Scientific Research Publishing

American Journal of Industrial and Business Management, 2022, 12, 1867-1912
https://www.scirp.org/journal/ajibm
ISSN Online: 2164-5175
ISSN Print: 2164-5167

Virtual Project Management (VPM) in Project Execution

Roberto S. Ybañez[1], Lincoln A. Bautista[2], Arvin R. De La Cruz[2]

[1]PUPOUS-DENG, Polytechnic University of The Philippines, Manila, Philippines
[2]Faculty, Graduate School, Polytechnic University of The Philippines, Manila, Philippines
Email: rsmaybanez@yahoo.com, labautista@pup.edu.ph, arrdelacruz@pup.edu.ph

How to cite this paper: Ybañez, R. S., Bautista, L. A., & De La Cruz, A. R. (2022). Virtual Project Management (VPM) in Project Execution. *American Journal of Industrial and Business Management, 12,* 1867-1912.
https://doi.org/10.4236/ajibm.2022.1212102

Received: June 10, 2022
Accepted: December 27, 2022
Published: December 30, 2022

Abstract

This research study will focus mainly on the LNG sector. The objective is to determine, investigate, and seek the operability opportunity in a virtual environment's project management, engineering, and construction. The researcher will tackle the importance and issues it addresses the virtual project management (VPM) platform demands without compromising the quality and safety of services during the execution of the project. This virtual platform simulated the model using conventional project management stated in PMBOKS. The researcher will randomly pick the possible solution and improve the existing project management consultancy (PMC) operation and processes, initially to virtualize the system to meet the technical personnel demand, lapses, and labor vacuum within the available time. The goal is to achieve this conversion, minimize face-to-face interaction, promote work at home, reduce operational costs, minimize technical human resource risk, and facilitate working space area capacity. This study divides virtual project management (VPM) into operational possibility, effectivity, and capability (OPEC). Operational Possibility and Effectivity are the primary concern in this research, and it discusses the elemental process attributes such as [1] Leadership Style, [2] Design Planning, [3] Functional Management, and [4] Performance Evaluation. However, conventional project management is the basis of this study's viewpoint and is translated into virtual. Moreover, this study still shows the operational capability and discusses it in the logical analysis as part of the OPEC overall model. The gathered data, discussion, and analysis in two (2) groups, the possibility and effectivity of this virtual platform, and the respondent's opinion, the virtual team from domestically is preferred by the experts in the field over offshoring or overseas. Moreover, the operational effectiveness with the two (2) highest attributes, as per the expert's opinion, the VPM should focus on the virtual team's Performance Evaluation [1st] and the Project manager's (PM) Leadership Style [2nd]. The virtual team's Performance Evalua-

tion concentrates mainly on efficiency and completion of assigned product deliverables. PM's Leadership Style focuses primarily on communication and personality. However, the other attributes of Functional Management [3rd] and Design Planning [4th] can be applied to the overall project execution concept. In this research, the highest recommended source of a virtual team (vT) and VPM operation effectiveness are preferred accordingly. However, the PM has fully responsible for this VPM operational effectiveness and outsourcing virtual teams in particular projects. In this regard, further verification is required for this research focuses on the implementation and application with collaborative software is needed.

Keywords

LNG, VPM, PM, PMC, Virtual Teams

1. Introduction

Since then, the concept of remote control is now trending. As a result, IT systems can operate beyond what we expect to be managed in this project management. Take note, throughout the project's life cycle, not only can the execution phase be converted to virtual but all phases.

An LNG terminal is a delicate and fragile process, and the project needs careful attention and care… as the personnel and staffs are experts in technical and management. Still, some say it cannot be managed virtually, and it is challenging to visualize the LNG sector. How can it be possible if the demand for industrial construction is very high, and the technical people are getting shortage? VPM is the answer to this problem, although this is only a concept; who knows if it would be resolved through such things?

Common problems can arise if the VPM concept is not regulated or illegalized. In some cases, such as the project, the owner will detect the usage of this concept during the execution stage; workforce pooling for technical staff and personnel will put a risky position between the project contractor and the project owner. Therefore, there will be expected depute and causes trouble in the long run, the project in the execution stage and even in the project management consultancy (PMC) operation; however, this type of issue is minimal and can be prevented. Other points should be highlighted in the PMI staff availability area, specifically for functional engineers or specialists.

This research paper will allow the basic concept and perspective of execution in a VPM environment that can be operated even in massive projects; it will be the basis of acceptance by the industry and regulatory Board. As a result, the Project Management Institute (PMI) will accept, adapt, and assist in becoming regulated as part of business process outsourcing (BPO) in PMC businesses, the project's operation, and even the strategic plan (McCarthy, 2020). Furthermore, during the execution stage of VPM operation, the possibility of a low/high risky envi-

ronment and even matrices will be highlighted to allow and show that VPM concepts are reliable for operation even in a virtual environment.

2. Conceptual Framework

The conceptual framework is based on the concept described in the PMBOK guide (PMI, 2021). There are no different approaches between conventional and virtual platforms as research models in project management for project execution (Hill, 2008). In PMBOK (PMI, 2021), the virtual concept views from a general perspective in the project management system since there are no differences from the conventional. This conversion aims to reduce operational costs, minimize technical human resource risk, and reduce the working space area (Ybañez, 2017).

Referring to **Figure 1**, conventional and virtual platform conversion has many benefits. Moreover, the scope of VPM focuses on the project execution phase in LNG project engineering, construction, and management, as stated in **Figure 2**.

3. Methodology

There are two (2) ways to investigate and analyze this research on VPM operational possibility, effectivity, and capability (OPEC). First, the statistical analysis to ask the opinion of field expertise and experience in this type of project thru a survey. Second, to analyze and investigate those items in the model based on the D5 process, as **Figure 3** stated. The researcher will re-establish, re-figure, and re-structures the concept to the best of his ability, experiences, and expertise to make VPM works smoothly.

