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تطبيق المنهجيات الرشيقية (AGILE) في إدارة مشاريع إنشاءات
APPLYING AGILE METHODOLOGIES TO MANAGING
CONSTRUCTION PROJECTS

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Abstract

A general retro-scope view of how applicable agile management in construction can be, where it can be utilized & how it fails in an application.

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Abstract

The Paper discusses the views on agile management and how it can be applied to project management and how it relates to construction in terms of the frame of work attached to it, where construction is a process that has many obstacles going on towards the execution of the projects, from the delays in deliveries to, faulty material to weather conditions and other aspects related to how the process can be managed and performed.

Throughout the paper, a general overview of the types of project management strategies will be compared to the agile project management concepts comparatively as well as viewing the concepts where agile projects management is more effective and more resilient and cost-effective as well as being more detailed where the overview of concepts is directed towards the possibilities agile management could offer.

الملخص

يناقش البحث وجهات النظر حول الإدارة الرشيقة وكيف يمكن تطبيقها على إدارة المشاريع ومدى ارتباطها بمشاريع الإنشاء من حيث إطار العمل المرتبط بها، حيث تعتبر مشاريع الإنشاء عملية بها العديد من العقبات التي تحول دون تنفيذ المشاريع ، من التأخير في التسليم، إلى العيوب والنقص في المواد وإلى الأحوال الجوية والجوانب الأخرى المتعلقة بكيفية إدارة العمليات وتنفيذها.

في جميع جوانب هذه الورقة البحثية، سيتم مقارنة لمحة عامة حول أنواع استراتيجيات إدارة المشاريع بمفاهيم إدارة المشاريع الرشيقة، بالإضافة إلى عرض المفاهيم التي تكون فيها إدارة المشاريع الرشيقة أكثر فاعلية ومرونة

من حيث التكلفة وأيضاً كونها أكثر تفصيلاً حيث يتم توجيه العرض الزائد للمفاهيم نحو الإمكانيات التي يمكن أن توفرها الإدارة الرشيدة.

الكلمات الدالة | Keywords:

[Agile management; construction; agile artifacts; scrum teams; software; waterfall management]

Background on the Development of Management Models & Tools the concepts of project design began to take a formal form of management in the early '50s and kept on being developed and tailored for various sectors, from formal and standardized methods of documentation and planning to the stages of execution as well as writing the guidelines to perform the tasks according to the need, demand and to supply the frame of operation according to what is being tailored; in terms of the theories surrounding efficiencies of performance, to tools and techniques to make the tasks clearer for the client, faster, and more detailed and well organized for the operations and managers running the projects.

The Growth and development of project management took its peak starting in 1958 and kept on being developed with CPM/PERT modes these models either saw light for the financial institutions as the economy grew, some sorted it for being a chemical concept framed to ease education and understanding of concepts while others argued like Morris in 1987 that these origins spurred out of military application during WWI & WWII.

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With Jumps in changing models between 1958 till the year of 1995, these four periods covered aspects of developing Human relations administrations, Human Resources, creating a new Environment, and project management and detailing how the actual projects take place in reality. Between these periods technology has come a long way in easing these functionalities providing tools for measurement, elaboration, and effective communication of tasks to clients, and those who are managing and performing the tasks. These functionalities also gave specifications of jobs, descriptions of tasks, and an accurate estimation of how much time it would take to perform virtually and in actual based on estimation and acquired skill sets with approximations of what is needed, in cost, time, manpower, milestones and procurement of items needed to perform tasks as well as managing the job.

Introduction | المقدمة

As the country of Saudi Arabia is one of the many countries sharing the vision of 2030, which is aimed towards changing the social infrastructure, a firmer prospect is needed to meet the newly applied agenda which requires running lots of construction projects and catching up to the projects that had been delayed for decades due to bad resource management and horrible time management and never truly planning them well.

The conventional method was a general breakdown of tasks, a needed description of the project and the material needed for it but never truly setting the time frame, or the milestones for the execution of the projects along with never utilizing the resources available along with having weak coordination of the projects, staff, and among the executing parties.

Traditional project management is a fixed methodology where projects take place in cycles of initiation, planning execution, and then examining the project and closing it, if all checks out well, the process contains the process of documenting everything and taking a linear approach towards ending the project and monitoring the stages.

The Traditional methodologies do offer ultimate control as all parameters of projects are detailed and broken down into segments, well-defined objectives, and requirements and needs to be met to complete the projects; along with different styles of documentation and following standardizations and fairly good accountability.

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Whereas the agile project management prospect is based on software and depends heavily on teamwork management. Team dynamics and collaborations, and time framing the tasks and creating room for adjustments and changes if needed, also it is based on four crucial points:

- Focus on individuals and interactions.
- Working on software/product and detailing the project steps in it.
- Customer collaboration is vital and weighs more than negotiation.
- The processing of the project is responsive to change and not fixed and can be adjusted in time frames, effort, and whatever aspect needs to be adjusted.

These concepts factor into flexibility and prioritizing the tasks according to need, early and predictable deliveries, and the costs are often accounted for, improving quality and more transparency. The concept is different where projects are broken into milestones on time intervals, whereas with agile it is a sprint of shorter time intervals, and less time is spent on initial planning.

When it comes to the construction process and agile management the way construction phases have changed drastically due to the implementation of modern planning techniques using agile management software and the management software in general as the approach itself is meant to ease the planning, execution, and prompt changes needed to a plan by creating the time gaps needed for the adjustment and for the calibration to assess the process to have their final product tailored according to however they desire it to be.

The newer techniques like agile management through software has shown positive outcome where most which still using the waterfall techniques are however the distinction made by agile management in the construction industry could bring many benefits through the adaption of Agile

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management and show why traditional management methods are falling behind in comparison to what agile management has to offer.

