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Related Literature Review 5D Model for Project and Operation/Maintenance Remote Monitoring of Equipment and Piping System

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ABSTRACT

This 5D model research study gathers data and integrates existing research papers and related studies into this review. The goal is to reflect on the concept to realize this research and the issue and problems faced by previous research. Moreover, the industries' operational possibility, practicality, and applicability align with Industry 4.0 and the Digital Twin perspective. This paper presents an extensive literature analysis concerning the 5D model concept utilizing and integrating into one (1) platform with 3D CAD software during the entire project engineering construction stages, including operation and maintenance. The 5D model study focuses on platform development and innovation in a remote or virtual environment. The remote control and monitoring apply to project engineering/construction, plant operation/maintenance (OM), and system decommissioning. Specifically, Oil & Gas, Petrochemical, Petroleum Refinery, etc. It will also include Building Information Model (BIM) related research study, especially in costing and scheduling development. Due to the limited and unavailability of data for a specific study, the 5D model concept is not everywhere. However, it has already been formulated from various perspectives of researchers, modelers, and software developers in different stages. The researcher brings together related topics like virtual project management (VPM), virtual team (vT), data management system (DMS), web-portal system, building information modeling (BIM), cloud-based software (CBS), project triad, multi-structure & scale, lean construction, safety, quality, google earth, control/inspection, and remote-control monitoring, 3D model design, and computerized maintenance management system (CMMS). The study review of the 5D model concept within the specific area is evaluated, analyzed, and summarized in the below, figures and tables. It concluded that the effective implementation of the idea increases competitiveness, high safety, quality, and performance. Moreover, it does not duplicate another research study on this 5D model concept. However, the relevant topic's idea may be improved, optimized, and innovated to realize this concept and better application.

1. INTRODUCTION

Project constructions are getting harder to complete, with a higher level of competition, creating more dynamic and complicated surroundings. However, due to the industry's rapid growth and development, standard management [1] and monitoring systems are currently unable to keep up, which creates several issues with task efficiency and information transmission across project delivery phases [2].

The literature review is one way to check the duplication and redundancy of the concept, it might be re-applied or mis-implemented. It searches for alternate and creative ways to replicate or entirely replace some processes' long-standing traditions and is gaining ground [3]. Moreover, it is achievable in the age of smart gadgets and the Internet of Things [4].

Most organizations increasingly move into virtual project environments [5]. For team members, including global [6], to take full benefit of virtuality [7] while avoiding its drawbacks, it must be identified the practices and viewpoints contributing to virtual projects' effectiveness. The features of the company as a whole and the broader societal context, which can include governmental and environmental challenges, are significant factors in managing such initiatives [8]. It's not restricted to specific cultures, projects, or countries, although virtual teams have many benefits for organizations, including managing workload and teams.

The 5D model concept aligns and contributes to the Industrial 4.0 perspective and is cheaper than the digital twin concept. It's higher virtual plant maintenance management, CMMS, and a slightly predictive maintenance level.

Furthermore, concerning this research, the 5D model for project and operation/maintenance as remote environment base monitoring for equipment and piping system is rare and seldom in this process. See Table 1 for the market's definition of current commercial software.

2. SCOPE AND DEFINITION

The research review is within the scope of the primary research framework, the project construction management, including operation/maintenance management, see Figure 1.

The concept of "5D modeling" is currently the focus of many theories; from the standpoint of a researcher, it can be described as follows,

- 3D Model (ePlant). To show, analyze, create 2D drawings, and fabricate detailed drawings,
- 1D Model (eMgnt). To maintain the project's timetable and progress,
- 1D Model (eOM). To assure the projects' adaptability, dependability, operability, and maintainability.

It can be one-time software or utilize the existing 3D model software (ePlant), add to eMgnt and eOM. In addition, there are options for how the 5D model will work from different link software.

This 5D model is a software foundation that can input data into the 3D model connected to project construction management and operations/maintenance schedules to monitor the plant status quo. For details, see Table 1 below.

The study review of the 5D model concept within the specific area is summarized in Tables 1 and 2, including relevant subjects. Potential outcomes of this research include facts checking, evaluating, and collaborating with a related field. Additionally, research on BIM, particularly in the creation and relation of costing and scheduling, will be included.