4. Literature Review

As part of this study, the researcher gets ideas from other research and published related studies. Tackle the issues where the current concept can fill the gap encountered by previous research studies past track 20 years ago. Far beyond, the research will incorporate all of these, if needed, applies, and cover LNG sectors application, operational effectiveness, implementation, and improvement with the collaboration of software (Aljabri & Khayyat, 2020) in a virtual platform.

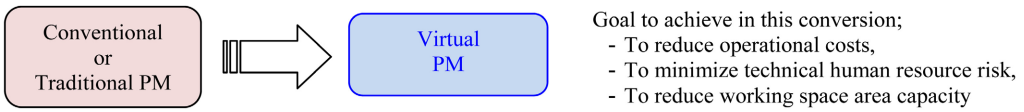

Figure 1. Converting platform from traditional to Virtual Project Management (VPM).

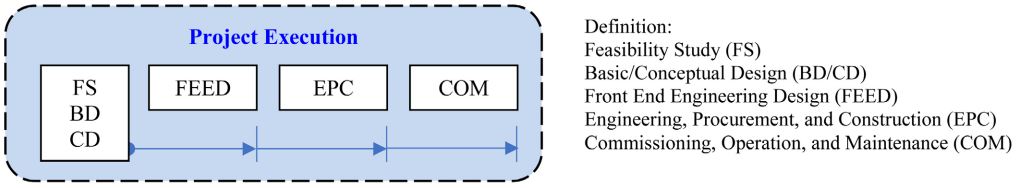

Figure 2. Stages of VPM in project execution.

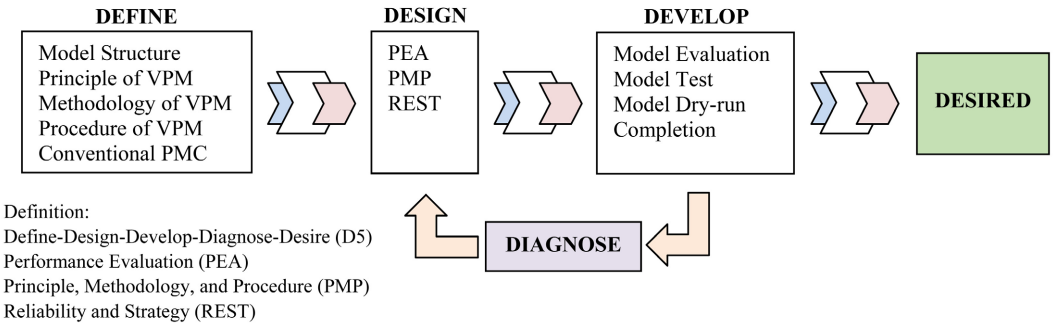

Figure 3. D5 model analysis.

In general, implementation and application, the virtual concept, developing team trust (Casey, 2010), good communication (Lee, 2014), and software collaboration are essential to effective virtual operation (Casey & Richardson, 2008). The software application is everywhere in the market (Christianson et al., 2017). The PMBOK Guide (PMI, 2021) is the bases of the project management system. However, the virtual environment has not detailed the guidelines of the virtual project management (VPM) system. Even though EMBOK (ASEM, 2019) and PMBOK (PMI, 2021), especially PMBOK, are based on the reference of project management, the virtual idea is still hiding on the shelves. The VPM operational effectiveness lies in virtual teams and collaboration with software (Alnsour, 2014) and its development (McMahon, 2001).

In most cases, challenges other researchers encountered, the collective issues are technical and language barriers (Smith & Ruiz, 2020), especially the overseas virtual team. Challenges of a virtual team (Marquardt & Horvath, 2001; Owen, 2017) are always part of the PMC operation. However, how effective the virtual unit was? It all matters in the project completion and individual performance (O'Neill et al., 2019). Considering the overseas and domestic virtual teams (Dumitrascu & Dumitrascu, 2016). Various advantages (Robinson, 2020) to applying and implementing remote work.

The development of the virtual concept (Baylor et al., 2010) and software innovation is growing so fast (Puolitaival et al., 2016). The full-blown virtual environment was during the pandemic outbreak of Covid-19. The following researcher's data analysis regarding virtual project management (VPM) (**Table 1**).

5. Significance of the Study

The research's primary objective is to understand the importance of virtual project management (VPM) in the middle of circumstances such as a pandemic (Abarca et al., 2021) like covid, etc. The essential contribution of the technical labor force in the organization is significant while in the lockdown period. Moreover, assuming the construction execution process is continuous, the project team should continuously operate in a virtual platform, especially in the LNG sectors, since the LNG tank (full containment type) construction duration for almost 24 months.

Table 1. Review summary for VPM[1].

Analysis	Objectives (Optimization)	Significance (Strength)	Author
Descriptive	Coordination, control, and communication are the three main process aspects.	Combine capacity in human and technological resources.	Zigurs et al., 2008
	Establish confidence and eliminate boundaries.		Owen, 2017
	Establish project strategy, high performance, global standards, team trust, knowledge management, sharing, and decision-making.	Technology-mediated communication, collaboration, and an established methodology.	Baylor et al., 2010
	Additionally, it is crucial to implement policies and procedures.	Leadership, decision-making, negotiation, and trust-building are all necessary skills.	Aljabri & Khayyat, 2020
	Assess the impact of leadership style on project application and implementation.	Transformative leadership styles use emotional intelligence.	Renzi, 2020
Empirical	It encourages group learning, facilitates extensive communication, and uses eConference.	The effectiveness of communication as measured by experimental design.	Abbattista et al., 2009
Model	Adapt, motivate, and train members of your project team, engineers, and colleagues to use Web 2.0 tools.	Collaboration with Web 2.0 tools.	Gholami & Murugesan, 2011
	Geographic communication technology, such as synchronous and asynchronous communication.	The documentary nature of cyberculture in VPM.	Nozari et al., 2016
	For the project, set a VCPM, develop paradigm construction, and create comprehensive body information.	VCPM is a tool for teaching construction management, VDC procedures, and BIM technologies.	Puolitaival et al., 2016
Statistical	Cost reduction, headcounts, customer relations, product development, service provider, and utilizing a more diversified pool of personnel within a company are being replaced by VPM.	GVT intensifies and concentrates on flexibility and globalization.	Nauman & Iqbal, 2005
	Trust greatly facilitates relationships.	Assess, test, and suggest a trust model.	Mumbi & McGill, 2008
	Relationship between social intelligence and leadership style in projects.	The influence of social intelligence and leadership style.	Nauman, 2012
	Effectiveness of collaboration tools and VPM.	Software collaboration and other tools used for social networking and informal communications may or may not cause minor issues with data management.	Bissaliyev, 2017
	Impact the leadership behaviors that lead to the success of virtual projects.	Behavioral possibilities such as establishing trust, completing tasks, and facilitating.	Behling, 2019

Note: 1) The abbreviation and definition will detail in Appendix 6.

