hybrid model that illustrates the combination of P2M, the P2M 3S agile model and the industrial Scrum for new product development with the integration of some tools and techniques of the Lean Start-up Method.

Description of the Stakeholders:

The main stakeholders in this model are The Product Owner, The Scrum Master, The Program Manager, and the development teams.

Figure 3. The proposed Framework based on P2M, Industrial Scrum & LSM



The product owner is responsible for the project requirements and goals and works with the team without authority over the project (Sverrisdottir et al, 2014).

The Scrum Master is considered as « the servant leader », his main mission is to serve the team by addressing obstacles encountered during development and facilitating the team's functioning (Shastri, et al. 2021).

The Program Manager is responsible for the management of all the projects resulting from the program, namely the management of all the multidisciplinary teams. Its main role goes from the definition of the mission to the execution of the last task of the last project.

Description of the Model, Tools, and Techniques Used:

The objective of this paper is to create an innovative program management model with an agile and lean approach. Innovation is always their keyword in this article. This is why they have sought to combine and adapt methods and tools specially designed to respond to the innovation themes. In this sense, they used the P2M framework, then they were inspired by the industrial scrum method of Sommer et al. (2015) and the conceptual diagram of the 3S agile model (Kato, 2019), and finally, they introduced some lean tools and techniques in the different phases of their model. The steps of this framework are established on different layers that represent the different phases of their model, namely the Initiation phase, Design & Planning phase, the Execution phase, the Monitoring phase, and the Closing phase.

Firstly, in the initiation phase, the program manager defines the mission and with the help of Swot (Strengths, Weaknesses, Opportunities, and Threats) analysis he starts analysing the current situation and then establishes the right strategy to be implemented. The SWOT tool is designed through its construction based on strengths, weaknesses, opportunities, and threats to analyse the current situation of any organization and investigate the internal and external environment of the organization to derive appropriate strategies (Ghazinoory et al, 2011). These two tasks (Define the mission & Analyse the current situation) can begin in any order based on the objective of the organism (Japan International Cooperation Agency Social Development Department, 2006).

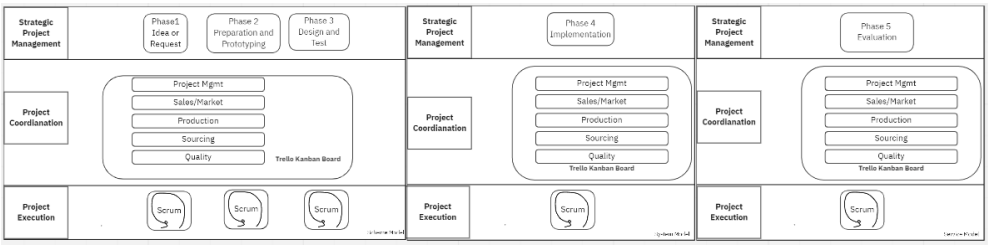
In the Design & Planning phase, and with the help of the Balanced Scorecard tool, which is a technique that allows assigning all the elements necessary for the success of the desired state and it is one of the techniques for building the outline of the program (Japan International Cooperation Agency Social Development Department, 2006), the program manager starts developing the program framework. Then, based on the conceptual diagram of the agile 3S model (Kato, 2019), the segmentation of the program into projects is carried out. The next step is to prioritize projects based on costs and resources, as not all projects can be started at the same time (Japan International Cooperation Agency Social Development Department, 2006). In this step, project selection is often involved with some criteria and in order to find the convenient assessment, it's important to use multiple criteria decision making (MCDM) (Sadi, N. S, 2017). According to (Danesh et al, 2018), MADM (Multi-Attribute Decision Making) methods are the most appropriate for such goal and in particular UBTs (Utility-based Techniques) namely, MAUT (Multi-Attribute Utility Theory), AHP (Analytic Hierarchy Process) and ANP (Analytic Network Process), due to their simplicity and capability to handle uncertainty. The AHP method is proposed in this step as it's a pairwise comparison based methodology (Siekelova et al, 2021) and it's considered among the most popular methods in project selection (Sadi, N. S, 2017) (De Souza, et al 2021).

