

Investigating the Application of Agile and Lean Methodologies to Nonprofit Organizations (NPOs) Using Clustering Methodologies

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Abstract

The research objective is to evaluate the use of the lean and agile methodologies and highlight the implications for addressing the project management gaps within non-profit organizations (NPOs) by using clustering algorithms. The rationale behind investigating this study is to demonstrate the importance of lean methodology practices for the non-profit organizations, which faces difficulties and issues due to the limited resources, to provide managerial tools to the project managers who are required to make decisions that can reduce the costs and errors of the project and ensure the successful completion of the projects.

Keywords

Lean methodology, Agile Methodology, Non-Profit Organizations, Clustering Methods, Group Technology

1. Introduction

The first significance of conducting this research is exploring the topic of agile and lean methodologies to cover project management gaps in nonprofit organizations since it is a relatively specific topic that has only just begun to acquire people's attention. This research will contribute to the present body of knowledge about project management gaps in nonprofit organizations. Moreover, the study's next prominent aspect is developing recommendations depending on the fundamental analysis and conclusions found using clustering algorithms. Managers of nonprofit organizations may turn these recommendations into firm strategies and employ them to gain a competitive advantage. The suggestions focus on using lean and agile methodologies to solve project management gaps in nonprofit organizations by using clustering algorithms. This research is being conducted to give managerial implications to project managers who are expected to make decisions that will decrease project expenses and mistakes and ensure the successful completion of projects. Furthermore, at an operational level, the results of this study will promote the use of lean project management and/or agile methodologies as a substitute or complementary to traditional project management, which could have a favorable effect on nonprofit organizations. This study can benefit academia and industry circles by establishing the foundation for further research into advising and project management philosophy usage

2. Literature Review

The agile method refers to the continuous reexaminations of the project's basic requirements or the product and making the changes required by the project (Rasnacis and Berzisa 2017). Concerning the application of the agile method in the non-profitable organization, that is necessary to describe the least possible viable product. After that, bring together the cross-functional group and then motivate the group members (Špundak 2014). According to the research study conducted by Obradović et al. (2018), agility denotes the state of mind while an individual deals with a project. Agile methodology in project management prioritizes easiness, flexibility, and face-to-face interaction. Nusraningrum and Thamrin (2020) state that the agile management strategy to project development is still a

comparatively new practice for the most modern organizations to acquire and implement. Pieńkowski (2016) states that the Lean methodology is one of the most widely used management principles in manufacturing and services.

The adaptation of lean manufacturing concepts to project management is known as lean project methodology. Lean management aims to enhance productivity while minimizing the amount of non-required resources in achieving the sought goals. Glover and Hurley (2014) argue that reduction in cost and productivity improvements have become one of the primary priorities for each organization in the contemporary era of highly competitive marketplaces. These difficulties must be solved not only by commercial enterprises, but most importantly, by non-profit organizations (NPOs). Furthermore, Sońta-Drączkowska and Mroźewski (2020), in their analysis, have shown that firms worldwide are adopting agile management approaches more than the waterfall methodology management practices to increase long-term advantages, particularly in non-profit organizations.

Sodhi and Singh's (2020) analysis has revealed the importance of agile management methods and their positive effect on the effectiveness of a non-profit corporation. Nahrkhalaji et al. (2018) and Anderson and Lannon (2018), stated that the NPOs face issues and challenges due to limited resources and capital. They often turn their attention to improving their strategies and procedures for efficiency and effectiveness. Studies shows that agile methodology in project management is divided into several strategies, such as: Linear strategy, Incremental strategy, Iterative strategy, Adaptive strategy and Extreme strategy. Linear Strategy refers to the initial stage of the project; it is deep research on identifying and catering to the project's goals (Cater et al. 2013). By focusing on achieving the project goal, the linear strategy helps project planning, including quality, cost, time management, and user requirements. In the organization, the leaders are responsible for planning the strategy to be followed throughout the project cycle; leaders identify the workflow and time distribution for task completion. For this type of strategy, adoption leaders have strong communication and coordination with the team members (Mir et al. 2014). The incremental approach in project management refers to planning changes

that must be implemented under several circumstances. (Roy et al. 2021). The incremental strategy does not have any influence on the project's objectives. It is usually planned under a time frame for deployment; the tasks are subdivided for timely submission (Kashikar et al. 2016). The iterative strategies are implemented after the planning phase. Ge et al. (2010) proposed that the iterative approach in agile performs better in safety systems. An iterative approach is the basic unit of agile project management. The iterative process reduces debugging and error resolution to cope with the mistakes before the development. Moreover, according to Diamond and Powell (2011), it is a continuous process that requires improvements throughout the project development. Hutton (2011) found that a project manager takes accountability for the changes in the project life cycle that can have errors or cause the project's failure. Teamwork functions best in adaptive strategy as there is a need for team members to adopt the variations made in the project lifecycle, also influencing the objectives and goals of the project. Wysocki (2010) exemplified the scenario in the kitchen, where the chef is cooking as per recipe and ingredients.