This research study can be highly significant to the project team as the project includes stakeholders, project contractors, and project companies, most especially technical specialists, which are usually done in this type of project LNG Process and Receiving Terminal in which the researcher focuses. However, it is not limited to them if the kin of this research can proceed with their specific study. The personnel usually involved in the project should be the candidate of this platform, projecting to the VPM set-up. From traditional to the new virtual concept can be a highly demanded environment for this time, middle of the pandemic, and for the coming generation of project management managers, technical specialists, staff, and personnel.

As shown in Figure 4, the researcher will analyze, evaluate, and investigate through the survey and confirmation of model analysis based on the researcher's experience and expertise. It benefits the project construction team, especially with the software collaboration in specific applications. However, this implementation's limitations might occur if one thoroughly misunderstands the virtual platform concept. Therefore, the researcher's validity with other research on this application confirms the importance and realization of VPM in the application and implementation of different industrial sectors.

Although this VPM is not the solution to PMC operation, it's a useful concept to continue controlling, inspecting, and monitoring the project. Furthermore, with the collaboration of software, the 5D Model, and the Project Triad concept, the VPM of the LNG sector is essential to run and operate smoothly (Ybañez, 2017). In addition, pertinent points were discussed to avoid misconceptions about this research.

6. Model Analysis

In this section, the analysis will divide into two (2) parts, a statistical and logical analysis; logical will be used the D5 Process Model as per the researcher's experiences and expertise. The statistical analysis is derived into two (2) areas,

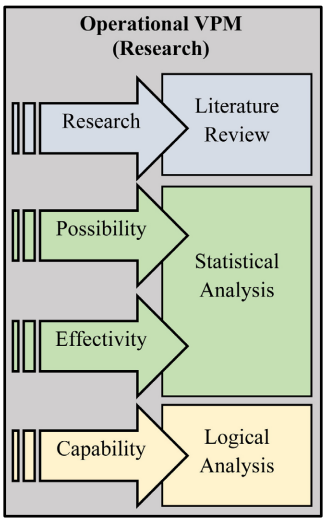

Figure 4. VPM research model.

operational possibility and effectivity in this long-term PMC operation. In Figure 4 and Figure 5, the D5 Model will solidify the VPM capability, concept, and statistical data into the basis of virtual and remote works in this PMC operation, especially in the LNG sectors.

6.1. Statistical Analysis

The researcher surveyed with two (2) series of questions for the primary data in the analysis. This will convey top management, managerial threats, operational effectiveness, and dealing with operations' priorities with a virtual team. See Appendix 1 for detailed questionnaires and Appendix 2 for a detailed graph and table in Appendix 2 of the result.

In Appendix 2, the typical equation calculates the percentage relationship and significance of seventeen (17) respondents, considering their experience and expertise in the LNG sectors. Furthermore, the results are based on surveys and the opinion of most experts in the field. Therefore, the researcher will take this result as experimental data, although it is inconclusive.

Operational Possibility

According to the respondent's survey results in Appendix 2, Figure A2.1, the VPM operation in LNG sectors is possible for domestic or overseas virtual teams (vT). The survey data from the respondent's point of view are credible, highly recommendable results, and the confirmation from field experts is enough to understand the survey results. The researcher sets the criteria for at least 50% of the sample population to qualify for the project team (virtual) for VPM set-up. According to the result in Appendix 2 as follow *vT Domestic* (94.1%), *vT Overseas* (76.5%), and *Both* (overseas & domestic, 76.5%).

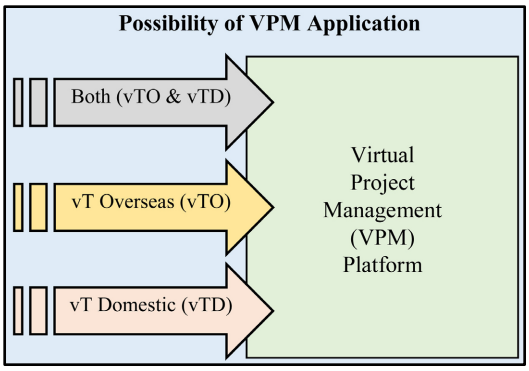

Figure 5. VPM possibility, results refer to Appendix 2.

Table 2. Level of criteria.

Gage Level (%)	Good	Satisfactory	Very Satisfactory	Excellent
96 - 100				
91 - 95			vTD	
81 - 90				
71 - 80	vTO Both			

According to survey data, the operational possibility of working with a virtual concept, the VPM environment, has a very high credit and percentage rate because this concept can benefit project team members and contractors.

Although more than 50%, 60%, or more collective stand is a probable and better decision for a possible virtual team, both overseas and domestic, to join in the execution of the project. 70% is enough to conclude and ensure the application of the virtual environment in the LNG sector construction business, even in the energy and power sectors.

Operational Effectivity

Appendix 2, **Figure A2.2**, **Table A2.6**, and **Figure 7** show that performance evaluations were derived as ACES (see Appendix 1) had the highest rate, 87.9%. Among the top seven (7) attributes, *efficient* (95.3%), *completion* (92.9%), *ability* (90.6%), *communication* (88.2%), *structure* (85.9%), *file-handling* (85.9%), and *personality* (85.9%) are essential in VPM operation. Although, up to *system* (72.9%) shown in **Figure A2.2** and **Figure 7** are still helpful in VPM operational effectiveness. The attribute definition and function will detail in Appendix 1, the survey questionnaires.