Then they move on to the three important steps of their model which represent the modeling, execution, and monitoring of projects, in fact, these steps have been presented with reference to the adapted Industrial Scrum method (Sommer et al. 2015), These steps represent the Scheme, system and service model of the P2M framework.

The Industrial Scrum method of Sommer et al. (2015) has been adapted according to our study' needs:

The Scheme, system, and service model which represent the modeling, execution, and monitoring of projects has been illustrated by the 6 phases (Figure 4):

Figure 4. The proposed Scheme, System and Service Model



Then to coordinate between the management team and the development team, we introduced the Trello Board (Kanban Board). It is a web-based project management application (Hidalgo, 2019), that allows sharing, printing, copying of documents and desired information between project teams (Ray, 2016). Trello allows the sharing of information and progress to the entire team with the provision of details of each task e.g. due dates, attachments, comments… etc. The synchronization and collaboration of teams located in multiple sites also represent an important advantage for this tool (Littlefield, 2016).

The execution of these 6 phases is done using the Scrum method to ensure the quality of deliverables, the number of sprints is defined according to the deliverables (Sommer et al. 2015). At the end of the evaluation of the projects, a modification of the objectives can take place which will impact a modification of the project models and thus of the program model.

In parallel, the program is illustrated with the agile conceptual 3S model (Kato, 2019), where each modification at the end of the service model of the first version is transferred to the service model of the program and projects of the next version.

Rarely following this evaluation, the program team may have a modification of the global mission of the program (dotted line going from step 9 to step 1) and thus the modification of the whole program.

According to the research of Yordanova (2017), three LSM tools are the most efficient tools for project management. For that reason, the researchers decide to use them in order to enhance their framework. These tools are measurement, Problem-solution, and product-market approaches, Tests and experiments.

1. **Measurement:** This tool gathers the essential metrics capable of measuring the actions with reference to the main objectives and results. Based on the article of Montero et al (2015), seven experts, using the Delphi method, proposed 26 performance indicators for project management. Below the proposed indicators are classified by knowledge area: This is a numbered term.
    a. Project Scope Management:
        i. Delivery deadline met: Delivery deadlines met / Delivery requests.
        ii. Project milestones missed: Milestones missed / Project Milestones * 100.
    b. Project Time Management:
        i. Project delay: Σ Project delay during project i.
        ii. Overdue project tasks: Tasks overdue / Current tasks * 100.
    c. Project Cost Management:
        i. Budget at completion (BAC)
        ii. Cost variance (CV): EV - AC
        iii. Schedule variance (SV): EV - PV
        iv. Variance at completion (VAC): BAC - EAC
        v. Cost performance index (CPI): EV / AC
        vi. Schedule performance index (SPI): EV / PV
        vii. Cost schedule index (CSI): CPI * SPI

viii. Estimate at completion (EAC): AC + BAC - EV
ix. Estimate to completion (ETC): EAC - AC
x. To complete performance index (TCPI): (BAC - EV) / (BAC- AC)

d. Project Quality Management:
   i. Project issues identified
   ii. Open non conformities: Open non conformities / Project Non conformities
   iii. Open complaints: # Open complaints / Project complaints
   iv. Customer satisfaction: Global satisfaction
e. Project Human Resource Management:
   i. Project resource utilization: Project resources used / Project resources allocated
   ii. Performance appraisal: Average (Performance appraisal items)
   iii. Productivity: Performed man-hours in production / Global performed man-hours
   iv. Employee satisfaction: Average (Employee satisfaction)
f. Project Communication Management:
   i. Timely production of management reports: Management reports produced on time / Management reports due.
g. Project Risk Management:
   i. Risks: Risks number
   ii. - Possible risks: Possible risks / Risks number.