Extreme strategy refers to the unplanned implementation of the project. In this type of approach, there is no planned methodology and a step-by-step execution plan. Still, the question arises of why this type of methodology is chosen for project management? that is answered in Wysocki (2011)'s book that the projects have a short deadline that is not even half of the actual deadline, change in customer's requirements without expectation is another major cause to switch over extreme method. Moreover, the team members have never used the decision to practice new technology for development (Hanney 2018). The Lean methodology is based on two key concepts, mainly, respect for the workers and the improvement in the organization through minimizing waste. Hence, an organization that depends on Lean considers the perspective of the workers in customer service and the product manufacturing sector as they know the requirements and demands of the customers

(Sohi et al. 2016). According to the lean methodology, it is the responsibility of every group member to enhance the organization's procedure (Ansah et al. 2016). Transportation, inventory, skills, waiting, unnecessary motion, overproduction, overprocessing, and faults are examples of lean waste (Jasti et al. 2015). The similarity coefficient is used to identify the relationship between parts with regard to certain characteristics under investigation. Based on this relationship, groups of items are identified. Among the algorithms that are used to identify and to form part-families that are associated with the machine cell formation, clustering algorithms are based on the similarity coefficient method, which is used to find similarities between parts/machines, and then to group them into part-families/machine cells. Pairwise similarity coefficients between machines/parts are calculated by using specific similarity coefficient formulas. These similarities are then organized into a matrix called the similarity coefficient matrix. This matrix is

used as an input for one of the clustering algorithms, such as single-linkage clustering (SLINK), complete linkage clustering, or average linkage clustering, to form part-families/machine cells, where the inputs can be the distances or similarities between pairs of objects. Single-linkage clustering forms groups by merging the nearest neighbors together according to the highest similarities between them [15]

3. Methods

This research has followed a quantitative research design to examine how lean and agile methodology in projects can allow project managers to overcome project management gaps in NPOs. The instruments used for the data collection is survey questionnaire comprised of closed and structured questions measured on a 4-point scale system as follows: 3- Very Extensive, 2- Extensive, 1- Average and 0- Limited. Statistical tests are applied to analyze some results, then single linkage clustering algorithm is used to join the responses of the correspondents to come up with the conclusion about the status of the applications of lean and agile methods in the NPOs.

4. Data Collection

The data is collected online from the project manager, executive, supervisor, and manager by sending participation information sheets and invitation letters to their email addresses. Several statistical techniques have been applied to generate the results. A Test of reliability analysis is conducted to examine the internal consistency, reliability, and validity of the responses generated. Concerning the current research study in terms of sampling technique, a non-probability sampling technique has been applied, and the method adopted is the convenience-sampling method which allows the researchers the convenience to select and recruit research participants as per their accessibility, reach, and availability (Park and Park 2016). It is a less time-consuming and less costly process for data collection. Therefore, based on this technique, data is collected from 92 participants.

4.2.1 Agile Methodology

The following questions were presented to the participants:

Are you familiar of Agile Methodology? if the answer is yes, then the participants presented with the following questions:

- 1- The level of implementation of management commitment in organization dimension of agile process effect delivering a good working product.
- 2- The level of the commitment of management in organization dimension of agile process impact total projected cost and effort.
- 3- Teamwork & Customer Relationship in people dimension of agile procedure effect on-time delivery of the project.
- 4- Progress tracking phenomenon in procedure dimension of agile procedure impact delivering a good product and on time
- 5- Client presence in process dimension of agile process effect total estimated cost and effort?
- 6- Agile methodology ensures appropriate planning and designing of the project plan that deliver effective project outcomes
- 7- The completion set of precise agile practices in technical aspect of agile procedure consequence accomplishing a good working project
- 8- The analysis of risk in project dimension of agile procedure impact aggregate projected cost and effort

Using single linkage clustering method to group the collected responses related to the answers from the respondents; according to table 1, the highest similarity is formed by the formation of clusters 4 at 76.5313%, by joining responses number 4 and 6 together. This indicates that the responses of the progress tracking phenomenon in procedure dimension of agile affect delivering a good product on time, and agile methodology ensures appropriate planning and designing of the project plan that deliver effective project outcomes. The second highest similarity of the responses was by joining responses 5 and 7 at 76.2119% level of similarity, which indicates that agile practices in technical aspect procedure consequence accomplishing a good working project and client presence in process dimension of agile process effect total estimated cost and effort.

