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Project Planning and Scheduling in the Face of the Fourth Industrial Revolution (4IR)

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ABSTRACT

This paper addresses the integrated processes of planning and scheduling of projects using technologies advanced tools as means for managing change in the era of the 4IR. The paper explores the traditional project management planning and scheduling tools in conjunction with what technology has to offer, to bridge the gap between the traditional project management planning and scheduling tools and what the modern-day business market demands. An analysis of literature covering a wide range of theoretic and empirical studies was performed. The theories underlying various planning and scheduling methods were analysed in relation to the design of projects. A descriptive quantitative secondary data was used as a tool to assess the impact of technology on project planning for scheduling. The analysis of the study's data was conducted using the principles of cross - tabulation. Inferences were drawn on the significant impact of the use of advanced technological tools on project planning for scheduling in current business time. Organisations can make use of the findings of this study to correctly apply the available advanced technological tools for more efficient schedule management planning to enhance the successful delivery of their projects. Further, this research can be used to provide learning opportunities for new and inexperienced planners and schedulers, and as a basis for further research in this field of knowledge.

1. Introduction and Background to the Study

Project management is the process of planning, coordinating, and controlling the implementation of the project objectives for the benefit of stakeholders in the most efficient way possible^[22]. A clear definition of project management tools insufficiencies and their pertinent impact on the project performance is needed to promote new management changes in project planning^[10]. In order to improve the performance of a project, a competent management team must be able to monitor and control both

the project's operations and its planning^[22]. Additionally, the ability of the project management team to formulate a project plan, monitor its progress, estimate schedule variances, and take corrective actions is an important skill towards successful planning^[22]. The Project Management Body of Knowledge (PMBOK) expound on the importance of the planning process by highlighting that project processes are iterated frequently^[13]. As a consequence, defining the activities prior to scheduling and costing them must occur often before completing the project planning process.

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It is imperative that competent personnel should be involved in the plan and schedule processes. This is especially the case in construction project management, as the manner in which the work will be carried out determines the overall success of the project ^[2]. Planning involves a variety of tasks including ^[18]:

- Developing the project scope and integrating it into the project management system,
- Establishing the project's inputs and outputs.
- Establishing detailing methodology on how the project schedule will be executed.

The Management's efforts to plan and control schedules are often obscured by inadequacies in coordination and resource allocation in planning ^[1]. In spite of its perception as a discrete process, scheduling is integrated into the planning process in its many inherent characteristics. It is concerned with the planning process, in which a balance of resource trade-offs and controls, including activity sequencing and durations estimates, has to be identified provisionally ^[1]. Therefore, it is imperative that schedulers, planners and generally project managers should consider scheduling methods and systems in practical terms during implementation of the aforementioned processes ^[2]. The use of visual models and scheduling control systems by project planners and schedulers has increased in recent years ^[24]. Despite the above statement, the dynamic nature of project environments can lead to additional challenges ^[24]. Identification and control of risks and uncertainties during project implementation are examples of these, as well as the effectiveness and efficiency in the management of time and resources. Significantly, among these challenges is the connection between the different project management methods and how they can be linked to technology to take advantage of the many benefits of technology while also managing change. In this connection, although many scheduling techniques have advanced considerably, project managers and other project practitioners still face a substantial amount of challenges in creating a schedule that matches their needs and fits within their resources and time constraints^[24]. As such, the complexity of scheduling and the inability of project managers to keep all relevant information concerning the schedule to make an informed decision may account for this ^[24].

The appropriate process of implementing project plans and schedules is by ensuring a variety of effective methods and tools. While development has taken place and brought about positive change, there is still a need for modification and integration of the project management tools and techniques particularly with the newer scheduling approaches. These methods and tools differ in their effectiveness and efficiency according to the views of

different project practitioners. Several factors contribute to this condition. A lack of understanding of the most appropriate basis for the implementation of these tools and methods that may be one of the factors to be attributable to this problem. As such, the present study seeks to remedy this deficiency by conceptualising and as well as adopting a more technology driven approach to planning and scheduling methods.

2. Problem Statement

Even with the evidently effective project management tools for planning and scheduling and despite the progress made in modern business, plan-and-schedule processes remain challenging. It is relevant to the project management industry to identify and address these challenges. Therefore, existing project scheduling tools and techniques have to be properly considered and assessed in order to find ways in which they can be used congruent with technology to ensure effectiveness and sustainability while managing change. With this in mind, the goal of this research project was to determine the importance of technology and its maximum applicability and use as a means to maximise the efficacy of planning for scheduling with the already existing project management scheduling tools. In order for the study to be conducted, the researcher made use of analytical method based on quantitative data in which quantitative secondary data were used to address the current research questions in order to achieve the studies objectives. As a result of the study, there are useful recommendations for improving project management planning for scheduling with the use of advanced technology driven tools.