Below are some details about these proposed KPI (Montero, 2016):

EV: Earned Value: The amount allocated to the work actually performed it answers the question, "how much work has actually been completed from that initially budgeted?"

PV: Planned Value: Budgeted cost of the scheduled work of a task or activity over a period of time. It answers the question: "How much work should be completed by the analysis date?

AC: Actual Cost of Work Performed: Total cost incurred in performing the work of the task or activity during a given period of time. It answers the question, "How much have we spent to date?"

CV: Measures the difference between earned value and the Actual cost

SV: Measures the difference between earned value and the planned value

AC: Actual Cost of Work Performed

BAC: Combines all the budgets for the work to be done in a project.

EAC: Measures the total expected cost of an activity programmed in the WBS, or the entire project in cases of work is fully realized.

VAC: Measures the estimated difference in cost at project completion.

CPI: Measures the numerical value describing the overall cost performance of the project.

SPI: It measures the value of the work done for each monetary unit of labour performed, expressed as a quotient of the budgeted cost of the work performed compared to the budgeted cost of the planned work.

CSI: Measures the probability of recovery for projects that are late and/or over budget.

ETC: Measures the expected cost to complete all remaining work on the project.

TCPI: Measures the future cost efficiency needed to complete the target "Estimate at Completion (EAC) or Budget at Completion (BAC).

TSPI: Measures the amount of work the project team has to do with the time remaining to complete the project.

2. **Problem-solution and product-market approaches:** Collaborate directly with the client to identify the needs and the appropriate means to cover these needs
3. **Tests and experiments**: Regroup all tools to directly test the potential customer.

Finally, the closing phase is where the program manager ensures that all projects are completed and provides with the help of all teams all the necessary capitalization for the next programs. In this phase, we introduced the Standardization technique in order to ensure a set of Standard Operating Procedures and standards of good practices for other programs. This technique refers to all activities which makes two projects most identical by means of standardization of design, strategic planning, standardization of procurement… (Saviz, N & Azharul, K, 2011), (Bajjou, et al, 2018).

The proposed framework is better for the innovative program compared to the traditional project management frameworks, because, it introduces the customer feedback in different phases of the program (the agility approach) and it uses some lean start up tools & techniques convenient for such program.

APPLICATION CASE

With the COVID-19 pandemic's devastation, health care workers and patients frequently use disposable medical supplies and personal protective equipment (masks, syringes, tubing, gowns, gloves, vests...) that must be securely eliminated. These contaminating wastes have become a real problematic and their reduction or elimination is become the ultimate goal. This situation has prompted our desire to plan the application of the proposed framework step-by-step to this following innovative program in the area of medical waste management.

Step 1: Mission & Vision: Optimizing the collection of contaminated medical waste

Step 2: Current situation: Increase in medical waste and risk that some of this contaminated medical waste will be landfilled.

Step 3: Strategy: Create a mobile solution based on artificial intelligence for the optimization of contaminated medical waste collection.

Step 4: Outline of the Program using The Balanced Score card (BSC):

1. **Client Perspective:**
   a. Controlling the Risk of Contamination
   b. Developing an on-board mobile solution for transporters
2. **Financial Perspective:**
   a. Optimizing costs (transport, treatment)
   b. Optimizing the flows and logistics fleets
3. **Business Process perspective**
   a. Pooling resources in case of hospital capacity overrun
4. **Study and Growth perspective**
   a. Proposing a national plan for the environmental impacts of the studied waste.
   b. Developing a manual of procedures and best practices from collection to the end of the waste life cycle.