The agile work mechanism was developed in the 1990s as a response to the changing economy of Japan after the second world war which led to finding ways to optimize production, management, and construction methods that could utilize the maximum potential available with the resources they had, and eventually, many methods of management came to light the like Six Sigma and PMP concept as a formal way of practicing and approaching project to run them efficiently.

Throughout the paper a general running comparison covering the concepts of traditional management and what it offers as opposed to the newly found agile management which is assisted by software and taking incremental frames of work to run the jobs efficiently.

Chapter 1: Statement of the Problem | عرض للمشكلة

As Building information modeling became recently accepted through the design process of construction to create the needed milestone to serve as a guideline to the time frame, and needed adjustment and to break tasks into increments to ease the process of acquiring the needed material, manpower anticipated time frame to finish the task, leaning towards agile management methods became the go-to concepts for architects in digital modeling and to offer a better insight with ease through the functionalities offered by the application used rather than the waterfall method which was often followed in the process, where the waterfall method failed when applied into the same method.

The effects of traditional are extended to the cost and time frame related to the project affecting the construction cost and most of the studies projected that the implementation of agile management can reflect positively on the process (Patel et al.,2013).

Research Problem | مشكلة البحث

The Use of the Agile Management method in construction does help seal the gaps left by the traditional management of running things, for instance in the implementation and altering the scope of work in design, and the overall process, however, the obstacles exist mainly in the area where implementation takes place as most workers do follow the traditional waterfall method rather than the agile which leaves some projects failing.

Throughout the paper, the review will be on what obstacles do on the implementation of agile management faces and what issues come to rise when applied to construction.

Purpose of the Study | الغرض من الدراسة

The purpose of the reflective research is to set a guideline and frames preventing the waste and effects on cost and process overall due to the traditional project management method taking time and affecting the cost and process of execution and relatively and how it relates to construction and where the complexities are broken down through the task management and bunning of tasks to ease the process as opposed to traditional management that has slipped in the process in terms of the time it would take and clients engagement as well as the open time frame it would require to achieve a certain task.

When agile is applied to construction often the result carries a collapse in efficiency when it is supposed to raise it and make the project easier as in principle the concept is supposed to make tasks run smoother and increase clients' satisfaction and engagement rather than drop it.

Motivation | الدوافع

As construction projects are a lengthy process and take time, the cost is by the hour, by the feet or meter cube, and the planning and designs of projects run for a long period, switching from the

traditional waterfall method, can be useful; where throughout the research an analytical investigation would take place discussing where the issues in using agile management are, based on the feedback of survey and published literature and published survey results as well as the attempts of applying it into construction giving positive outcomes of the process itself or finding out why the efficiency drops when applied to reality.

الكشف عن المشكلة والمبررات | Problem Statement and Justification

The use of the agile methodology in the management of construction projects faces some major obstacles that result in the collapse or inefficiency in the use of the available resources. Thus, agile methodology application in construction projects faces huge obstacles that need to be addressed to enhance its abilities to make sure that project management is effective to reduce the chances of a project failing or using huge financial, human, and technical resources that would have otherwise been reduced. Solving this research problem experienced in construction project management will make the process of running and managing projects in the future using agile methodology effectively.

The main research deliverables involved in the research included writing a research proposal, carrying out a literature review associated with the research problem, collecting data from the field, analysis of the data from the field, and presentation of the study findings. To fully address the research problem, behavioral research was carried out, whereby, the behaviors of the project managers and the use of agile methodology were fully investigated to determine some of the obstacles experienced by the

participants. Based on the experiences and behaviors of the participant possible solutions to the problem were developed.

Limitations on the Study | قيود الدراسة

The main limitation of this study is that a small data sample has been used. The use of a small data sample has a negative implication on the reliability and validity of the study findings. In addition, the bias of the study participants might also be a major limitation during the completion of the study as it impacts the quality of the data collected in terms of its accuracy reducing its reliability (Cohen, Manion, and Morrison, 2013).

Furthermore, the limitations on data integrity were based on the lack of critique of the method applied in academic circles and professionals where mostly the method was praised or a statement of the limitation in the application rather than the method itself.

Also, Another problem of the study was the information by those who validated the survey and practiced the method itself where no clear statement of the issue was clarified by them or by those who judged the survey itself as well as finding the right candidates to take the survey and validate it as the method itself is not practiced locally that often.

For the online literature, the data reflected similar issues with no clear statement of where the failure of practicing the method took place and not stating the ratios of efficiency drop or where and how and what was the issue in the scrum teams applying the method in depth giving a blurry data.

Comparison between Agile Management Vs Traditional Management I

مقارنة بين الإدارة الرشيقة والإدارة التقليدية

Traditional management | الإدارة التقليدية

On the other hand, the traditional management approach is highly customized according to the task where a detailed breakdown of tasks takes place and it is meant for long-term projects which carry many stages to execution and planning, and building infrastructure in terms of documentation planning and mapping the aspect of the project are all carried out manually which makes it rather hard to do and time-consuming to plan yet the projects are made to be will be detailed and planning and in terms of planning the IT infrastructure the design and the project stages, planning, market survey's and studies around the project are as well made by selecting team members for each task with the needed skill set to focus on the segments of operation and administration as well.

As for the process and operation mechanism, the traditional approach unlike the agile approach is rigid, slow, and comes in sequences which means detailing a long-time frame for planning and execution and having many repeated tasks for conflict resolution.

The stages of development are submitted as tickets and the dealings between managers are made to the designer, either the application developer or the task manager who either works by hand or through an application following the traditional approach.

Issues with Traditional Management | مشاكل مع الإدارة التقليدية

Even-though the traditional management has been used for over 50 years there are gaps in execution as the regulations of doing the projects and how the tasks are broken down have changed creating an issue of uncertainty about the project progress and the approvals following the finishing of the project and delivery to clients creating a loop of anxiety and stress as the project itself could be lost if regulation is overlooked leading to a massive capital loss. Shifting the perspective at which the project is planned and viewed by clients and formal Authorities can go a long way in creating quality assurances and quality control and regulating the job more easily back the traditional management started the rules and regulations surrounding constructions were far fewer and not as strict when it comes to planning, design, spatial calculations and also concepts of testing managerial approach towards achieving a certain task in construction.