3. Aims of the Study

This study aims at examining the advantages of using smart technologies in the planning process for scheduling project activities as a means to manage change in the 4IR era. The research questions guiding this study are:

4. Literature Review

4.1 Complexities of the Project Management Planning Process: An Overview of Existing Perspectives

In order to ensure a successful project completion, planning and execution must be properly implemented. Planning precedes execution, therefore, it is critical that planning be done properly ^[17]. When the project is poorly planned, and the execution and control processes are ineffective, the project will not be executed and controlled efficiently and therefore successfully ^[17]. Keeping track of

Table 1. Questions and Objectives of the study

Questions	Objectives
Does effective planning impact on the successful execution of projects?	To determine the impact of effective planning on project success.
Do you think the traditional project management scheduling tools are commensurate for project success in the modern project management environment?	To examine the gap between the traditional project management scheduling tools and what the modern project management environment.
How much technology is used to assist in the planning and scheduling of project activities, if used at all?	To determine the state of technology in the planning and scheduling of project activities.
What are the most commonly used technological scheduling tools in the modern project environment?	To determine what technological scheduling tools are currently being used in the industry.
What are the factors affecting project management effectiveness? Time management	To determine factors contributing to project effectiveness.
Are the current management planning and scheduling processes effective in the era of 4IR?	To determine the state of change management in the domain of project management.

all planning processes is the responsibility of the project manager, who is fully accountable for the project’s success [16]. Project planning is a critical function in project management [11]. The responsibilities of this function include identify and schedule processes and comparing the status of the project to its baseline, analysing deviations, detecting out-of-control situations, and taking corrective action as necessary [11]. The structure of a project is typically decomposed at an aggregate level by a Work Breakdown Structure (WBS), which breaks it up into manageable activities, and on a detailed level by a precedence diagram, which represents the technological and execution dependencies between the project activities [13]. To achieve this goal, the activities are linked in hierarchy by means of precedence relations. By definition, project success involves completing the project within budget, on time, and to specifications, while ensuring the satisfaction of the customer and all other relevant stakeholders [2]. Efforts to achieve the above will be more successful with effective implementation of plan and schedule processes [1]. The project planning process involves a lot more than the application of well-established methods. The outcome of any project is dependent on effectively planned and proactively directed goals, scope and its quality standards [1].

In order for a successful delivery of projects to be achieved, implementing plans and executing them effectively are both essential [3]. Monitoring is used as a means of ensuring that each one of the two stages has been carried out appropriately, with corrective actions taken where there have been inconsistencies between the plan and execution of the phases [3]. The fundamental importance of effective project planning is an antidote to poor planning that inevitably result in poor execution, and ultimately failure of the project itself [13]. A project manager’s role includes overseeing the ten project management knowledge

areas, in which 39 different processes must be managed. Initiation, planning, execution, and closure are the four stages of a project life cycle under which all the 39 processes are grouped [20,18]. The PMBOK identifies 22 of the 39 processes listed in relation to planning [20]. Therefore, according to the above statement, to effectively plan a project, these 22 steps must be completed. It is therefore, necessary to evaluate the product of each single process in order to evaluate the quality of the planning process implementation.

4.2 Science of Scheduling and Its Usefulness in Project Management

Defining Scheduling in Project Management

Project scheduling is defined as “predetermining duration and precedent activities of a project” [26]. Essentially, scheduling is an important sub process of project management as it specifies the time frames for completing the project, the costs associated with the resources and labour requirements, and the order in which the tasks should be completed [26]. Schedule management is also argued to involve the assigning of resources to tasks in a project in an iterative and multifaceted manner [13]. By implementing proper time management, project managers can reduce overhead costs by ensuring that the project is not over-staffed, thus reducing the cost of completing the entire project [11]. Project management scheduling consists of listing important project management tasks, deliverables thereof, and milestones determined within a project [11]. In addition to the above, Each schedule also indicates when an activity is set to begin and end, its duration, and the resources allocated to it [4]. A successful time management strategy depends on efficient project scheduling. During the planning phase of a project, the schedule management