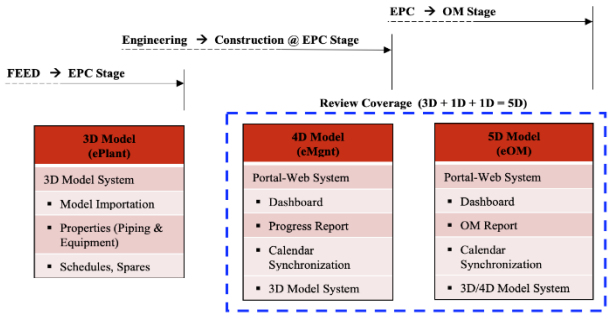

Figure 1. Scope of review

Table 1. 5D modeling concept definition

3D Model (ePlant)	1D Model (eMgnt)	1D Model (eOM)
o 3D Model view for further analysis, such as stress, surge, and hydraulics o 2D General arrangement drawing o 2D Sectional drawing o Isometric drawing o Material take-off (MTO) o Cost estimation for Procurement	o Project/Construction Schedule (Level-3/4) o Construction Progress Status	o Animated view for process flow o Maintenance Schedule (Level-4/5) o Operation (Standard Procedures and Guidelines) o Maintenance (Corrective and Preventive)

Table 2. Individual software, the remote monitoring

No.	Description	Commercial Developer [1]	Definition
1	**3D (ePlant)** Drawing Generation, and Material Take-off (MTO)	**3D CAD** (Aveva, Autodesk, Bentley, and Hexagon)	3D CAD Software [9, 10] Aveva – Plant Design Management System (PDMS) Autodesk – AutoCAD Plant 3D Bentley – AutoPLANT 3D Hexagon – Intergraph Smart 3D (Plant Design System, PDS)
2	**1D (eMgnt)** Costing, Scheduling, and Progress Monitoring	**BIM** (Autodesk, etc.) CBS (Asana, ClickUp, Monday, etc.)	Building Information Modeling (BIM). Known for generating schedules and costs for building construction. It's creating and managing information for a built asset throughout its lifecycle, from planning and design to construction and operations [11]. Cloud-Based Software (CBS). Known for work management such as project progress monitoring, processes, operation, time, etc. [12]. Asana, ClickUp, Monday, etc., are commercial cloud-based software, available in the market.
3	**1D (eOM)** Operational, Maintenance, and Decommissioning	**CMMS** (MaintainX, Fiix, etc.)	Computerized Maintenance Management System (CMMS). Known as a software package that keeps track of information on organization maintenance operations in a computer database [13]. MaintainX, Fiix, etc., are simplified maintenance task software, available in the market.
Note:	1. Any 3D CAD, BIM, CBS, and CMMS software can be a base sample for this review study. However, only 3D CAD (new/existing) can be used as a database for this research study.		

3. DATA COLLECTIONS

The researcher obtained articles on the 5D model by searching four (4) areas: VPM, vT, vS, and BIM. Searches on digital libraries thru internet access, such as journals, websites, articles, and papers. It caters to multi-disciplinary research articles in engineering, sciences, and arts. ASEM, CMAA, and PMI have several published essay articles, papers, books, and standard practices that can aid the research review. All gathered data would be processed using the C4 flow model, a simplified qualitative analysis is shown in Figure 2, with the functions of OSEL (Objectives, Significance, Evaluation, and Limitations).

Collect. Collect and categorize the gathered data, such as publications itemized in dates, applied sectors, and authors under the contexts of the VPM, vT, vS, and BIM in the 5D model, including related publications.

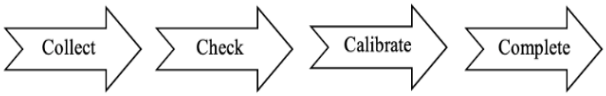

Figure 2. C4 flow model

Check. In the following context, check and classify the gathered data, such as the VPM, vT, vS, and BIM, in the 5D model. In virtual project management (VPM), finding the gap and gathering the topics related to the papers focuses on (1.1) the virtual world, (1.2) project management, (1.3) engineering management, and (1.4) construction management. Also, the virtual team (vT), the same as VPM, finds the gap and gathers the topics related to (2.1) team management, (2.2) functional management, (2.3) leadership styles, and (2.4) the manager's responsibility, including the virtual software (vS), finding the gap, and gathering the topics related to 3D CAD, BIM (software), CBS, and CMMS. The BIM model is related to project schedules and cost management.