Often at the beginning of a project, the amount of money is poured into the designing segments of the project, which is the initial point, and from that point, a building up or a waterfall method takes place calculating the following costs and needed capital for the highest peak of the anticipated expenditure. This method shows where the possible peaks and valleys of needed money and where possible changes in the construction phase could take place; however, throughout the traditional method any changes in design or plans could prove costly in terms of material, design, construction, labor and finishing time as well; Another point worth considering is material, schematics, and designs produced from the initial stages till the late stages of the project which could carry errors in either design, parameters, and execution which can bring the cost up. (Gould & Joyce, 2009).

Agile Management | الإدارة الرشيقة

A short breakdown of the differences between the two approaches.

Characteristics of the Agile approach | خصائص الإدارة الرشيقة

When it comes to organizational structure agile structuring is iterative and often designed to accommodate small to medium projects and the adjustments are made to be interactive to the extent of adjusting according to the need into the milestones of the projects from planning to execution of steps with flexible time frame. As for the extent to which there is involvement with the client the degree of involvement is high and the same can be said for the development model which is meant to be extraordinary in fashion where the steps are adjusted according to performance and optimization principles to deliver as fast as possible.

As in terms of the customer and client's involvement, their interaction is rather high and often engaged throughout the work cycles till the point of delivery. Also, the agile management type offers a unique approach towards the escalation of issues where team engagement is crucial to solving whatever problem comes to rise in an adaptive model with less formal conflict/ problem resolution methods.

The testing of products or visual inspection of projects are viewed and examined and tested on short time intervals where adjustments could be made and the issues can be resolved based on each unique milestone; as for the Estimation of the work itself, it is viewed by the performing team on its own.

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Reviews and approvals; as each segment of the project is completed the team does the estimation on the aspect of the project milestone from the cost, performance, time, team dynamics, and collaboration clients satisfaction/ customer satisfaction which gives assurances to clients and customers making the agile methodology of segmenting projects an optimum choice as it provides.

- Flexibility, when it comes to making any needed adjustment or the client noticing something that needs to be changed or edited out, as well as providing a guideline to the team to work through the problem and experiment with solutions with ease, as in comparison to the waterfall method which is based on the traditional methodology which gives a rigidity to the performance itself where the traditional is top to bottom and last minute changes would not have a rippling effect on the whole project.
- Creating these flexible changes would also allow room to create smart budgeting techniques and manage projects better as the drainage is in the small details.
- More transparency, in Agile methodology everything is broken down into smaller segments and magnified and then the clients make their assessments and be active starting for the initiation of the project, to the point of making a critical decision which creates a more creative, assuring healthy work environment and more assuring one.

The Evolution of Agile Project Management | تطور إدارة المشاريع الرشيقية

Agile management started when the world was recovering, from the 2nd world war when reconstruction and means of rebuilding fast, efficiently, and with minimum cost were crucial and

needed to be done in a way where resources were utilized. Initially, this sort of management was used to optimize the production, and planning stages of a task or a production line, and then different mechanisms came into play in terms of application, and the real progress of this field saw light in the information systems department through the development of different software & attached tools for design, planning, cost and estimation, documentation and inventory control as well as communication channels and shared functionalities in terms of sharing communications internally and with clients as well as updating documents according to progress and milestone, detailing every step and framing them into time intervals or stages and phases and can be utilized from the first stage including designs and budgeting to the executions and material acquisition and even planning what materials to be used as charting the needed work and skills as well.

Agile Manufacturing | تصنيع الإدارة الرشيق

The iterative and the use of incremental method was defined by Shewart in 1930 expanding into Japan to develop the Plan-Do, Check Act (PDCA) cycle which is currently used by TOYOTA in their product development (Liker,2004), which follows the scientific method and model of control, and it is built based on the data bases attached to the software used and the ad-hoc coding (which is based on philosophical approaches in terms of logic and analysis), along with Royce's sequential (waterfall developmental methods), where these methods were coded and reapplied to give an output of optimum efficiency when it comes to cost and estimations and managing projects and production; however the Royce's method which is the traditional one has faced some problems when impeded

into software making the adjustments throughout the stages of the project which led a lot of workers to speak up about it and eventually having the method fade into the background in 2003 as a secondary measure of evaluating the check list or the to do list related to the project in terms of formal representation of facts, documents, labor skills and material acquisition; and also giving many issues in the design stages and estimation related to it and ultimately not giving accurate readings of the budgeting and cost approximations.

Agile Project Management | إدارة المشاريع الرشيقية

The methods of Agile management were analyzed by 'Degrace and Stahl', using the waterfall method or model in information system, and noticed that the model needed extra work as it came with overlapping issues once coded into a program (Degrace & Stahl, 1990), and once these issues came to raise and caused the method to be reduced by the Japanese the Scrum methodology emerged along with other methodologies by the year 1993 and spread across several corporations. By the year 2001, the term agile was introduced into software development in 2003 and continued being such throughout the year and then taught academically through the book of Schwaber and Beedle (Schwaber & Beedle, 2002).

In terms of the Scrum and Agile principles, they are founded on the basics of creating increments of work, collaboration, and community, defined widely in the concepts of sprint planning, daily stand-ups, sprint review, and sprint retrospectives.

As for the seven artifacts of the scrum approach which is a part of the agile methodologies of applications towards management, these artifacts can be broken into different segments three main ones and the rest are the guideline of the process.