Step 5: Segment the program into projects: in this step, the program is divided into 5 projects:

Program: Optimization of contaminated medical waste collection

Project 1: RFID Tracking

Project 2: Elaboration of Zoning, strategic coalitions and mutualisation of resources for the collection and treatment of the studied wastes

Project 3: Development of a legislative framework for the management of contaminated medical wastes and their impacts

Project 4: Elaboration of Standard of good practices of wastes collection Test your hypothesis by doing an experiment

Project 5: Development of a solution based on AI (Hybrid Genetic Algorithms) to guarantee optimal routing without risk of contamination

Team program is composed of:

Program management team: The Product Owner, The Scrum Master, The program Manager,
Team 1: IT engineer, IT technician
Team 2: Statistical engineer, Statistical technician
Team 3: Environmental Engineer
Team 4: IT engineer

The program management team is involved throughout the program and during all their phases in order to ensure a good management.

Step 6: Prioritization of projects: In this case of application, as there are no resource constraints, the 4 projects can start at the same time to give the hand to the 5th project.

Step 7: Modeling of individual projects (Scheme Model): After validating project ideas, prepare and validate prototypes for all projects. The phase 3 represents a work breakdown structure of projects:

1. **Tasks of Project 1 (Team 1):**
   a. Data collection for RFID tracking
   b. RFID Labelling
2. **Tasks of Project 2 (Team 2):**
   a. Census and mapping of waste generating sites
   b. Census on waste treatment sites (incinerators, pits, landfills, etc.) and on the transport fleet.
   c. Formation of strategic coalitions using "game theory"
   d. Mutualisation resources (incinerators, pits, etc.) and transport fleets, including the new mobile medical waste treatment unit
3. **Tasks of Project 3 (Team 3):**
   a. Establishment of a survey of the Moroccan legislation concerning the studied wastes
   b. Proposal of a National Plan for the environmental impacts of the studied wastes
4. **Tasks of Project 4 (Team 1):**
   a. Establishment of standards of good practice for the collection of the waste studied
5. **Tasks of Project 5 (Team 1, 2 & 4):**
   a. Collection of information on each coalition
   b. Development of multi-purpose vehicle tour models
   c. Application of the appropriate GA (Genetic algorithm) to this model, adjustment of parameters, experiments, interpretation of results.
   d. Location of the best solutions for collecting and transporting medical waste to treatment facilities
   e. Development of hybrid AG models for units in remote locations
   f. Mutualisation of resources between neighbouring units belonging to these locations
   g. Optimization of collection and incineration capacities and time windows
   h. Development of the software solution embedded in the drivers' smartphones

Step 8: Projects Execution (System Model): The execution of projects is done by tasks, each task represents a sprint, a meeting at the end of each sprint is done to give the agreement of Go / No Go to the next phase.

Step 9: Projects Evaluation (Service Model): The evaluation of projects is done in two stages:

1. Evaluate the project tasks using the defined indicators presented before in section 3.
2. Propose improvements if needed to the next Scheme Model and thus to the whole Program

Below are some examples of Trello Board utilization in this case study (Figure 5 & Figure 6):