Table 2. Project Management Knowledge Areas and Planning Process products

Knowledge area	Planning processes	Major product
Integration management	Project plan development	Project plan
Scope management	Scope planning	Project deliverables
	Scope definition	Work breakdown structure
Schedule management	Activity definition	Project activities
	Activity sequencing	PERT or Gantt Chart
	Activity duration estimating	Activity duration estimates
	Schedule development	Activity Start and End Dates
Cost management	Resource planning	Activity required resources
	Cost estimating	Resource cost
	Cost budgeting	Time-phased Budget
Quality management	Quality planning	Quality management plan
Human resources management	Organisational planning	Role and responsibility assignments
	Staff acquisition	Project staff assignments
Communications management	Communications planning	Communications management plan
Risk management	Risk management planning	Risk management plan
	Risk identification	Risk list
	Qualitative risk analysis	Project overall risk ranking
	Quantitative risk analysis	Prioritised list of quantified risks
	Risk response planning	Risk response plan
Procurement management	Procurement planning	Procurement management plan
	Solicitation planning	Procurement documents
Stakeholder management	Develop stakeholder engagement plan	Stakeholder register

Source: Developed by author.

plan is developed as part of the project management plan^[4]. In addition to project managers being able to summarise the beginning and end times of all the individual tasks that form a project, a project schedule can be a visual representation of how long a project is likely to take^[22]. Developing a project schedule is a complicated task as during this process, tasks are identified, sequenced, milestones are decided, and then schedule management is executed for those activities only afterward^[22]. According to the aforementioned statement it is evident that developing a schedule management plan that is effective project managers must define the work breakdown structure, identify the interdependencies amongst activities, sequence their order, estimate task duration, identify risks, and ultimately develop the schedule management plan as a whole^[22]. Schedule management planning includes many of the tools associated with schedule management, such as the Gantt chart, which is a type of bar chart illustrating a project schedule. For extremely complex projects, separate Gantt charts can be created for each key stage^[3].

The project management industry recognises six processes of managing time^[18]:

- Developing of the project schedule

- Planning schedule management
- Defining project activities
- Sequencing activities
- Estimating resources and
- Estimating durations

The schedule of a project can be developed, monitored, and controlled by project managers through the use of a variety of tools and techniques^[10]. There are increasing numbers of applications that can be made digitally using software and programs such as Excel and Microsoft Project.

Project Management scheduling tools and techniques

GANTT Chart - is a type of bar chart that encourages stakeholders to structure projects at different levels of detail in consideration to dependencies between all the tasks in the project. As a result, the duration of the project can be estimated and the critical path can be identified. A Gantt chart can also be defined a bar chart used to illustrate a project schedule. That includes some milestones although it includes no information about the resources or materials that will be required to complete the project^[3].

Schedule Network Analysis - consists of a graphical representation of all logical interrelationships of the ele-

ments of the project as seen in chronological order from planning through closure. Regularly monitoring the network diagram throughout the project is important to ensure the project is progressing as planned ^[4].

Critical Path Method (CPM) - shows the required sequence of activities to complete the most time consuming tasks in a project, and any dependencies between them. By using the CPM, project practitioners can visualize a project and calculate the amount of time and resources required to accomplish each activity. It also determines critical activities requiring attention in order to ensure that the project is completed on time” ^[4].

Programme Evaluation and Review Technique (PERT) - In comparison with CPM charts, PERT charts calculate time for activities more accurately. A time estimate is determined for each activity using three variables: the shortest time (SP), the longest time (LT) and the most probable time (MT). Based on the weighted average of these three estimates, the estimate for the activity is calculated. The formula is: Expected time = $(SP + 4(MT) + LT) / 6$. PERT is the most visually accessible scheduling tool in the construction industry. This diagram serves essentially as a visual representation of the phases of project activities in the order they should be completed.” This process represents the use of time, resources, or both ^[11].

Resource Oriented Scheduling - This method of scheduling is based on the project’s resources, and it prioritizes its most efficient use. Due to the limited resources, delays are most likely to occur as the teams rely upon them. In the absence of an effective method for deciding who gets them and when. Resources are allocated in an orderly manner in the Resource Oriented Schedule according to those who will use them while the project is in progress. This includes any resources that are limited in supply but highly sought after by project teams, whether it is space, machinery or labor ^[23].

Line of Balance (LOB) - The Line of Balance (LOB) technique is based on repeated iterations of thoughtful project planning. This is a part of the management control process that involves the repetitive work activities that are found in a project, such as high-rise buildings, pipelines, tunnels, and railways. In the LOB, time, cost and completion of the project are measured, presented, and compared to a specific plan. The scheduling tool was developed to identify the specific points in time where deviations occur in projects, as well as the subsequent results, reflecting project goals as a single line on a graph, of activities completed/time, to which teams are expected to adhere to stay on track ^[23].

Q Scheduling - The Q scheduling method, also known as quantitative or queue scheduling, uses a bar graph to show the quantities of materials to be used in different lo-

cations and at different times during a project. Scheduling in this way allows companies to determine the amount and type of material they will need at various times and locations. In addition, it integrates a hierarchical component which enables managers and workers to access which materials they need at what time, to order those materials accordingly, to follow tasks in sequence and to avoid disrupting other people’s work, all while tracking expenses ^[23].