The Main artifacts | الآثار الرئيسية

1. Product vision- may that be a long-term goal of a project or product, and this artifact defines the overall direction of the process, and this vision is a guide to the building blocks of what needs to be done, and with the main emphasis on the short-term effects and the long-term effects.
2. Product backlog, which is listing all that needs to be done and achieved in a project then broken down into smaller tasks and intervals and a detailed description of the tasks, related costs, and aspects of the required time frame for each task easing the process for the clients. The good aspect of using agile throughout this process is the ease of changing those designs, tasks, projects, and changing certain parameters which would be harder for the clients if they are using the waterfall method and can be costly whereas with agile the smaller increments for the projects makes recovery easier as everything is detailed in depth using the software. Back-logging is made of three different types.
 - The narrative and descriptions of the detailed analysis of the project to the client and scrum team easing communication.
 - Providing ease when it comes to fixing issues.

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- A detailed description of the tasks that will be assigned to the scrum team to finish from the initial stages to the late planning.
 - The project/Product is always refined throughout the stages of execution; The stages are made in an iterative sprint fashion and then refined throughout the sprint and then the process gets refined by the scrum team for a finer outcome and more detailed and efficient performance and the process repeats itself throughout the planning meetings to save either on the time, cost, process, or for better performance or till the client is satisfied with their project/product/construction.
 - The refining process views the activities that are being carried out and to be carried out, reviewing the users' stories and highest priorities of the comments left by the users for the work progress and changing the priorities according to progress and need.
3. Sprint Vision: This point is one of the main artifacts tailored for the scrum teams and simply frames the teamwork dynamics and made to planning sprints and aspects of building a guideline for the following task. As for the sprint backlogging, this step is made for the team to document their current and coming steps of work. The sprint backlog is mainly like a to-do list, The sprint backlog is based on the tasks needing to be developed and further documented and for the scrum teams to plug in their inputs either on observations or alterations needed to the work and reflect on the aspects of the job either from the time affecting ripple due to the change or the need to adjust a task while considering the cost. The tasks are often broken into the following:
- To DO checklist that has yet to be started or documenting where the work took place

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- Verification step of the process and for the scrum team to view
- Refining the log by regular discussion and these are often short sprints as they are mainly on either changing tasks or editing tasks.
- The new work orders are added to spring backlogs for further management and work by the scrum team along with updating the old logs which are known as refining.
- The scrum team has an all-access pass on the backlog and they can share pictures of the work updates or any ongoing problem which is ideal for construction work and these sorts of projects are given constant updates.
- DOD: Definition of done, stating completion of a stage, where the scrum teams do their logs and to-do list and set up the future progress needed to be done which is updated as stages get completed.
- Product increments: One of the main artifacts including the backlogs of the sprints finished and which also gets logged into the DOD stages of the projects as these are deliverables of the project as each phase is completed logged and fully accounted for and approved by the project owner; this function sums up the completed stages of the projects.
- Burndown chart: is another major artifact which is the graphical representation of how fast the team is completing their tasks, doing their backlogs, and in general gives an accurate illustration of the facts and how the project is steady and progressing and meeting the deadline as well.

برمجيات الإدارة رشيقة | Agile Software

In terms of the software used, there are many applications for instance the Agile leadership network (APLN), which promotes customer satisfaction, values, teams, and frame of work along with the context and the uncertainties regarding the progress and stages and time estimation (Anderson and Et al, 2005).

For the agile adaptive management methods, the artifacts stated above should guarantee a method of delivery that assures the client's satisfaction, ease of work, and the ability to replicate the process and refine it over and over as building the logs on the software can provide a guideline and tactics to replicate the process across different projects and avoid making the same mistake twice. The software does provide that building index of knowledge and insight for the process itself and then adapts the required changes for the newer project and refines and duplicates for projects of the same genre aside from factoring human error in the application or the material shortcoming and factory faults in case of construction. (Sanchez and Nagi, 2001):

فوائد الإدارة الرشاقة | AGILE BENEFITS

Based on the reviews and logs provided online and on various projects reviewed for the process of depicting the issues and benefits of using agile management and the accompanying obstacles of applying the literature reviewed has shown a substantial cost reduction, through cutting cost on the hours spent per projects, implementation process and has shown how a decrease of hours spent on the

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process does affect the project and the same can be said for making adjustments on the projects or altering the plans of execution as well as enhancing the end products. Using agile in construction provides managers with the opportunity of putting in place measures that facilitate making the required adjustments to the project process (Chen,2004).

Another advantage made by the use of agile management is the communication bridges between staff, management, and the client making sure that the staff is always up to date for any changes, their needs paychecks and any obligations are met.

In terms of the efficiency prospect, we collected between 7 to 13 sets of data from studies published on google Scholar showing the levels of satisfaction and project fulfillment showing an average of 50% Plus on the completion of the project and about 80~ % as a result of the method adaptation.

Table 1. DSDM in Process Improvement – Outcomes

Objective	Target Improvement	Actual Improvement
Improve on-time delivery and customer satisfaction	20%	23%
Increase process predictability; higher maturity level	10%	40%
Improve organizational skills of both management and development personnel	20%	79%

(Source: (Stapleton and Consortium, 2003), p.191)

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In the 2nd table results from companies published online were gathered on a piece of literature reviewed giving an approximation on given surveys including our own resulting in the following giving a context on quality improvements.

Table 2. Agile Survey Results

Did Agile Processes Result In:	Positive	Neutral	Negative
Reduction or significant reduction in cost	49%	46%	5%
Better or significantly better productivity	93%	5%	2%
Better or significantly better quality	88%	11%	1%
Better or significantly better business satisfaction	83%	16%	1%

(Source: (Shine, 2003))

Once the agile method has been applied accurately and refined, a positive outcome has been shown in terms of improving organizational structure, results, methods, and cost and hours applied.

As for the construction projects carried out, the studies reviewed and the Survey given has shown that most engineers, and managers, prefer to apply the agile methods to design and early stages however the method is rarely carried out efficiently throughout the project' the table below is a reflection of the benefits being broken down based on the survey and studies reviewed.