Although the minimum percentage criteria are 70%, as per the researcher's recommendation, 85% is enough for the VPM to operate smoothly in the LNG industry sector and to lead the virtual team.

The following definition of the top seven (7) attributes shown below in **Figure 7**, referring to Appendixes 1 and 6.

Efficient—Meeting the client's expectations as required in the project.

Completion—Completing the task as per the contract and project requirements.

Ability—Task over time, determining each project's technical familiarity, capability, and understanding level.

Communication—Contacting and coordinating often thru email or phone for the project team, e.g., to a virtual team (vT).

Structure—Organizational support, such as technical staff and workforce for the specific project.

File-Handling—Keeping and storing deliverable data safely under confidentiality.

Personality—Motivating and maintaining a good attitude toward each project team member.

6.2. Logical Analysis

In this analysis, the researcher will convey and simplify the unconventional process by using the D5 model to discuss the operational capability with a logical concept based on the researcher's expertise and experience as part of the OPEC overall model. Appendix 3 will detail this analysis and, like the conventional model, initial, output, and process (IPO). In addition, the steps of the D5 model (Define-Design-Develop-Diagnose-Desired) will determine the other side of the

process in dealing with VPM in LNG sectors. In Appendix 3, as shown in Figure 8, are the steps of the D5 model.

7. Results and Discussions

In Table 1, the VPM research literature review is collected, summarized, and viewed according to the description of the study's analysis, objectives, and significance. Each researcher contributed their findings and shared their knowledge within the period. Moreover, the application of most previous VPM research studies is gradually implemented, especially at the height of the Covid pandemic. However, not all construction and industrial sectors, specifically in the Oil & Gas and LNG sectors, are applying the environment. In addition, in most of these studies, such *fear* due to working with the team at a distance, *trust* due to efficiency/completion of deliverables, *communication* due to clarification/coordination of technical matters, and *collaboration* with software to make this VPM environment operate smoothly.

In Figure 6, as the result of the survey regarding *operational possibilities*, the minimum criteria of 70%, the team from domestic (vTD), overseas (vTO), and both (domestic/overseas) choices are accepted and reasonable. Although domestic (vTD) received the highest credit, acceptance and selection should be based on each technical discipline's qualifications and experience.

In Figure 7, the project manager and virtual team should possess at least seven (7) out of several attributes as described, such as *efficient* (95.3%), *completion* (92.9%), *ability* (90.6%), *communication* (88.2%), *structure* (85.9%), *file-handling* (85.9%), and *personality* (85.9%). Therefore, the recommended cut-off level of 85%, although 70% is the minimum criteria, would be enough in this VPM *operational effectivity*.

Figure 8 shows the logical analysis and the suggestive model to understand the *operational capability* of the VPM environment. The researcher explains and suggests the concept as detailed in Appendix 3-5. Moreover, these suggestive concepts are based on the researcher's expertise and experiences.

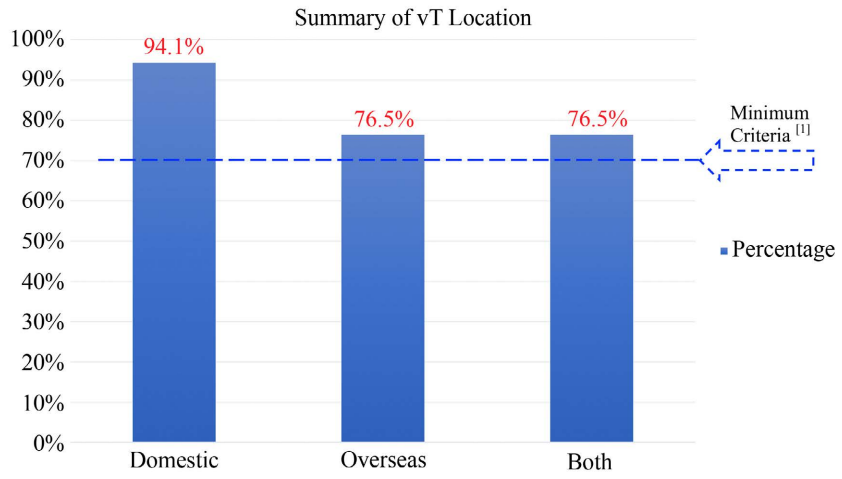

Figure 6. VPM possibility, results refer to **Figure A2.1** in Appendix 2.