4.3 The Coming of the 4RI and What it Means for the Project Management Industry

The 4IR is defined as a fusion of technologies. This characteristic of the 4IR blurs the division between physical, digital, and biological spheres ^[21]. In comparison to previous industrial revolutions, this fourth one is evolving at a much faster pace than those of the previous three ^[21]. Moreover, 4IR significantly disrupted the global economy, the way businesses operate and the way people work and live, socially and as well as professionally. This has taken place in almost all industries in almost all countries ^[8]. Systems of production, management, and governance are being transformed in an unprecedented way. Thus, to be successful, business leaders and executives need to understand the evolving conditions in their environments, challenge the assumptions made by their operating teams, and remain relentlessly innovative. In contrast, although some organisations and people are ready to face the challenges of 4IR, equipped with the tools they need to take advantage of it, others are unaware that a storm is brewing ^[10]. Knowledge is very important in the Knowledge era to deal with the disruption of the 4IR, but not just any knowledge ^[14]: organisations and project practitioners need knowledge of technical domains. It is not the technology that contributes most to productivity improvement, but the knowledge of how to make the best use of technology in particular work contexts ^[16]. Businesses are being impacted to a substantial extent by the technologies underlying the 4IR ^[1]. The complexity of modern projects has increased over the years comparatively to traditional projects of about (40-50) years ago, because of the current complexities, project managers are required to use much more effective and efficient ways to manage current projects ^[15]. Project managers already have an overwhelming amount of work on their hands, so this fact puts an even greater strain on them. However, digital technology has the ability to assist ^[15].

4.4 Importance of Technology in Project Management

As customers become more demanding these days, project management companies are demanded to innovate,

find ways to reduce timeframes, and develop evermore cost-effective resolutions while improving the quality of the work. Presently, technology is what has the ability to meet all of these demands. Technology has been revolutionising the business landscape in the past decades. We're witnessing a shift in the way project management is performed today that we've never seen before. Digitisation has made it possible to collaborate in real-time from any location with Building Information Modelling (BIM). Project management has greatly improved due to the substantial accelerating processes in the Project Management Office (PMO) and on site. The challenge for organizations is to incorporate these new methods into their traditional strategies in order to remain competitive in the so ever increasingly saturated industry.

4.5 Effective Use of Technology to Plan and Schedule Projects in the Project Management Environment

Although some companies remain reluctant to use technology, fast-rising and well-established project management companies are benefiting from the advantages of streamlining workflows with the help of technology tools as organisations implement better project management strategies^[15]. The assisting tools are listed below:

Virtual Designing with BIM

The concept of virtual designing with BIM gives the project team a vision of how the project should look when they follow the design and plan instead of using drawings. This allows the project team to detect errors even before they occur. In this way, which saves significant amounts of money, energy and as well as time in the process of corrective actions. Enhancing the project manager's original plan and creating mitigations and contingencies that may have been overlooked^[15].

Enterprise resource planning (ERP) Software

The process of project planning is never simple. Reviewing processes that worked in the past is often required when working on complex projects. An ERP system allows project managers and their teams to do so as the system allows for large amounts of data to be stored from previous projects. The modern project management software makes use of the cloud to store project files in a safe manner even after the project has been completed. All devices connected to the internet are able to download and view these files with convenience. The software has also expanded to offer other vital functionality, such as project management, document management, communication,

collaboration, file sharing, and system reporting. Thus, making use of this single platform, data can be shared across a multiple aspects of a project while minimizing double entry^[15].

Document Imaging and Digitisation

The general contractor's and project manager's office used to be overcrowded, filled with file cabinets overcrowded with submittals, time cards, change orders, drawings and diagrams, plans, invoices, and reams of other printed documents. As a result, if the project manager needs to locate a particular file, browsing through all the other folders takes a lot of time. These are sometimes misplaced or trashed by mistake. However, today's project managers are using document imaging, when they scan files, save them as images of PDFs, and arrange them into folders on the computer. In some cases, other project practitioners use electronic receipts and invoices to save them automatically to folders. As a result, the project manager is able to find files easier and attach them to reports, communication channels, or emails^[15].

Automated Workflow Tools

The process of reporting and sending team schedules in project management are some of the tasks that can be automated through digital means. Alarms can be set to notify the person-in-charge before a task is due, allowing projects to move faster and reducing instances of stuffing. The result is an increase in work quality^[15].