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Benefits	Positive	Negative
Reduction in project costs	80%	20%
Improved project productivity	75%	25%
Quality	86%	14%
Client/Business satisfaction	77%	23%

معوقات استخدام الإدارة الرشيقية | Obstacles to using Agile

According to turner (2014), the major restriction in using this sort of management, in terms of the time frame associated with the project which doesn't support the use of agile methodologies as they require a longer time frame to perform well, along with the regulation regarding construction which forces a time frame to some extent, along with issue related to the cost to not exceed sat budgets dropping either the quality or the restrictions on making changes on the existing designs and plans on the projects.

Also, another factor is the control of the project phases associated with agile, where if a change is needed a halt comes to play forcing a time delay may that be on design, material or hours, and cost which affects the process negatively. (Drury, Conboy, and Power, 2012)

Furthermore, Tindirectlyn business interest itself is an obstacle where the longer and bigger the project the more profit the contractor makes on a construction project and so is the retailer and so on in market segments related to the gap which brings the planning and material acquisition to play where planning the material and sorting them to make savings takes time and the same can be said for the

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design the more detail and the more adjustment the more money spent on the service which reflects indirectly to the hours spent by the planning team and directly to the cost of services which makes the method ineffective eventually.

Chapter 2: Literature Review | المراجعة الأدبيات

Agile Management | الإدارة الرشيقة

According to Turner (2014) agile is an incremental, interactive technique of managing the building and designing activities of information technology, engineering as well as other business fields that aims at providing a new service or product in a highly interactive and flexible manner. Agile provides phases that are supposed to be followed in the process of developing and managing a given project, such as software development (Chow and Cao, 2008). Agile management usually requires people with appropriate skills and experience to successfully use it while managing different types of projects (Chen, 2004). Turner (2014) points out that agile management in most cases is viewed as broadening as well as generalization of principles that have in the past been successfully used in software development in other areas of project management in the world of business.

Agile project management indicates that a project is supposed to be undertaken using different phases for it to be successful. The first phase is a feasibility study, where detailed studies are carried out to determine the costs and benefits of a project. After a feasibility study reveals that a project is viable, the next phase according to Chen (2004) is the design phase, where the product to be produced is designed, with appropriate features. The next phase is the construction stage, where the building or infrastructure construction takes place (Turner, 2014). The last phase is construction management, which is the closing phase, where the project is fully evaluated to determine whether the intended outcomes are attained or not (Hoda, Noble, and Marshall, 2008). The last phase is

concerned with determining whether project costs were maintained or due to changes the cost ended up being higher than initially planned.

Benefits of Using Agile Management | فوائد استخدام الإدارة الرشيقة

Gaps in the Existing Literature | الثغرات في البحث الموجود

The literature shared online mainly speaks of the perks of using agile management for, the most part, showing positive outcomes on small and medium establishments and how the agile management is not so applicable to the large ones, where costs would grow due to the fact that breaking of tasks takes time as well as the smaller process and the artifacts related to work and how they function in logging and editing these logs over and over and how time-consuming those smaller increments can be. When it comes to construction there one no real report showing the results of using agile management in large projects and as for the medium and there are many gaps in execution and the skills used to utilize such thinking where the method can be successful in one place and fails in another. (Vijayasathya and Turk, 2008)

لماذا لم تعالج ا Why the Existing Literature Review has not addressed the problem

مراجعة البحوث الحالية المشكلة.

The information collected throughout the surveys was based on applications that carry the algorithms carrying the agile management tools and their functions, perks, and how they can be utilized in certain ways.

Another resource that was used in the general construction of the paper and building the needed literature was using existing research papers discussing the same points of the research as well as the customer reviews and the feedback from engineers and managers working with this method is designing these methods.

Chapter 3: METHODOLOGY | المنهجية

The research methodologies took an approach of examining the mechanisms by which project management is made and how they function and what was the initial reason for creating them and averting from the traditional management towards agile examining the difference of outcomes between the two methods.

Once the grounds of the logic behind the agile management were formed and why the need for it was created; we took a similar approach for the paper and the survey understanding to break down agile management and establish a relationship towards construction work and how it also can be utilized for different application along with also building a basic understanding of the coding language behind the software used.

The Survey methodology reflected project managers in the construction field reflecting upon the reliability and applicability of the project and how it may relate to the actual practice of the method as well as the segments of the practice and related software to understand how the method could possibly work.

The general questions were based on understanding the depth of engagement between clients, and project managers, levels of experience, and the nature of the projects taken by them and what methods are used for the planning and execution stages.

The questions were phrased to question the stages where agile management was applied and what challenges and difficulties faced those managers in terms of applying the methods and attached tools to it.

In terms of building a general construct about applying the method a general review of the applications that use the agile methodologies differently, time and how the tools and functions ease and pave the way of designing and planning projects and reviewed the assisting tools related to it to understand the project; however, unfortunately, the code itself was not fully shared and no in-depth insight was possible as each code differently yet the concepts are based on a philosophical approach of analyzing the response and design of increments showing what approach is recommended versus the option chosen by the planner's themselves explaining what needs.

Research Approach | منهج البحث

The research approach was based on gathering data using a survey to check for the frequency at which agile management was used in different industries and their relationship to construction to collect qualitative data and quantify the extent of involvement using the agile management method and at which stage or phase of a project do they revert back to traditional as agile itself seems inapplicable in certain phases of the projects and what obstacles they are facing these methods.

As for sorting out the logic and reasons for the switching between the two methods we resorted to using the existing literature as a backbone for the data analytics seeing the focal points of the survey conducted on other research to dig for justification related to the data use itself.

The experiences shared either on the feedback loop after using the application or feedback on the problems faced when using agile management have provided qualitative data concerning the stages of planning and designing projects along with logging the data.