Calibrate. Calibrate and clarify the data, evaluate according to research tools, and develop the study. If the data isn't in-line with the scope of selection/review, it should be *changed* from gathered data or rejected, look for other sources.

Complete. Clear and complete the data, summarized into each objective (optimization), significance (strength), and limitation (feedback). It simplifies into an unconventional process and come-up with bonafide results in this literature review.

4. RELATED WORK

The literature selection addresses problems, issues, and challenges in the 5D model research concept and structure. Alternative terms and definitions related to the 5D model are described in Tables 1 and 2. Some other authors' use is simplified and often more complex than suggested in this review. More detail on collective data is described in Table 3. The limitation of data includes issues, articles, variables, parameters, and constraints that are considered without any reservation from fears [14].

Moreover, the highlight avenue of this literature review is the virtual team (vT) and the virtual software (vS) to be used since the 5D model is under the umbrella of virtual software. In addition, each vT faces and addresses physical factors such as location and cognitive, social, and emotional challenges [15]. Integrating and executing new techniques as part of the review and applies to the concept [16].

Gathered data was collected and separated into simple information such as year, area, study type, sector, and country. After process analysis, evaluation, and selection, it will incorporate and summarize for further assessment, see Table 3. The review, together with previous research publications and relevant studies, was categorized into four (4) areas, virtual project management (VPM), virtual team (vT), virtual software (vS), and building information modeling (BIM), sorted by years (from 25 years ago to the latest publication).

As shown in Figure 3, from 2005 to 2022, the *descriptive* publication has the highest, while statistical model and model analysis follow. In the *descriptive* publications, IT/Software has 20, project management has 7, construction has 6, and the rest follow. In the *statistical model* publications, IT/Software has 16, construction has 2, project management has 2, and the rest follow. In the *model analysis* publications, IT/Software has 14, construction has 7, project management has 2, and the rest follow.