Scheduling software/Intuitive Project Dashboard

It is not sufficient to have a project management software that has all the features and functions a project manager needs, as this software will be also used by the project members of the team, the dashboard therefore, should be intuitive and straightforward. As a result, they will be able to drill down into the data and will save time and resolve confusion when navigating the menu. The dashboard is where most software displays the most pertinent data so that the project manager can see them instantly. In addition to special software that allows the contractor and subcontractor to share a single workspace, the subcontractor can also access only data related to their project as part of his access^[15].

5. Research Methodology

Academic research is often started by identifying what is currently known and what remains to be discovered about a topic^[6]. Literature related to the topic and supporting material should be cited, but it is also important

to consider previous data for further analysis. There may already be data that can be used to address the research questions [7]. For the current study, an in-depth literature review of the area of interest was conducted, examining the previous and current work of experts in the field. The literature on Project planning and scheduling and as well as what changes the 4IR demands from organisations has been critically reviewed. In the review of literature in the ‘literature review’ section of this report, other researchers on this topic were identified and as well as cited, the same was true of agencies and research centres that conducted similar studies. Usually, original survey research does not use all collected data, and this unused data has value in supplying answers or in providing other perspectives on questions or issues [7]. For existing survey data to be useful, it needs to be well matched to the right research questions [7]. In this study, the research questions were addressed using existing data from three primary investigations on related topics. The method of data collection from the primary investigations was appropriately suited for this current study. To answer the research questions that were posed in the original research, it was decided to use existing survey data.

5.1 Analysis of Research Findings and Discussion

The study focused on analysing the impact of technology on planning and scheduling projects in the face of 4IR. Having used a descriptive analysis, the findings of the study are discussed in the figures below.

The results of the study demonstrate that effective planning has substantial impact on the successful execution of projects. The figure below indicates 55.5 per cent of the respondents to be in agreement with the statement above while 29.5 per cent are in between and the remaining 15

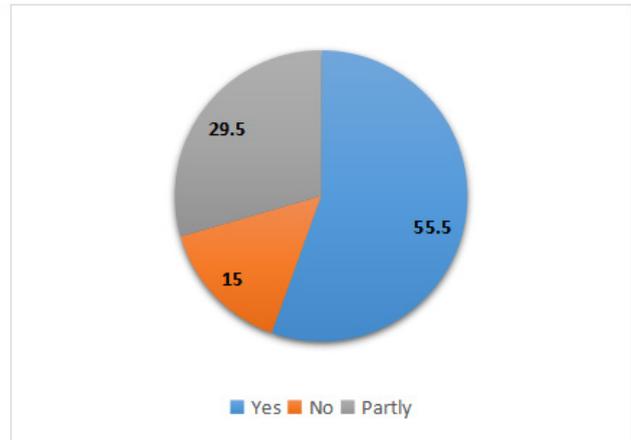


Figure 1. Does effective planning impact on the successful execution of projects?

per cent of the population disagreed with the fact that effective planning has an influence on successful execution of projects. The literature reviewed in this study reveals that without effective and efficient planning, organisations may lose a substantial amount of money in ineffectively planned projects resulting from mismanagement of resources and delayed projects. Therefore, any project management firm wishing to be successful in delivering projects in the 4RI era must take advantage of the benefits of technology with regards to tools available for planning for projects.

The graph above provides an indication of the amount of technology that is currently being used to assist in the planning and scheduling of project activities in project management. Wherein it is indicated that 55 per cent of the results show that it is moderately used, 50 per cent of the results convey that it is used only at minimum while 25 per cent indicates just enough, 35 per cent of the