Research Design | تصميم البحث

The research design used in the study was formulated based on the opinions versus reality and actual practice of the method using a massive collection of data giving a piece of descriptive information on the issues of using agile in construction and where and how they might be effective and how it may hinder the work itself. (Devault, 2015). Also testing the principles and the framework via comparison of the two methods in theory versus practice, through testing the completion ratios and satisfaction levels of the two methods as opposed to taking each separately.

The research was mainly based on qualitative data where concepts are tested in theory versus practice and the application of the instrument showing how agile would be better in many stages however it may affect the cost eventually and the time frame in one way and raise client's satisfaction in another.

Sample Size and Sampling Method | حجم العينة وطريقة أخذ العينات

The study sample was made of about 100 participants in the survey, about 20 research papers, and 4 feedback loops discussing the method and how it was applied however the details were missing as each had its own unique way of applying the method to construction.

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Also, the literature and the survey have covered aspects of the depth at which the method is applied, and where it may fit in construction as well as measuring the involvement of the client in it and their responds.

The participants in the survey were selected based on their trades, professions, education, and levels of experience to give the results consistency in response as much as possible.

Data Collection Method | طريقة جمع البيانات

The Survey questions were based on the depth of involvement with agile management and construction methods, as well as building a solid database on the aspects of agile, years of experience, nature of projects, relationship to projects management, and also specifying what stages of the project it can be used along with user preferences and the stages at which they switch to a different method.

Survey Results & Data Analysis | نتائج الاستطلاع وتحليل البيانات

Survey first validation by 5 experts | التحقق من صحة الاستبيان الأول بواسطة ٥ خبراء

1. The 1st validation was made by a Deputy project manager with 11 years of experience who works with the Lantern software and security system co. LTD; where he commented on the content of the survey and advised on adding extra questions and elaborated on the method by stating that it was mainly a study for him and not practice where the practice is mainly done through traditional management.
2. The 2nd validation was done by a project manager with 7 years of experience working for Saudi Railway, who supported the used type of questions of the survey.

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3. The 3rd validation was by a projects manager who works for the ministry of sports with 6 years of experience and decided that more questions exploring the method should be added with no specifications.
4. The 4th validation was done by a project manager with 4 years of experience working for Saudi Railway, who give a note that the waterfall methodology's goal was not made clear.
5. The 5th validation was done by a project manager with 4 years of experience working for Saudi Railway, who supported the used type of questions of the survey.

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	19	76.0
	Excluded ^a	6	24.0
	Total	25	100.0

Listwise deletion is based on all variables in the procedure.

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Reliability Statistics

Cronbach's Alpha	N of Items
.818	16

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance
Item Means	3.043	1.105	4.316	3.211	3.905	1.535
Item Variances	1.149	.099	2.468	2.368	24.824	.504
Inter-Item Correlations	.141	-.567	.927	1.494	-1.637	.177

Summary Item Statistics

	N of Items
Item Means	16
Item Variances	16
Inter-Item Correlations	16

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Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How long have you been involved in construction projects?	46.95	78.608	-.025	.830
Have you ever applied any Agile methodology?	47.53	77.708	.158	.820
How long have you used the Agile methodologies in construction projects?	47.32	78.561	-.002	.825
How many construction projects have put Agile methodologies into practice?	47.47	80.041	-.176	.828
In which phase of the project did you use Agile methodologies?	45.47	87.374	-.495	.859
What disadvantages are there to applying Agile methodology in construction projects?	45.26	79.316	-.088	.843
Do you advocate applying the Agile methodologies approach in	47.58	80.591	-.317	.828

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construction projects?				
I could complete construction project tasks more quickly by using Agile methodologies.	44.95	60.053	.800	.777
Using Agile methodologies has improved the quality of work in construction projects.	44.89	58.988	.836	.773
Construction project management has become more productive thanks to the application of Agile methodologies.	44.84	59.585	.912	.769
I now have more freedom in how I may complete project responsibilities because to the usage of Agile management methodologies in construction project.	44.74	62.871	.749	.784
It has become simpler for me to communicate with clients utilizing the most basic communication technologies thanks to the use of Agile	44.53	64.263	.788	.784

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methodologies in my construction project management.				
When I managed construction projects, I used Agile methodologies to involve clients more in the project's scope, which increased customer satisfaction.	44.37	67.023	.662	.793
It was simpler to make changes throughout the advanced stages of projects thanks to using Agile methodologies in my construction project management.	45.05	61.497	.606	.794
By implementing Agile methodologies, I was able to control costs associated with changes made at an advanced stage of the project.	44.79	63.398	.676	.789

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My project management improved delivery dates for construction projects by utilizing Agile methodologies, and it facilitated the forecasting of variables in later project stages.	44.53	63.041	.822	.780
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Scale Statistics

Mean	Variance	Std. Deviation	N of Items
48.68	78.895	8.882	16

Data Analysis

The content of the questions and their analysis through SPSS were a reflection of a neutral attitude towards the method and its applications however the application of it was initially shown in the initial stages of the projects mainly in the planning and design of the project, as well as the planning stages, however, most feedback followed the trends from other survey's and research papers were adapting the method across the entire project would problematic where most have stated it would be hard to carry it across and it would be time-consuming and somehow delay the work contradicting the fact that it was established that increases efficiency.

Furthermore, the data have shown an even scale toward the general acceptance of the approach itself, yet the issue is in the practical application. In terms of data integrity and the ethical issues in

collecting the data, the issues were building a solid database built on concrete facts; also the information, questions, and feedback representation are meant to be accurate and solid in terms of passing the validation of the survey and integrity of the responses reflecting practical experience as well as following the copyrights of published researches, papers, and also resources relating to the use of the agile methods in construction and infringing on the results on other surveys, so they were mainly used to target the issues with the research and applying agile management to construction.