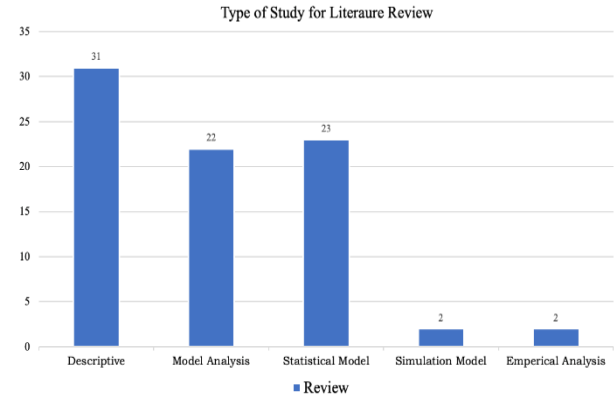

Figure 3. Study for review

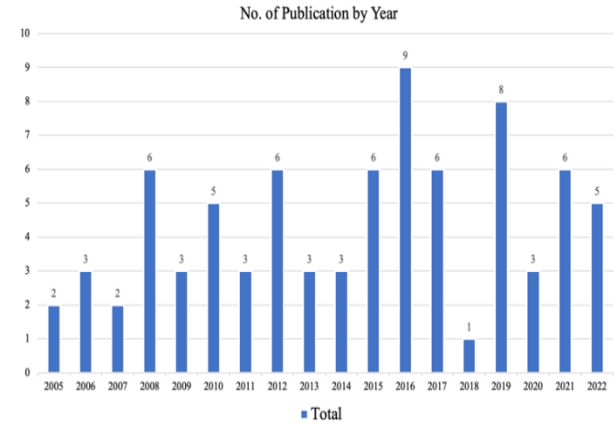

Figure 4. Research study published: Year

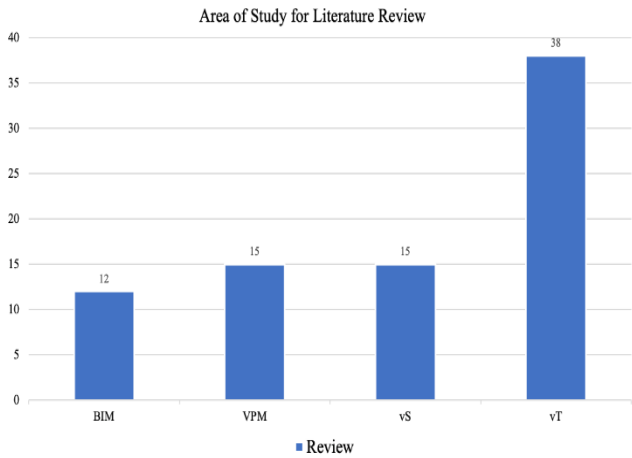

Figure 5. Research study published: areas of study

From 2005 to 2022, the *IT/Software* sector has 52 (65%) related publications, construction has 17 (21.3%), project management has 13 (16.3%), and the rest follows. The *descriptive* has 31 publications, the vT has 17, the vS has 4, while BIM has 5, same as VPM has 5 related publications. The *statistical model* has 23 publications, the vT has 13, VPM has 6, and vS has 4, while BIM is 0 associated publications.

Finally, the *model analysis* has 22 publications, the vT has 7, vS has 7, BIM has 5, and VPM has 3 related publications.

As shown in Figure 4, 2016 got the highest publication, 9 articles, while 2019 has 8 related publications. The data is based on the researcher's information from journals, research papers, and studies. Figure 5 shows that the virtual team (vT) has 38 collective data, more than twice that of virtual software (vS), the same as BIM and VPM. The area concerning the study in the virtual environment is a virtual team compared to virtual software development. However, the research topic is more on the collaboration of virtual software.

From 2008 to 2020, in the BIM area, the Construction sector has 100% of related publications from different studies. While in vT and VPM areas, the IT/Software sector has 78.9% and 66.7%, respectively, making related publications from various studies.

Emphasizing and focusing on the area and sectors in this literature review is essential for this study. For example, IT/Software, construction, and project management significantly impact this 5D model review. Although some sector applications are still necessary since the 5D concept applies to all plant construction projects as long the compatibility of 3D software is ok and acceptable.

5. LIMITATION

In this research, the review covered and focused only on project engineering, construction, and management for any field of engineering related to 5D modeling structures, see Figure 1. Therefore, it's limited to college and university operations such as hybrid virtual, online schooling, and webinars. It would be better and appropriate for mechanical (piping/equipment), chemical, electrical, IT, architectural, civil, industrial, project management, engineering, and construction if the topic is related to the project and construction field. Moreover, further research and development are highly recommended for future implementation and specific applications. For more detail, see Figure 1 and Tables 1 and 2.

6. RESULT, DISCUSSION, AND SUMMARY

The concept of virtual project management (VPM) will reduce space and operational costs. However, this concept is not exceptional to the challenges and risks such as communication, planning, technical, cost, schedule, etc. [17]. The most significant challenges are diversification changes [18].

The 5D model concept is the primary platform for this virtual monitoring of piping and equipment collaborating with a 3D CAD model, even the overall virtual project management software database. The virtual concept is deepened to achieve Industrial 4.0 and beyond. In the digital era, the Internet of Things (IoT), the digital twin, is approaching this virtual world [3]. Due to the limited and restricted resources for review, the related articles, journals, and papers, including books that can help in this review, are heavily considered.

As described in Figure 4, over 90 articles/papers are randomly collected, and 80 articles/papers are selected for the C4 flow model. The reviewed papers are classified according to the years published, study type, sector application, and study analysis, and with a combination of the area of studies such as VPM, vT, vS, and BIM.

As a result of the analysis in Figure 2, the below sections for descriptive, model analysis, and statical model are discussed. Table 3, this review classifies and focuses on four (4) areas such as virtual project management (VPM), virtual team (vT), virtual software (vS), and building information modeling (BIM) in project construction management, such as cost and schedule. Furthermore, as listed in Figure 4, it identifies closely through the research analysis and evaluation, objectives (/optimization), significance (/strength), and limitations (/feedback). In summary of this discussion, see Table 3 for more detail. As shown in Figure 3, the descriptive, model analysis, and statistical model are the common viewpoints and most highlighted ideas of this review in four (4) different areas such as virtual (vT), virtual software (vS), virtual project management (VPM), and BIM.