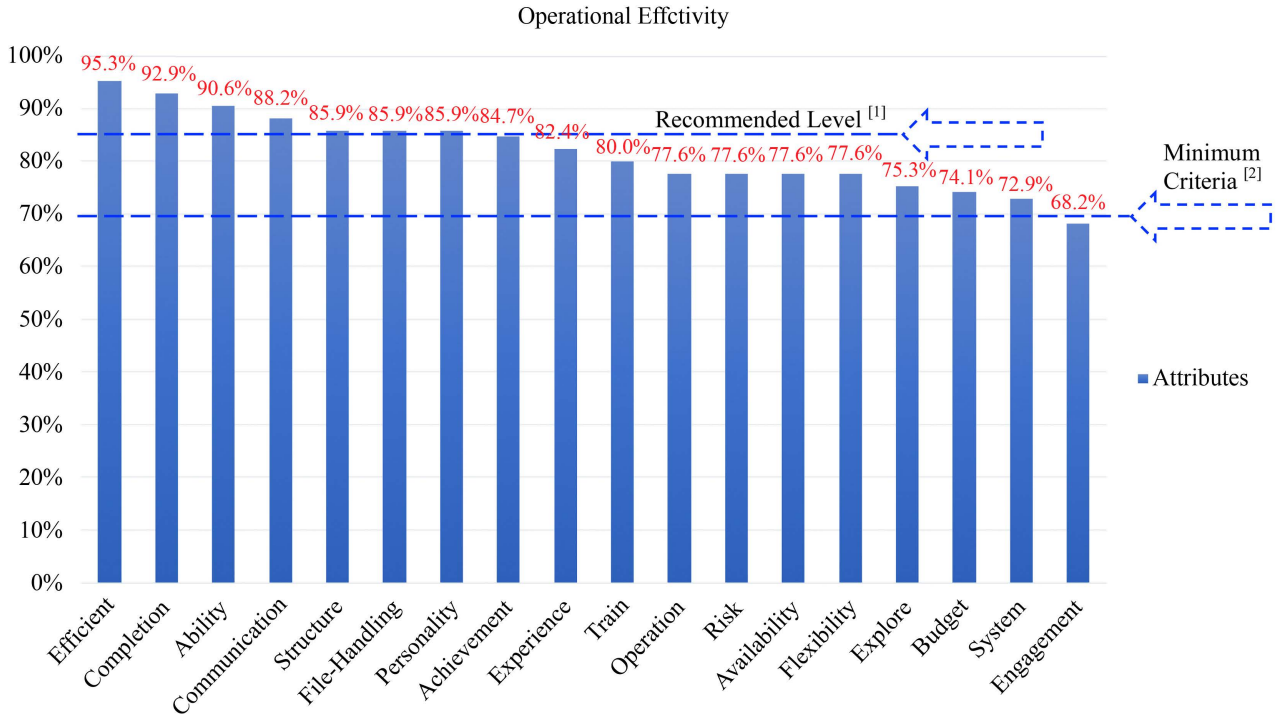

Figure 7. VPM effectivity results refer to **Figure A2.2** in Appendix 2. Note: 1) Recommended level set by Researcher. 2) Minimum criteria set by Researcher.

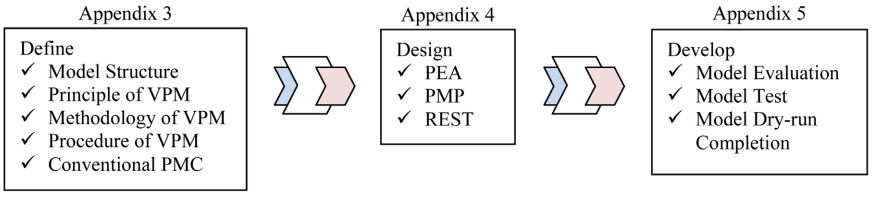

Figure 8. Steps of D5 model[1] [2]. Note: 1) The virtual team (vT) should understand the basic concept of the D5 model. 2) The abbreviation and definition will detail in Appendix 6.

All the above mentioned, such as *fear*, *trust*, *communication*, and *collaboration* (with software), are additives and a glimpse of an essential factor in the successful implementation of VPM operation. However, the main factor will be considered only in the initial phase, together with *statistical* and *logical* analysis, the OPEC model. Further investigation is recommended.

8. Conclusion

VPM environment is essential for every project engineering and construction, especially during the height of the Covid pandemic. This VPM operation will keep the project team maintained even working virtually. Working remotely is more convenient if connected to the internet or cloud, and the capability of DMS, DI, PTC, VPC, and 5D Models during the implementation. Moreover, as discussed in Sections 6 and 7, and referring to appendixes, are more relevant to smooth VPM execution and performance.

Table 1, the literature review contributes and significantly impacts this research due to sample data (such as *fear*, *trust*, *communication*, and *collaboration*) and the recommendations. Moreover, direct and focus on LNG sectors, the area of study.

In Figure 6 and Figure 7, the survey results related to the *operational possibility* (70% minimum criteria) and *effectivity* (85% recommended level of measures) are essential traits that the researcher strongly recommends to the best of his ability, experience, and expertise. Figure 8 and the appendixes consider the *operational capability* in this VPM environment execution and implementation. Furthermore, as stated above, the researcher will recommend executing the VPM concept and environment.

However, further investigation is highly considered and explicitly recommended for industries other than the LNG sector, software collaboration, and conceptual improvement of VPM. The executor, implementor, and operator of this VPM environment have fully responsible for this application.

Conflicts of Interest

The authors declare before the law that the publication of this research paper contains no conflicts of concept, idea, interest, and understanding.

References

Abarca, V. G., Sanchez, P. P., & Camacho, M. A. (2021). Virtual Teams in Times of Pandemic: Factors That Influence Performance. *Frontier in Psychology, 12,* Article ID: 624637.

Abbattista, F., Calefato, F., Andrea De Lucia, A., Francese, R., Lanubile, F., Passero, I., & Tortora, G. (2009). Virtual Worlds: Do We Need the Third Dimension to Support Collaborative Learning? In *ICWL 2009 Virtual World (ViWo),* 1-6, ViWo Workshop 2009.

Aljabri, O., & Khayyat, M. (2020). Virtual Project Management Software Skills (VPMSS). *International Journal of Multidisciplinary Research and Publications (IJMRAP), 3,* 39-44. https://www.researchgate.net/publication/346492678

Alnsour, B. H. (2014). The Use of VPT for Project Management in Jordanian Corp. *Eurasian Journal of Business and Management (EJBM), 2,* 50-60. https://doi.org/10.15604/ejbm.2014.02.02.004

ASEM (2019). *EMBOK Guide* (5th ed.). American Society for Engineering Management.

Attridge, H. (2018). *Why Should Leaders Get to Know Team Members*? Academy of Leadership Coaching & NLP Program (ALCON). https://nlp-leadership-coaching.com/why-leaders-should-get-to-know-team-members/

Baylor, E., Philips, S. B., Coleman, C., & Craig, K. (2010). Virtual Project Management of Globally Outsourced IT Projects. *International Journal of Management & Information System, 14,* 1-8. https://doi.org/10.19030/ijmis.v14i5.7

Behling, C. (2019). *Project Success in Virtual Project: A Qualitative Study of Leadership Behaviors*. Capella University, ProQuest LLC.

Bissaliyev, M. S. (2017). The Effectiveness of Collaboration Tools on Virtual Project Management. *International Journal of Applied Engineering Research, 12,* 10747-10755.