Survey ANALYSIS | تحليل الاستبيان

The results have yielded .818 on the Cronbach alpha as a result of the survey giving a clear consisting valid scale of the questions and the variation providing satisfactory results authenticating the survey, however, once the results came out, and a deeper analysis of the results, statistical and qualitative data, we noticed that the question could have covered more ground regarding the method itself to further explore the issues rather than scratching the surface in terms of who used and who didn't, and also where the obstacles are in terms of the practical application of agile in construction and testing the methods of application.

The data itself has provided an insight into the psyche of managers and the general attitude where the method is massively accepted yet fears of failure, delays, cost, and means of applying the methods correctly do escape them, as well as managing it across all stages of the projects and carrying it till the end where they began to prefer using it only in the planning and design stages of the projects. The variation of the demographics has covered the ages between 24 till the age of retirement at 65, where the percentages refer to preferences for using it and showing generally positive outcomes.

Obstacles of using agile in construction projects | معوقات استخدام الإدارة الرشاقة في مشاريع الانشاء.

The data table below has been summed through gathering data from several studies online post-project completion to show the obstacles, benefits, and general feedback on the use of Agile management in construction projects.

Obstacles	Positive	Negative
Lack of flexibility	90%	10%
Business interest conflicts	82%	18%
Regulatory issues	87%	13%
Expensive to implement	70%	30%

Table 4: Obstacles associated with using agile in construction projects.

Coping With Emergent Requirements | التعامل مع المتطلبات الطارئة

As requirements do change according to either governmental regulation, clients, or simply for the material not being available and changes in the price market agile management gets to be more crucial and more essential to construction as the mean is saving cost, providing quality, and also keeping a good bridge of communication as well as having the contractors themselves make the money they need while assuring the client remains happy and content with the quality being provided.

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Regardless of the nature of the project may that be industrial which is not so applicable for agile management due to the size of the project the principles remain the same and essential in terms of building the milestones required to achieve certain feats and tasks, the agile thinking does ease the tasks needed and also create means of analyzing a needed task logging it well for document control and building project in increments that satisfy the need and build a collaborative perspective when it comes to working mechanisms (Ziv and Richardson, 1997).

Based on the Survey conducted as well as the data utilized from other research papers related to agile management and construction, the issue is with what needs to be constructed and fairly relates to the front-end design/ planning projects stage and building a solid relationship between the ratios of completing these projects and the defects attached to them where when agile is applied the yielded outcome has lower ratios as opposed when following the traditional waterfall method. (Howell et al., 1993).

Also, with agile building, a backup plan towards changing policies or change or order can be done in the planning stages or even going over specifications which can be factored into cost planning and also minimize the risk and put more control on the project if agile thinking and practical breakdown of tasks take place.

The scopes themselves are handled in increments, and accommodating changes in requirements can be forecasted better using agile management; setting priorities and breaking tasks to be designed as the client's desires and how it fits the budget sat for a project along with serving in concepts of risk mitigation which is often called dynamic system development method (DSDM).

The applicability of agile management in construction | قابلية تطبيق الإدارة الرشيقة في

الانشاء

Managers involved in construction projects are supposed to lead as well as manage their respective projects in their entire life cycles. Since construction projects carry a lot of risks, and are unpredictable in nature, it is not an easy task to manage them as a manager. According to Turner (2014) construction projects need flexible leadership and management for the purposes of responding to different changes that occur during their execution. As a way of trying to deal with construction project management challenges over the years managers have been using traditional methods of project management. However, due to weaknesses associated with traditional approaches of project management, the agile project management technique was designed for the purpose of being used in the construction industry (Turner, 2014). Nonetheless, its users have faced several obstacles and there is a need to understand these challenges with the objective of improving its use in the future to enhance the process of constructing project management. A minimum number of studies has been undertaken regarding obstacles associated with the use of agile in construction and designing projects. Hence, little knowledge concerning challenges associated with the use of agile makes its application in designing and construction projects a challenge for many managers. Hence, this study has helped in addressing this problem by looking in depth at the challenges of using agile in construction projects and ways in which the challenges can be addressed in the future.

Another useful tool in managing construction projects is the scrum team (Boehm and Turner, 2004), their functionalities extend deeper than their IT roles in filling logs, building organizational charts,

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building the infrastructure of the project itself, and presenting detailed increments of the project to manage any sudden changes and also push towards better results in terms of what material to be used in construction, giving room to trial and error in development, reflecting directly on cost and economical aspects, environmental, and benefits in construction and also managing the risks as it is itself an adaption of health and safety protocols if planned right as the concepts of structuring a mental set is based on logic, precaution, and delegation of tasks.

Survey Recommendations & Agile management recommendations based on the

Feedback provided through the survey | توصيات الاستبيان وتوصيات الإدارة الرشيدة بناءً

على الملاحظات المقدمة من خلال الاستبيان.

The survey has yielded .818 on the Cronbach alpha scale, however, based on the feedback loops from the survey and other material used to verify the feedback aside from the data used through SPSS, a deeper evaluation of the survey is needed to put the questions into a practical application addressing where the issues are in terms of the practical application of the method and data and how the data and feedbacks collected can be of assistance to further develop the method into practice in terms of realistic concepts.

- The questions can further examine where managers face problems doing the construction process and where the process itself gets to be problematic for the engineers and managers doing the method
- The drainage on the budgets and why efficiency drops in later stages and to what extent the budgets get affected and the segments of the project doing the drainage to further develop the method or the practice itself.
- The nature of the project can be further investigated.
- The questions on the survey could have addressed stages of different projects to reflect the quality of the methods and how they are being done.

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- The survey was mainly based on multiple choices however those choices could have brought about a piece of literature to diversify the opinions rather than an agreement or disagreement principle.

Discussion | المناقشة

Agile project management methods are about creating a sustainable work environment that delivers value, functions based on organization, and lean collaboration between team members and their functionalities; to deliver an end result that is satisfactory while engaging the client heavily; however, the backbone of the technique itself is the team members running it who should be trained very well, to work together and utilize the team hives they created to work efficiently. The job itself is divided into increments.