Table 1. Similarity Level of Respondents Answers of Agile Methodology

Step	Number of clusters	Similarity level	Clusters joined		New cluster
1	7	76.5313	4	6	4
2	6	76.2119	5	7	5
3	5	72.3966	1	4	1
4	4	61.6612	3	5	3
5	3	55.1608	3	8	3
6	2	46.0306	1	2	1
7	1	32.8661	1	3	1

However, as seen from the dendrogram show in Figure 1, answers 2 and 8 are at the least similarities from the respondents' point of view.

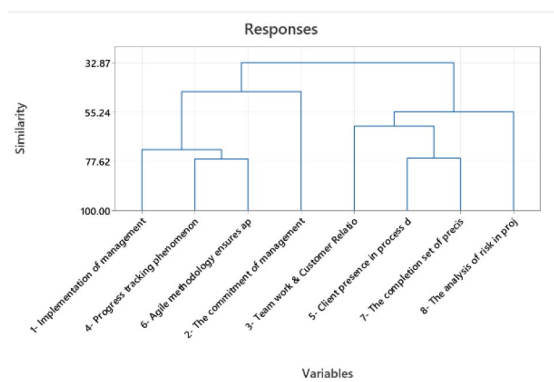


Figure 1. Represent the Level f Similarity of the Responses of Agile Questions

4.2 Lean Methodology

The following questions were presented to the participants:

Are you familiar of lean Methodology? if the answer is yes, then the participants presented with the following questions:

- 1- Lean methodology helps in appropriate preparation of effective risk management and mitigation plan that tends to reduce hindrances during the project lifecycle
- 2- Observe and evaluate the quantity of material, component or equipment that the members actually consuming to avoid cost-overruns.
- 3- Equipment, Material, and other needed resources are provided in a just in time manner when required to avoid project delays.

- 4- Management defines clear work Standard Operation Procedures (SOPs), procedures, and instruction to team members that ensures task and responsibility sharing
- 5- Management formulates a specific plan towards the understanding of project's long-term vision and clarity in goals that helps team members to stay on shared goals.
- 6- Lean methodology helps in proper scheduling of the project
- 7- Management steadily study and review the primary project procedure to make improvements in the project which helps in evaluation, control and risk management.

The same analogy will be used to join the respondents' answers based on their level of similarities by applying single linkage clustering method as seen in figure 2. The highest similarity is between answer 4 and 6, which indicates that lean methodology helps in proper scheduling of the project while management should define clear work standardization to team members. The second highest similarity occurs between answers 2 and 7. This indicate that the continuous improvements directed by the management is directly related to the cost of the project.

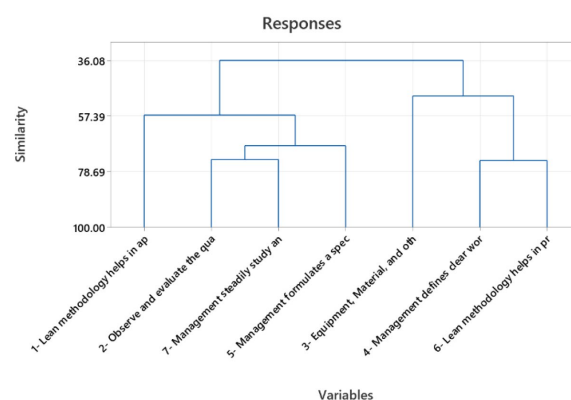


Figure 2. Represent the Level f Similarity of the Responses of Lean Questions

5. Conclusion

The research has suggested that Non-Profit organizations should adopt an efficient resource utilization model aligning with organizational goals and objectives. Also, it is found that the level of implementation of management commitment in organization dimension of agile process effect delivering a good working product. The level of the commitment of management in organization dimension of agile process impact total projected cost and effort. The implementation of lean management and agile practices in the non-profit organization has proven successful in providing effective administration, resource utilization, and cost management. Both of these approaches are helpful and aligned with the goals of NPOs, which leads to significant improvements in finances.

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