6.1 Descriptive

What's all about this virtual research? First, the publication views *descriptive studies* as many contributions from 2005 to 2022 in this virtual research study, almost 38.8% out of 80 (Figure 3) selected review papers, as shown in Figure 4.

Virtual Team (vT). Project leaders identified and managed the main challenges [19]. The software project management model (SPMM) was introduced [20]. According to the article of Tuffley [21, 22], the three (3) components of the leadership model such as virtual team leadership, integrated team leadership, and generic leadership, can be used even in a complex project [23] and with the help of process assessment model (PAM) and process reference model (PRM) in which another related study in 2011 [22]. Communication and monitoring are critical [14]. The virtual team concept demonstrates and mixes with an existing company employee [24]. The method reduces the need for synchronous communication, and as a result, increased project awareness leads to more effective project execution [25]. Virtual teams achieve the objectives of lowering costs and working [23] around various resources [26].

Virtual Software (vS). In collaboration with developers, human factors experts, and users, create innovative virtual reality (VR) and virtual environment (VE) systems [27]. The cloud-based project management system (PMS) will provide greater real-time visibility into project requirements [28], and the tools make it easier [29]. In addition, 3D visualization technology converts engineering design drawings and data into graphics or images, allowing simulated users to experience virtual reality in a future construction scene [30].

Virtual Project Management (VPM). The efficient administration of virtual projects [31] depends on the three (3) core process aspects of coordination, control, and communication [8]. Reducing coordination difficulties in the virtual platform can allow, establish, remove boundaries, and examine artifacts of teamwork with unique qualities of virtual technology [32]. Global outsourcing sets project strategy, high performance, international project standards, team trust, knowledge management, shared understanding, and decision-making [33]. Furthermore, investigate and assess the impact of leadership style on project implementation [34].

Building Information Modeling (BIM). The significant advantages of using BIM are making decision-making, alternatives in design & construction, and cost analysis [35].

Moreover, the 4D (schedule) models to 5D (cost) and even newly developed 6D (operation) models [36].

6.2 Model analysis

Why virtual concept is needed to understand? The *model analysis* research has 27.5% collected data from 2005 to 2022 in this virtual research study, as shown in Figures 3 and 4.

Virtual Team (vT). The development of trust and cooperation is a critical component for the success of any virtual team-based project [37]. The impact of leadership behaviors on a virtual team by investigating the interactions between leadership styles, task cohesion, and cooperative climate that influence team performance in decision-making tasks [38]. Virtual project teams' key challenges and collective success are good communication, team trust, and leadership flexibility [39]. According to Hosseini et al. [40], data envelopment analysis (DEA) is a method for comparing and evaluating the performance of global virtual teams (GVT). In 2015, the use and adaptation of the virtual design team (VDT) methodology will contribute to the growth of local businesses [41]. The investigation and analysis in building trust sorted the communication into three (3) categories: formal, informal, and awareness [42].

Virtual Software (vS). The database management system (DMS) used to track real-time data and cost control are critical management functions for completing construction projects [43]. In 2012, Zhou and Shao [44] introduced the capacity maturity model of integration (CMMI) to analyze the project's deficiencies. Since then, numerous software solutions have been available to evaluate project effectiveness from many perspectives [45]. In the article of Mashhadi [46], implementing a computerized maintenance management system (CMMS) is the primary element in the production processes working with services field maintenance (SFM) and production field maintenance (PFM). In the same year, 2019, product design life management (PDLM) and product lifecycle management (PLM) consider collaboration and implementation in engineering and design in various projects [47].

Virtual Project Management (VPM). Virtual communications, including geographic member distribution and synchronous and asynchronous communication technology, are components of virtual project management. In addition, operational model, project planning, filtered project memory, architecture, product planning matrix, product deployment matrix, component deployment matrix, conflict, breaking works, project rules, how to define duty, diversity, and language are all included in this part [48].

Building Information Modeling (BIM). The BIM idea integrated design and delivery, improving the standard of construction projects and enhancing their predictability [49]. The BIM's 5D applications are implemented with fundamental guidelines to approach project development, systematic planning, scheduling, and cost estimating to overcome roadblocks. In BIM projects, to supply what is required to develop a simulation from the beginning through attaining superior results [50].

6.3 Statistical model

How far do they view virtual concepts? In this *statistical model analysis*, the researcher collects data from almost 28.8% with a different point of view. See Figures 3 and 4.