The iterative nature of agile management makes the design and planning stage easy, well planning and precise, and well projected in terms of finance, cost, working hours, phases, and skills needed to achieve a task which can be a positive gain when it comes to construction as the cost is run by the hours, material survey and market research can be conducted and sampling can be presented to the client giving the options to know where to spend, and while it takes many hours to do these tasks in traditional the use of agile can be resourceful and if built right in terms of building a data index many of the hours can be saved as the connections made can make the trade, projects, construction and designs & estimations of costs far easier.

Furthermore, once agile is applied correctly it can yield a highly positive outcome as the acceptance is fairly good in the initial stages, yet the issue was found in the linking hubs of team's dynamics, the IT support attached to, and the massive logging of the process and refining the process which can be done over a number of projects and not a singular one or in different fields.

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The concepts are rather clear when it comes to theory and the mechanism of practice however the feedback was alarming as the method itself gets abandoned at a certain stage of the project or due to the lack of continuous updating and resulting in a decline in performance as well as

And as a result, most of the feedback from the survey was based on providing the stages of the project to the surveyor where a show of preferences on how the method was used and the analytics was done based on those responses the utilization of the agile was used in the initial stages and then somewhat segmented across certain stages of the project but never fully retained to avoid efficiency drops in performance.

Conclusion

The application of agile management was proven to be a success in small and medium enterprises, resulting in a decrease in cost, time for executing the project and keeping clients fully engaged, and due to the fact that the method does involve getting the clients engaged and providing a lean way of providing an increment of satisfaction across every stage of the project.

The overall research was based on finding out the underlying causes of where the data was utilized to find the gaps in the process itself and why the process losses its efficiency and through the analysis between the theoretical and the analysis using SPSS as well as the survey validations through professionals who worked and assisted in putting the survey together giving an affirmation on why the method doesn't work which fairly reflected on the findings where the issues were found to be in the nature of structuring the team dynamics rather than the method itself.

المستخلص

أثبت تطبيق الإدارة الرشيدة نجاحها في المؤسسات الصغيرة والمتوسطة ، مما أدى إلى انخفاض التكلفة والوقت لتنفيذ المشروع، بسبب أن الطريقة تتضمن إشراك العملاء بشكل مستمر وتقدم طريقة بسيطة توفر زيادة في رضا العملاء عبر كل مرحلة من مراحل المشروع.

استند البحث بشكل عام على معرفة الأسباب الكامنة وراء استخدام البيانات للعثور على الفجوات في العملية نفسها ولماذا تفقد العملية كفاءتها ومن خلال التحليل بين النظرية والتحليل باستخدام SPSS وكذلك التحقق من صحة المسح من خلال المهنيين الذين عملوا وساعدوا في جمع الاستطلاع، لإعطاء تأكيد على سبب عدم نجاح الطريقة ، وهو

ما ينعكس بشكل عادل على النتائج حيث تم العثور على المشكلات في طبيعة هيكلية ديناميكيات الفريق بدلاً من الطريقة نفسها.

Research Questions | أسئلة البحث

Recommendations | التوصيات

The method itself can be further developed once adapted across different stages of the project itself and also build the concept through indexing the logs and the connections attached to be more of a fitting paradox to utilize the segments of the projects as they fit into different stages however if the method of developing the tools, the teams are the issue a change of the way it is applied would revive the method and also put it into practical practice through providing cost and estimation, segmentations of design and planning stages and fitting them to projects to work better and increase efficiency.

- Building logs to fit the projects and build an experience index,
- The issues between IT and construction are constant refining process which can be somewhat an adaptation of the Six Sigma principles then refined to fit the agile concepts into construction then further develop to work better as the concept in use is the optimization of processes.
- The tools attached do cover all aspects of the project management and then refine the tools to fit the segments of construction as a tailored specialty
- Once the index catalog is sorted and the fitting of the tools and methods are well tailored for construction then the method can be readapted to suit the segments where performance falls.

الملاحق ا Appendix

Appendix One-Interview Survey Questions

These questions were used for data collection purposes and to build a solid background on the use of Agile management currently.

1. How long have you been involved in construction projects?
 2. Have you ever applied any Agile methodology?
 3. Why did you start using Agile methodology in construction projects?
 4. How long have you used the Agile methodologies in construction projects?
 5. How long have you used the Agile methodologies in construction projects?
 6. In which phase of the project did you use Agile methodologies?
 7. What disadvantages are there to applying Agile methodology in construction projects?
 8. Do you advocate applying the Agile methodologies approach in construction projects?
- [2] The multiple-choice questions: Providing different phases where agile management can be applied.
1. Using Agile methodologies has improved the quality of work in construction projects.
 2. Construction project management has become more productive thanks to the application of Agile methodologies.
 3. I now have more freedom in how I may complete project responsibilities because to the usage of Agile management methodologies in construction project.
 4. It has become simpler for me to communicate with clients utilizing the most basic

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communication technologies thanks to the use of Agile methodologies in my construction project management. I

5. When I managed construction projects, I used Agile methodologies to involve clients more in the project's scope, which increased customer satisfaction.
6. It was simpler to make changes throughout the advanced stages of projects thanks to using Agile methodologies in my construction project management.
7. By implementing Agile methodologies, I was able to control costs associated with changes made at an advanced stage of the project.
8. My project management improved delivery dates for construction projects by utilizing Agile methodologies, and it facilitated the forecasting of variables in later project stages.
9. Which Agile methodology do you think is ideal for managing construction projects?
10. At what stage of construction projects can Agile methodologies be applied in an optimal way?
11. Which Agile methodology protocols are appropriate for use in construction projects?
12. Do you prefer to apply Agile methodologies to projects you will be managing in the future?
13. Do you believe traditional project management is appropriate for construction projects?
14. What, in your opinion, is the main factor in the delays of many construction projects?
15. What are the disadvantages of using the water flow methodology in construction projects?

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