Figure 5. Trello Board Illustration of Project 1 RFID Tracking

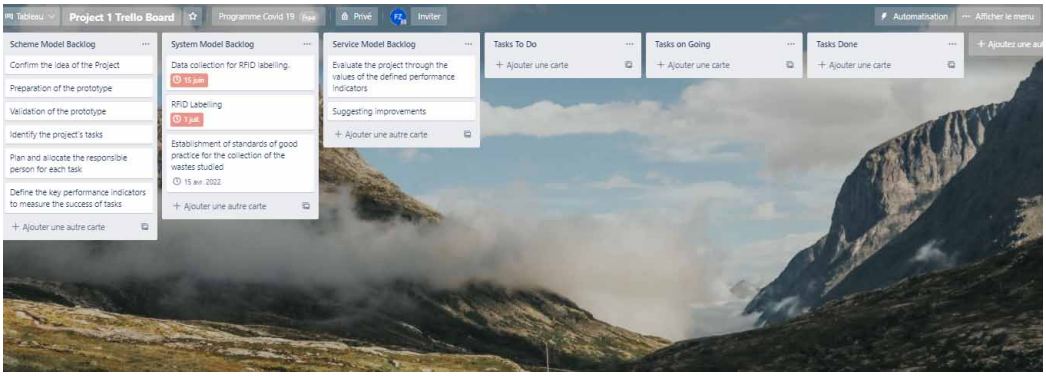
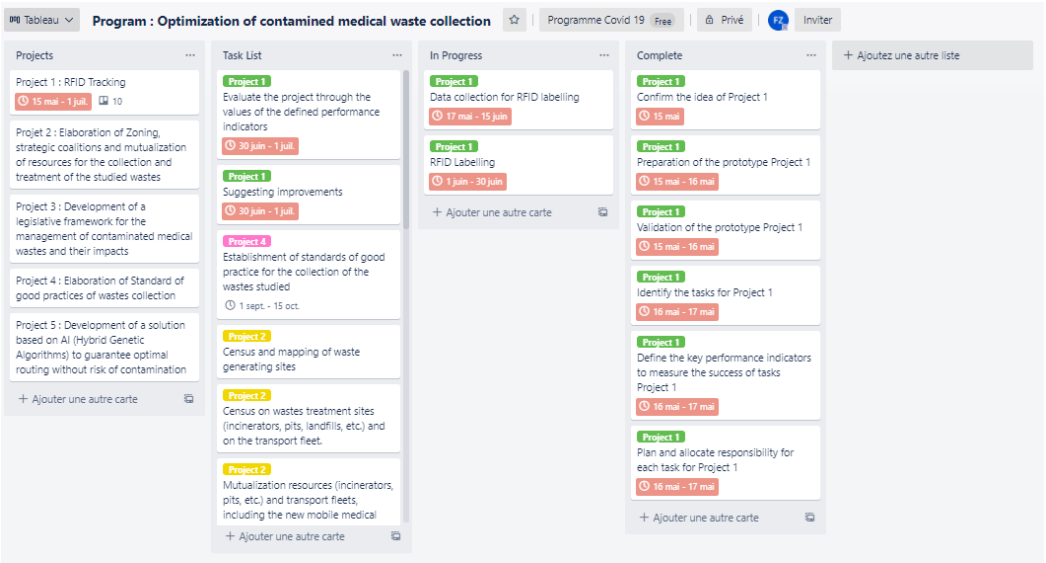


Figure 6. Illustration of the Trello Board Program



Step 10: Closing the projects: In this step, the program manager ensures that the 5 projects were applied completely.

Step 11: Capitalizing of the projects: In order to benefit from the experience of the program implementation, the program manager with the help of the team's work on the capitalization of the projects using the standardization technique.

CONCLUSION

The choice of the appropriate model for innovation programs is very crucial to ensure their success. This research proposes a hybrid program management model for innovation programs based on lean, agile, and traditional approaches. This work began by an overview of each approach, their guides, methods and methodologies, then, based on this information and the prerequisites found for each one,

we tried to find the best methods among these approaches to increase the program success and thus projects success. Therefore, they decided to focus their model firstly on the traditional framework of the guide P2M (Project & Program management for enterprise innovation), then combine it with Agile Industrial Scrum method and the agile 3S model of P2M, and finally with some lean tools and techniques oriented towards the innovation and project management context. The proposed hybrid model aims to be a reference for practitioners and tries to provide in detail the management practices for the creation of an innovative product in an efficient way. This research provides at the end of the paper an application case, where the researchers present the planning of the application of the proposed model on an innovation program entitled Optimization of contaminated medical waste collection.

In the context of future development, we will be able to work on certain points of improvement. First of all, a verification of this model will be necessary in order to confirm the results obtained in this research and through the collection and analysis of data following the return of the application, other modifications can be made to the initial model. In addition, the development of some surveys for the innovation companies could be essential, because based on the analysis of their feedback, an update of the model could be made. Finally, another future research proposed is to generalize this model to any type of programs and not just the innovation programs.

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