Casey, V. (2010). Developing Trust in Virtual Software Development Team. *JTAECR, 5,* 41-58. https://doi.org/10.4067/S0718-18762010000200004

Casey, V., & Richardson, I. (2008). Virtual Teams: Understanding the Impact of Fear. *Software Process: Improvement and Practice, 13,* 511-526. https://doi.org/10.1002/spip.404

Christianson, G., Wilson, E., Henke, M., Alhnaity, O., & Woo, J.H. (2017). Cloud-Based Project Management: Selecting IT Solutions for Construction Companies. *Lean & Computing in Construction Congress (LC³), 1 (CIB W78)*, Heraklion, Greece.

Dumitrascu, I., & Dumitrascu, D. (2016). Creating Effective International Virtual Project Team. *Revista Economica, 68,* 46-56.

Gholami, B., & Murugesan, S. (2011). Global IT Project Management Using Web 2.0. *International Journal of Information Technology Project Management, 2,* 30-52. https://doi.org/10.4018/jitpm.2011070103

Hill, G. M. (2008). *The Complete Project Management Office Handbook.* Auerbach Publication.

Jackson, B. (2010). *Construction Management—JumpStart* (2nd ed.). Wiley Publishing Inc.

Lee, M. R. (2014). *Leading Virtual Project Teams—Adapting Leadership Theories and Communications Techniques to 21st Century Organizations*. CRC Press.

Marquardt, M. J., & Horvath, L. (2001). *Global Teams: How Top Multinationals Span Boundaries and Cultures with High-Speed Teamwork.* Davies-Black Publishing.

McCarthy, D. (2020). *7 Elements of a Strategic Plan.* https://www.thebalance.com/strategic-plan-elements-2276139

McMahon, P. E. (2001). *VPM—Software Solutions for Today and the Future*. St. Lucie Press.

Mumbi, C., & McGill, T. (2008). Investigation the Role of Trust in Virtual Project Management Success. *International Journal Networking and Virtual Organizations*, *5*, 64-82. https://doi.org/10.1504/IJNVO.2008.016003

Nauman, S. (2012). Patterns of Social Intelligence and Leadership Style of Effective Virtual Project. *International Journal of Information Technology Project Management, 3,* 49-63. https://doi.org/10.4018/jitpm.2012010104

Nauman, S., & Iqbal, S. (2005). *Challenges of Virtual Project Management Developing Countries*. In *Proceedings. 2005 IEEE International Engineering Management Conference* (pp. 579-583). IEEE.

Navidi, W. (2011). Ch. 1-6. Sampling and Descriptive Statistics, Probability, Propagation of Error, and Hypothesis Testing. In W. Navidi (Ed.), *Statics for Engineers and Scientists* (3rd ed.). McGraw-Hill.

Nozari, H., Najafi, S. E., Jafari-Eskandari, M., & Aliahmadi, A. (2016). *Providing a Model for VPM with an Emphasis on IT Projects*. IGI Global. https://doi.org/10.4018/978-1-4666-9688-4.ch003

Nuells, N. (2013). Effective Project Management of Virtual Teams. *PM World Journal, 2,* 1-5.

O'Neill, T. A., McLarnon, M. J. W., Law, D., Taras, V., Steel, P., & Donia, M. B. L. (2019). GVT Communication, Coordination, and Performance across Three Peer Feedback Strategies. *Canadian Journal of Behavioural Science, 51,* 207-218. https://doi.org/10.1037/cbs0000135

Oberlender, G. (2000). Ch. 2. Working with Project Teams. In G. D. Oberlender (Ed.), *Project Management for Engineering and Construction* (pp. 17-30). McGraw-Hill.

Owen, J. (2017). *Global Teams: How the Best Teams Achieve High Performance.* Pearson Education Limited.

PMI (2021). *PMBOK Guide* (7th ed.). PMI.

Puolitaival, T., Davies, K., & Kestle, L. (2016). *Virtual Construction Project Management Environment*. Regional Hub Project Fund (RHPF), Ako Aotearoa National Centre for Tertiary Teaching Excellence.

Renzi, T. M. (2020). The Effect of Leadership Styles on Project Implementation. *OJL, 9,* 198-213. https://doi.org/10.4236/ojl.2020.94012

Robinson, J. A. (2020). *Virtual Teams and Remote Working: How to Successfully Work Remotely and Lead Virtual Teams.* Committee of the American Bar Association and Committee of Publishers and Associations.

Smith, S. M., & Ruiz, J. (2020). Challenges and Barriers in Virtual Teams: A Literature Review. *SN Applied Sciences, 2,* Article No. 1096. https://doi.org/10.1007/s42452-020-2801-5

University of Minnesota (UoM). (2016). *Employee Assessment*. Human Resource Management, Chapter 11, pp 323-353.

Waters, I. (2017). *10 Steps to Measuring the Effectiveness of Your Field Techs.* https://www.solarwindsmsp.com/blog/10-steps-measuring-effectiveness-your-field-techs

Ybañez, R. (2017). *VPM in Project Execution.* PUP MCM-608 and Thesis.

Ybañez, R., & De La Cruz, A. (2022). Multi Structures-Scales (MSS) in Project Execution Management (PEM). *OJMB, 10,* 2959-2973. https://doi.org/10.4236/ojbm.2022.106146

Zigurs, I., Khazanchi, D., & Mametjanov, A. (2008). *The Practice and Promise of VPM.* IGI Global. https://www.researchgate.net/publication/254007347

Appendix 1: Survey Questionnaires

Name:_____

Position:_____

1) What is your preference as a manager (respondent) in Virtual Project Management (VPM) Operational Possibility in terms of location, Overseas or Domestic (Local)? Why?

[ ] _____ (%) Overseas

[ ] _____ (%) Domestic (Local)

Reason:

_____

_____

Name:_____

Position:_____

2) What is the manager's (respondent) opinion on Virtual Project Management (VPM) Operational Effectivity in terms described below?