Virtual Team (vT). A virtual project team's importance to success, long-term advantages of managing work, keeping with prior findings, and adopting technology. Task completion, process management, and relationship development dimensions are intertwined with and through the levels and are complicated by technology use [51] - performance improvement of virtual teams for virtual work. Engagement, goal setting, empowerment, and effective communication are essential for virtual workers [52]. As Alnsour [53] pointed out, the virtual team will make collective decisions with interdependent experts and perspectives to determine the impact on the project team's effectiveness. According to Alhasanat et al. [54] comprehend the dynamics of information sharing and international cooperation with the virtual team. A successful vT as possible using communication tools, conflict management, and leadership abilities. In the detail of Alhasanat's [54] article, Bhat et al. [55] added the factor of virtual team effectiveness the reliance on one another, taking care of time, a desire for cooperation, permeation of information, diverse information, the trustworthiness of technology, equipment for communication, and application of the results. Agile is frequently used as the project organization standard [4]. Agile development in four (4) dimensions, written communication, team relationship, interactions, and documentation [56]. The analysis of case capacity for the project team, including the virtual environment, in the scale and structure model, determine and establish the capacity model of the project manager handling various projects [23].

Virtual Software (vS). The primary determinants of the management and operational effectiveness of a virtual software team include team strategy, risk management, infrastructure, implementation, organizational structures, and conflict management [57]. In the construction industry, cloud-based software (CBS) programs have evolved from specializing in a single corporate function to several areas, including daily logs, document/photo storage, prequalification, and scheduling [58]. As a result, project managers have challenges sustaining a software project's sustainability and increasing efficiency. Data gathered feature extraction, model creation, and analysis steps in the software project management (SPM) estimate process [59].

Virtual Project Management (VPM). According to Nauman & Iqbal [18], the approach to lowering costs, headcounts, addressing customer issues, developing products, providing services, and utilizing a more diversified pool of personnel within a company is being replaced by virtual project management (VPM). In addition, Nauman [60] published another article, the effectiveness of virtual project management (VPM) systems is influenced by social intelligence and leadership style. Trust greatly facilitates relationships in project teams and society at large. The partial least squares (PLS) assess, test, and suggest a trust model for virtual teams [61]. Collaboration tools are frequently used for social networking and informal communications, and they may or may not cause minor issues with data management [62].

When considered globally, cultural variations may impact the leadership behaviors that lead to the success of virtual projects [63]. Verified data results are essential to VPM's operational effectiveness for PMC company. Most data and model assessments supported this virtual environment's efficacy [31].

Below are the overall analytical ideas and views, evaluated and summarized in Table 3.

Table 3. Finding and summary

Areas	Objectives (Optimization)	Significance (Strength)	Limitations (Feedback)
VPM	The core process and attributes to improve the efficiency and effectiveness of virtual project management execution are as follows, ▪ Coordination and clarification [31] ▪ Control and monitoring [8] ▪ Check and review [31] ▪ Communication (Synchronous Technology) [64, 65] ▪ Cost reduction [23]	VPM can be executed [66] and reach the level of Industry 4.0 or beyond. The operational possibility, effectivity, and capability aspects collaborate [67] with the specific software base and high technical personnel [48].	VPM will encounter a lot of diversification challenges [68] and difficulties as follows, ▪ Language barriers [18, 69] ▪ Information duplication [23] ▪ Time differences [18] ▪ Cybercrime and security [70] ▪ Self-esteem and motivation [71] ▪ Cultural distinctions [72] ▪ Dispute resolution [18, 48] ▪ Trust the team [61] ▪ Technical differences [23]
vT	The virtual team [73] should increase awareness [74], which leads to effective execution [75], ▪ Ability, efficiency, and completion [31] ▪ Communication skills [42, 76] ▪ Leadership traits [63, 77] ▪ Fear and Trust [14, 78]	The successful virtual team [6, 79] focuses on project management areas aside from software collaboration [62], ▪ Performance evaluation [80] ▪ Functional management [31] ▪ Leadership style [34] ▪ Team trust [33, 37] ▪ Design planning [7]	It has been noted that fear of trust is always present in the team [33]. However, it's necessary to have a concrete policy and a mutual agreement within the group per project [52, 78, 81].
vS	Implementing CBS [58], CMMS [46], and DMS [49] will improve productivity and increase efficiency [45].	Using CBS [29], CMMS [82], and DMS [43] will increase competitiveness and marketability in the organization [30].	Not all CBS [47] and CMMS [83] available in the market will apply to a specific field, and should be aware of the intention [56] to meet the requirements, specifications, and application [27]. Moreover, integration into different applications might be costly.
BIM	BIM will improve [84] design efficiency, quicker methods, standards evaluation [85], cost analysis, and project schedules [2, 35, 86-88].	The benefits of having BIM [89], integration system approach [90], model construction [49], cost accuracy [36], planning, coordination, conflict analysis [86], level of development /detail, scheduling methods [91], and 6D improvement [2].	Some users hardly adapt and experience difficulties dealing with BIM software [86].
Definition: 6D – 6 Dimensional CBS – Cloud-Based Software		DMS – Data Management System CMMS – Computerized Maintenance Management System	