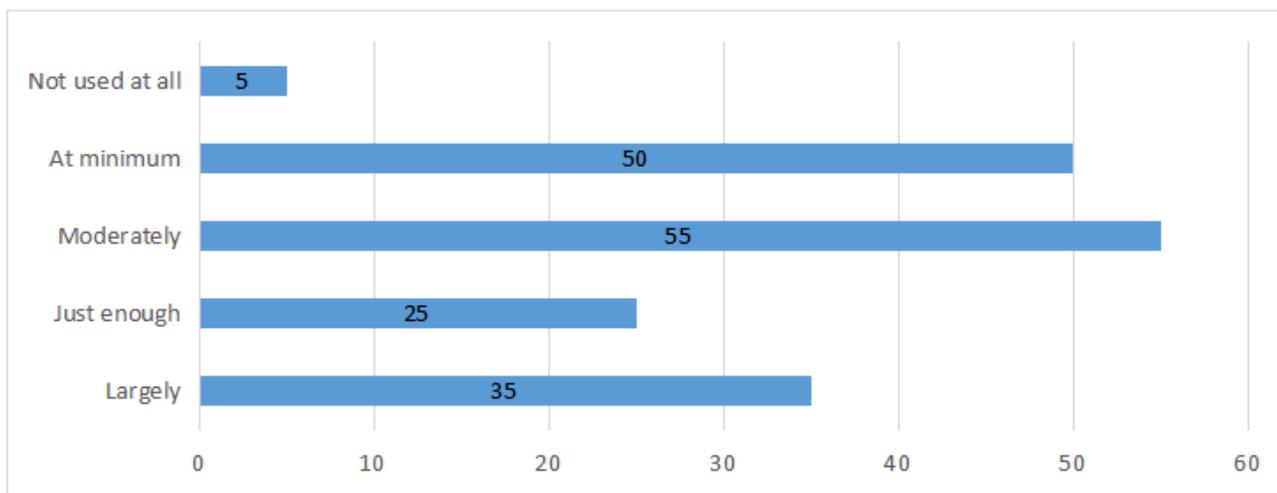


Figure 2. How much technology is used to assist in the planning and scheduling of project activities, if used at all?

results convey that it is used largely while only five per cent indicates that technology is not used at all to assist in the planning and scheduling of project activities. These findings fundamentally express the insufficient use of technology in the planning and scheduling of projects. This, therefore, is important information that pronounces what the objectives of this study aimed at exposing.

The provision of the findings depicted above indicate that 65.5 per cent of the collected data reports do not agree with the statement in question while only 35.5 per cent agrees to the statement. These findings summarise and simplifies the incommensurate effectiveness of the traditional project management scheduling for project success in the modern project management environment. With which we can conclude that there is a need for the integration of technology to bridge the gap between what the modern project management environment requires to

be (sustainable and thriving in the business market), and what the traditional project management scheduling tools are able to do or provide.

Figure 4 presents an interpretation of the commonly used technologies such as scheduling tools in the modern project environment where 65 per cent of the data indicates scheduling software to be the most commonly used tool, 35 per cent of the data, reports information gathering tools and as well as workflow automation to be the second most commonly used tools in the modern project environment. Both collaboration and tracking tools are reported to be the third commonly used tools by the 25 per cent of the data. The researcher sought to understand the current practised tools in order to draw recommendations of what else can be added to fill in the gap between what the industry demands and what is being offered. The summary of these findings, therefore, leaves us with the conclusion

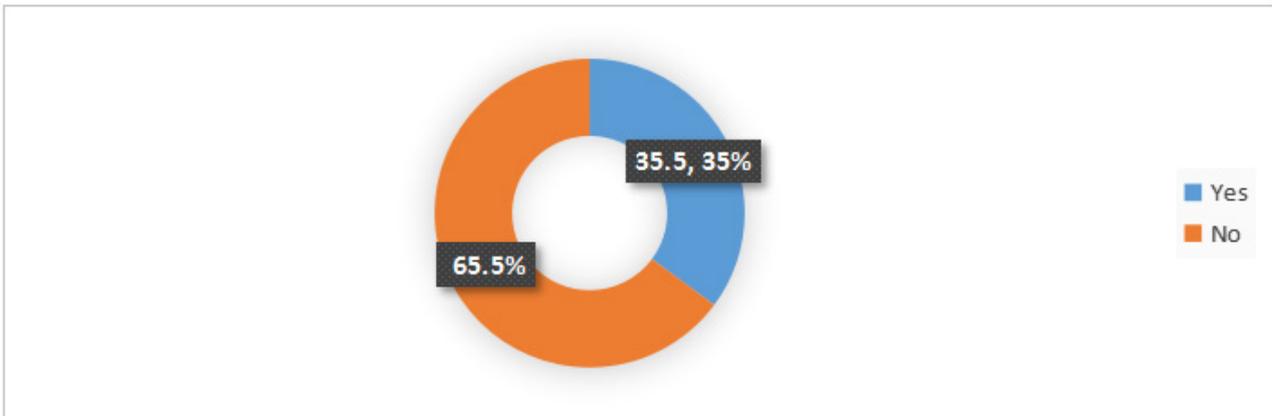


Figure 3. Do you think the traditional project management scheduling tools are commensurate for project success in the modern project management environment?