Instruction:	Please select and put check mark [✓] items applicable to you in the space provided below.
SCALE:	5) **VE**: Very Effective 4) **E**: Effective 3) **SE**: Somewhat Effective 2) **LE**: Less Effective 1) **NE**: Not Effective

What is the manager's (respondent) opinion on Virtual Project Management (VPM) Operational Effectivity described below?	**VE**	**E**	**SE**	**LE**	**NE**
2.1. LEADERSHIP STYLE (PEACE)	**5**	**4**	**3**	**2**	**1**
1) Personality: Motivating and maintaining a good attitude toward each project team member.	[ ]	[ ]	[ ]	[ ]	[ ]
2) Experience: It can quickly adapt and resolve situational changes.	[ ]	[ ]	[ ]	[ ]	[ ]
3) Availability: Easy approach and anytime can be contacted.	[ ]	[ ]	[ ]	[ ]	[ ]
4) Communication: Contacting and coordinating often thru email or phone for the project team, e.g., to a virtual team (vT).	[ ]	[ ]	[ ]	[ ]	[ ]
5) Engagement: Involve, meet, and visit personally; to check and confirm the status of the project deliverables assigned to each functional team.	[ ]	[ ]	[ ]	[ ]	[ ]
2.2. DESIGN PLANNING (BORE)	**5**	**4**	**3**	**2**	**1**
1) Budget: Buffer/contingency and considering miscellaneous in operation.	[ ]	[ ]	[ ]	[ ]	[ ]
2) Operation: Optimize and continuous improvement processes to achieve better output.	[ ]	[ ]	[ ]	[ ]	[ ]

Continued

3) Risk: Dealing with problems, including disputes from each functional discipline area.	[ ]	[ ]	[ ]	[ ]	[ ]
4) Explore: Application to achieve and strategies to address an internal/external issue.	[ ]	[ ]	[ ]	[ ]	[ ]
2.3 FUNCTIONAL MANAGEMENT (STAFF)	**5**	**4**	**3**	**2**	**1**
1) Structure: Organizational support, such as technical staff and workforce for the specific project.	[ ]	[ ]	[ ]	[ ]	[ ]
2) Train: Teach and train to improve and maintain the competency of each discipline for achieving objectives and goals in operation.	[ ]	[ ]	[ ]	[ ]	[ ]
3) Achievement: Team recognition and reward or additional benefits per the project completion, each discipline aside from the overall program.	[ ]	[ ]	[ ]	[ ]	[ ]
4) Flexibility: Flexible assignment and specialty, if possible, to perform the task.	[ ]	[ ]	[ ]	[ ]	[ ]
5) File-Handling: Keeping and storing deliverable data safely under confidentiality.	[ ]	[ ]	[ ]	[ ]	[ ]
2.4. PERFORMANCE EVALUATION (ACES)	**5**	**4**	**3**	**2**	**1**
1) Ability: Task over time, determining each project's technical familiarity, capability, and understanding level.	[ ]	[ ]	[ ]	[ ]	[ ]
2) Completion: Completing the task as per the contract and project requirements.	[ ]	[ ]	[ ]	[ ]	[ ]
3) Efficient: Meeting the client's expectations as required in the project.	[ ]	[ ]	[ ]	[ ]	[ ]
4) System: Calibrating and checking the overall design as part of the quality standard.	[ ]	[ ]	[ ]	[ ]	[ ]

Appendix 2: Statistical Analysis

The researcher surveyed with two (2) series of questions for the primary data in the analysis. This will communicate managerial threats, operational effectiveness, and managing priorities with a virtual team. Appendix 1 contains detailed questionnaires and a graph and table of the results, as shown below.

According to Ybañez (2017), in the thesis developed, the domestic virtual team members got the highest rate among managers' opinions in the initial research survey. In this case, the sample data with seventeen (17) respondents are the results as follows:

A2.1. Operational Possibility

Figure A2.1 and Table A2.1 show the operational possibility in terms of the necessity for this new virtual environment in project management consultancy

(PMC) operation, and it's very high. The domestics got the highest scale, 94.1%; next is overseas got 76.5%; and both (domestic/overseas) categories got the same overseas rate, 76.5%. As a result, considering the level of criteria up to 50% set by the researcher, both domestic and overseas virtual project teams are OK; considering the enormous scale, a domestic virtual project team is better than getting from an overseas virtual project team, according to manager's opinion survey (See Appendix 1). However, both virtual team location is possible even in actual operation.

Based on their experience and expertise in the LNG sectors, the typical equation calculates the percentage relationship and significance of seventeen (17) respondents.

$$\% = \left(\frac{y}{n} \times \% \text{ weight} \right) \times 100$$

where:

% = data percentage

y = opinion result

n = total population

% weight = data weight percentage

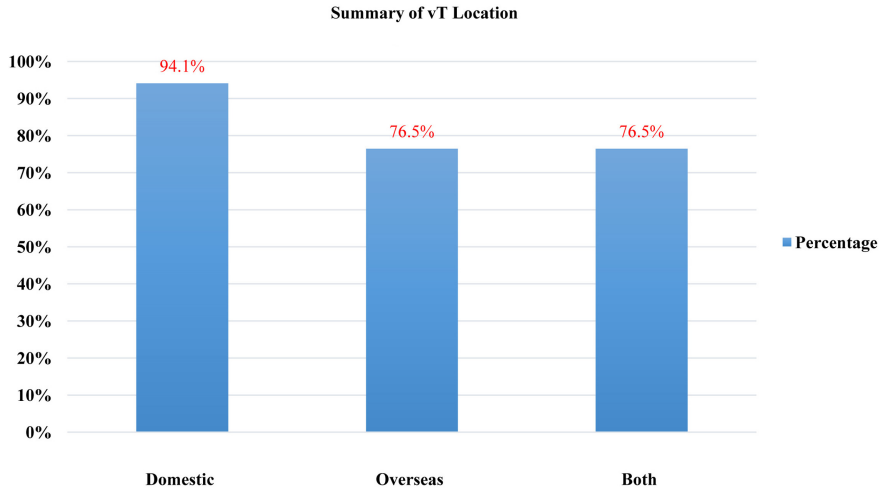

Figure A2.1. Summary of first interview (vT Location).

Table A2.1. Summary of first interview (vT Location)[1].

Group	Location		
	Overseas	Domestic[2]	Both
1			13
2		16	
3	13		

Note: 1) Refer to Figure A2.1. 2) Domestic means Japan setting since the respondents are mixed foreigners and Japanese.