Table 3 sorted, tracked, summarized, evaluated, and analyzed the importance of each document and the data gathered. The result was categorized and filtered into the following OSEL, Objectives (Optimization), Significance (Strength), Evaluation (Study Analysis), and Limitation (Feedback). The objectives, significance, and limitations stated in Table 3 are essential data for this research review. This review aims to examine and identify the importance of research study concepts, issues, and problems faced during the tenor of 5D development.

As shown in Figure 4, most researchers tried to reconstruct and improve virtual project engineering construction management, introducing cloud-based software (CBS) software into a different dimension to cope and align to Industrial 4.0 and beyond.

Until this moment, the specific study to be developed, the 5D model for remote monitoring of equipment and piping system, is not yet introduced and implemented for industrial purposes, specifically to open field process plants. Moreover, remote monitoring is essential and significant in a virtual environment. As a result, the 5D model concept increases the project's efficiency, system optimization, and process improvement. In addition, the constructability, maintainability, and productivity of overall project execution will increase competitiveness.

7. CONCLUSIONS

The data gathered from VPM, vT, and vS are essential ideas from various researchers for virtual execution, while the BIM, CBS, and CMMS support the 5D model concept. In this research, the 5D model environment is an innovative and developed software that collaborated and utilized the 3D CAD as a database integrated with the CBS and CMMS concept under the umbrella of the virtual software (vS) area, as stated in Figure 4.

In addition, Table 3 also concluded that the 5D model needs broader emphasis on multiple research studies addressing development, expansion, and innovation in the first tiers of the project construction industries. The 5D model is not clearly emphasized or mentioned in the collective data, see Figure 4, as a specific concept. However, it is recommended that software implementation is based on collaboration with available and existing project software. Therefore, implementing this 5D model concept could be helpful and significant to undergraduate engineering students, specific engineers, technical personnel, and operational staff to improve competitiveness, high safety, quality, and performance [92]. However, the relevant topic's idea may be improved, optimized, and innovated to pursue this concept to realization and better implementation to the specific application.

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NOMENCLATURE

2D	2 – Dimensional Drawing
3D	3 – Dimensional CAD (ePlant)
4D	4 – Dimensional, (eMgnt) Project & Construction Management
5D	5 – Dimensional, (eOM) Operation & Maintenance
6D	6 – Dimension
ASEM	American Society of Engineering Management
BIM	Building Information Model
CAD	Computer-Aided Design
CBS	Cloud-Based Software
CMAA	Construction Management Association of America
CMMI	Capacity Maturity Model of Integration
CMMS	Computerized Maintenance Management System
DEA	Data Envelopment Analysis
DI	Data Integration
DMS	Data Management System
EPC	Engineering, Procurement, & Construction
FEED	Front-End Engineering Design
IT	Information Technology
IoT	Internet of Things
OM	Operation & Maintenance
OSEL	Objectives, Significance, Evaluation, and Limitation
PDLM	Product Design Life Management
PFM	Production Field Maintenance
PLM	Product Lifecycle Management
PLS	Partial Least Squares
PMI	Project Management Institute
PRM	Process Reference Model
SFM	Services Field Maintenance
SPMM	Software Project Management Model
VDT	Virtual Design Team
VPM	Virtual Project Management
vS	Virtual Software
vT	Virtual Team (including Global, GVT)