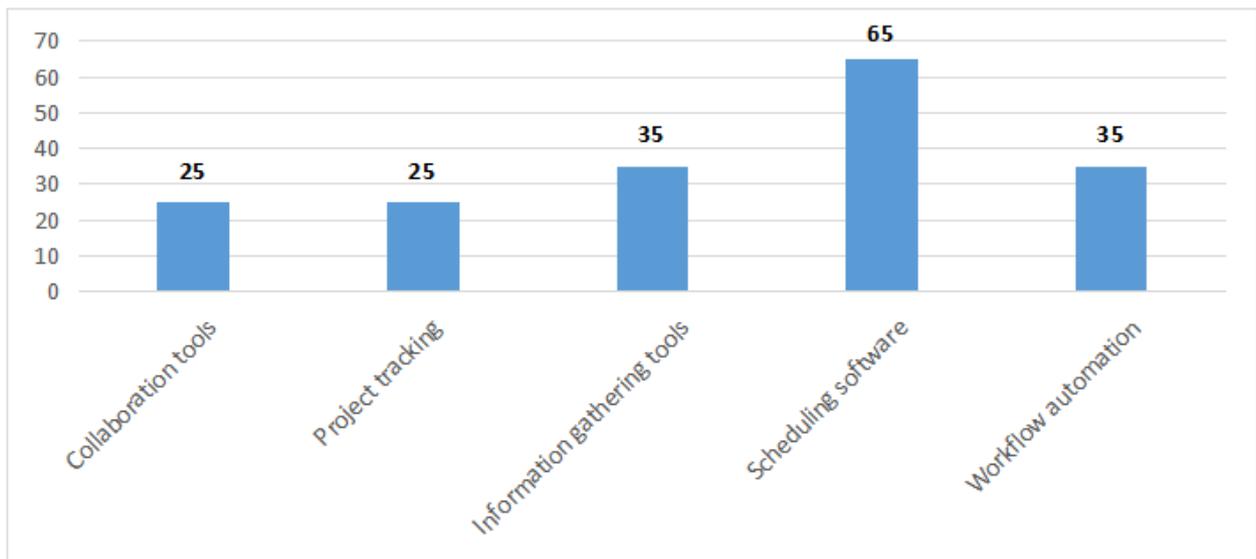


Figure 4. What are the most commonly used technological scheduling tools in the modern project environment?

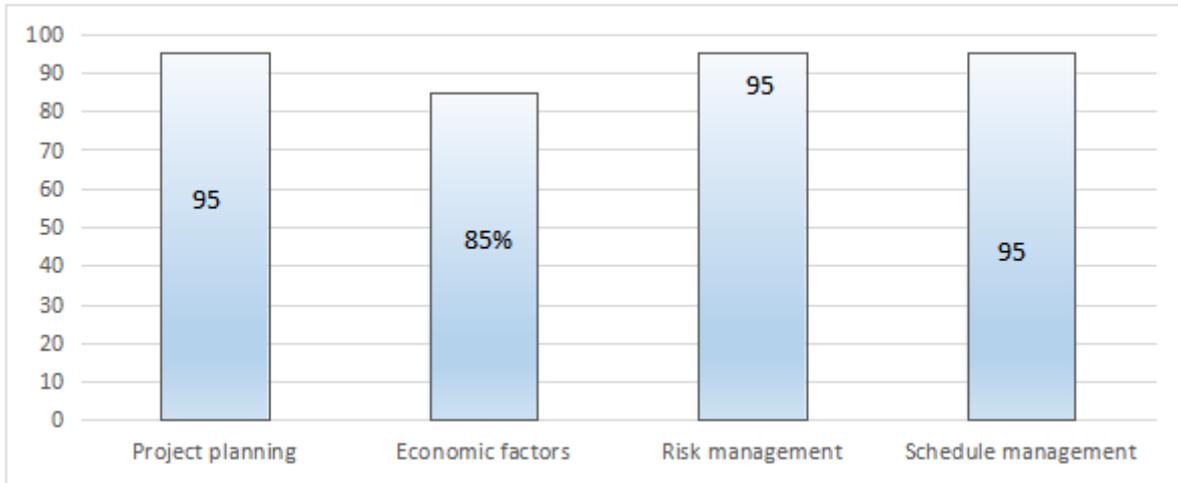


Figure 5. What are the major factors affecting project management effectiveness?

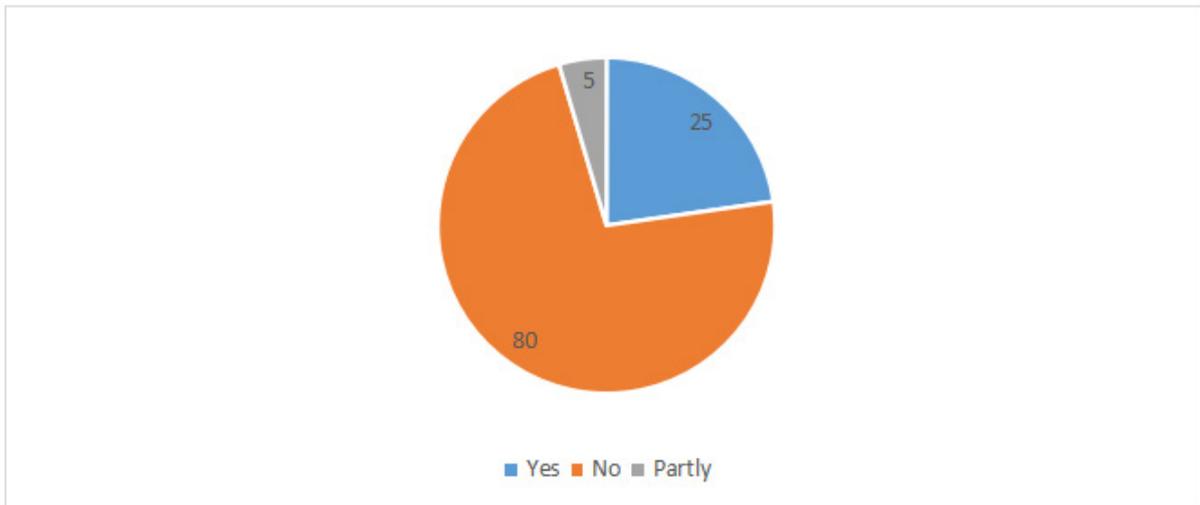


Figure 6. Are the traditional management tools and techniques used to plan and schedule sufficient to be effective in the era of 4IR?

that there is room for increased use of the technological scheduling tools in the modern project environment for a much more effective, efficient and well time managed project scheduling.

According to the data above, project planning, risk management and schedule management are amongst the major factors contributing to project management effectiveness, indicated at 95 per cent, while economic factors are reported at 85 per cent. The researcher here aimed to measure the level of the impact of project planning and schedule management on project management effectiveness in order to gauge their effect on project success.

The data above indicate that 80 per cent of the findings of this report indicate that the traditional management planning and scheduling tools and techniques are not sufficient to be effective in the era of 4IR. 25 per cent of the findings indicate positive to the statement in question

while a minority of 5 per cent indicates partiality. These findings, therefore, substantiates the information illustrated in Figure 4, that traditional management tools and techniques used to plan and schedule are not sufficient enough to be effective in the era of 4IR.

6. Conclusions

The findings of the study identify and examine a set of factors argued as contributors to the effectiveness of project management in the face of the 4IR. The literature reviewed in the study reveals that there are knowledge gaps within project management as far as technology can be effectively used to plan for scheduling in the management of projects. The research findings indicate a strong demand on the use of technology to be incorporated with the already existing project management tools in order to

ensure effective change management in the modern technology driven business market. Planning and scheduling are affected by the factors studied in this research which revealed a link between efficiency and sustainability of technology in today's businesses. Further, the study's results suggest that certain significant tools should be prioritized over others in the development of project plans and schedules. Additionally, project management policymakers should consider the possibility of ineffective planning and scheduling resulting from any mismatch between project management technology requirements. While the study only examines planning and scheduling aspects of project management, as far as technology is concerned, it has also provided some useful insights to the importance of effective project management in general. Since project management has traditionally been studied from a broad perspective, a number of tech-centric methodologies have emerged to improve its efficiency in operations, and one of those methodologies is schedule management planning. Scheduling management does not only help manage time, but also enables the tracking of different tasks with the use of advanced technologies so that the project can be managed more effectively. In addition to optimizing the use of resources and completing projects on time and effectively, this also helps employees understand their role and therefore, be more productive. Using the findings of this research, educators can better learn about the advantages and pitfalls of different planning techniques and tools, as well as strengthen their awareness of them. Consequently, this is hoped to motivate project practitioners to select and apply more appropriate methods, tools, and techniques in their work in order to improve quality planning processes. Based on the evidence collected and analysed, it is revealed that some successful projects utilise contemporary tools for project management, but they do not fully utilise them to their full potential. As a result, it can be concluded that scheduling is an important element of project success.

Contributions of the Study to Knowledge

The researcher of this article has the hope that this research study might add value to the pool of knowledge relating to planning for project scheduling with advanced project management tools in the face of emerging smart technologies, while it is not without limitations. This research study analysed the application of advanced project management tools for planning project scheduling in the face of 4IR. The study examined the traditional project management tools for project scheduling in conjunction with the use of smart technologies with the aim to provide a framework for change management. Moreover, it explored the common gaps between traditional project

management scheduling tools and those that are available as a result of smart technologies and suggested solutions to bridge these evidently promising and pervasive gaps between the two phenomena. Furthermore, this research study explored the positive characteristics of these concepts and offered recommendations on how they can be enhanced in value and usefulness. schedule planning and quality enhancement in project management.

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