A2.2. Operational Effectivity

In Table A2.6 stated below, Tables A2.2-A2.5, among all attributes, show the most extensive scale is *Performance Evaluation*, with almost 87.9%, and the next is *Functional Management*, which got 82.8%, followed by *Leadership Style* got 80.5%, and Design Planning got 76.1%. Although the criterion set by the researcher is only 60%, all attributes passed the scale rating. In the above summary result, the operational effectivity in VPM will be focused on performance evaluation attributes in the context of *efficiency*, *completion*, and *ability*; Efficiency got 95.3%, most enormous scale, Completion got 92.9%, and Ability got 90.6%. It follows functional management attributes in organizational structures and file handling in keeping, storing, and confidentiality of data with the same scale rating of 85.9%.

Refer to Figure A2.2 and Table A2.6; considering the most extensive scale among those attributes, the operational effectivity in a virtual environment for project management consultancy (PMC) operation will focus on Performance Evaluation in the context of Efficiency, Completion, and Ability.

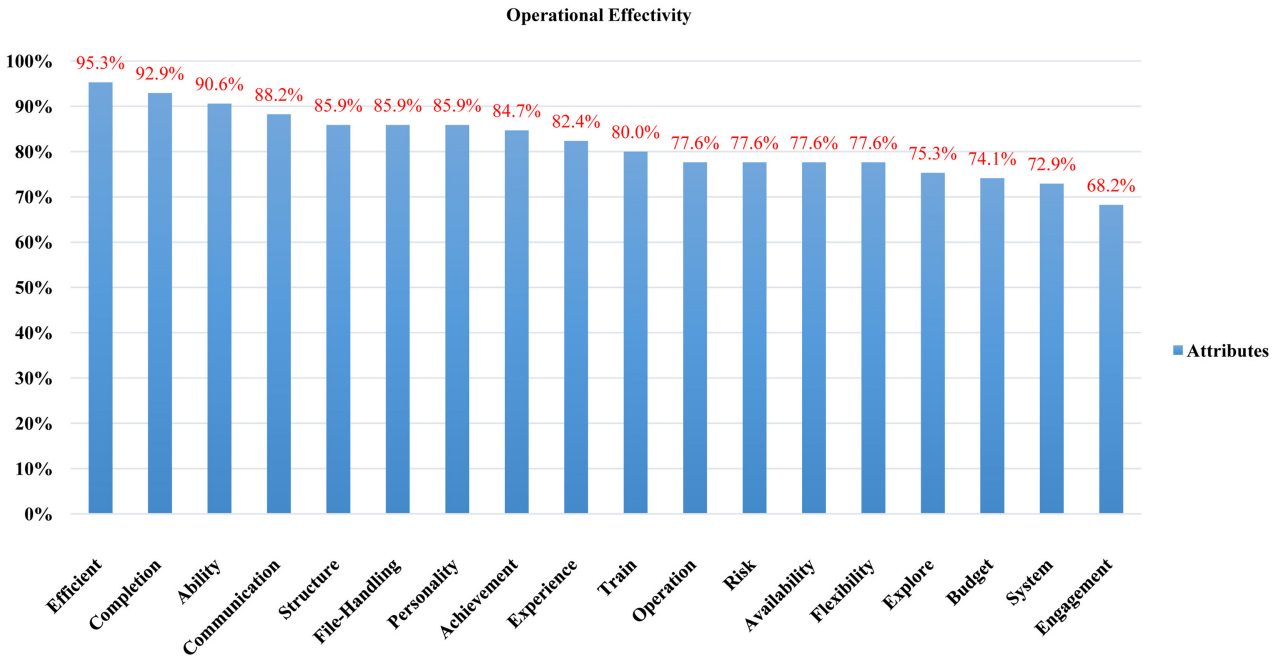

Figure A2.2. Summary of second interview (operational effectivity).

Table A2.2. Summary of second interview (leadership style).

Attribute	1st	2nd	3rd	4th	5th	Average
	Communication (Q4)	Personality (Q1)	Experience (Q2)	Availability (Q3)	Engagement (Q5)	
Leadership Style (PEACE)	**4.412**	4.294	4.118	3.882	3.412	4.024
	88.2%	85.9%	82.4%	77.6%	68.2%	80.5%

Table A2.3. Summary of second interview (design planning).

Attribute	1st	2nd	3rd	4th	Average
	Operation (Q2)	**Risk (Q3)**	Explore (Q4)	Budget (Q1)	
Design Planning (BORE)	**3.882**	**3.882**	3.765	3.706	3.809
	77.6%	**77.6%**	75.3%	74.1%	76.1%

Table A2.4. Summary of second interview (functional management).

Attribute	1st	2nd	3rd	4th	5th	Average
	Structure (Q1)	**File-Handling (Q5)**	Achievement (Q3)	Train (Q2)	Flexibility (Q4)	
Functional Mgnt. (STAFF)	**4.294**	**4.294**	4.235	4.0	3.882	4.141
	85.9%	**85.9%**	84.7%	80%	77.6%	82.8%

Table A2.5. Summary of second interview (performance evaluation).

Attribute	1st	2nd	3rd	4th	Average
	Efficient (Q3)	**Completion (Q2)**	**Ability (Q1)**	System (Q4)	
Performance Eva. (ACES)	**4.765**	**4.647**	**4.529**	3.647	4.397
	95.3%	**92.9%**	**90.6%**	72.9%	87.9%

Table A2.6. Summary of second interview (highest scale) in average.

VPM	Performance Evaluation (ACES)	Functional Management (STAFF)	Leadership Style (PEACE)	Design Planning (BORE)
Operational Effectivity	**4.397**	4.141	4.024	3.809
	87.9%	82.8%	80.5%	76.1%

Appendix 3: D5 Model—Define (Process Input)

A3.1. Model Structure

As stated in Figure 2, the D5 model process, an organizational structure described in PMBOK (PMI, 2021), are typical to all Projects and even construction management companies. It may differ only from each company's traditional practices; see Figure A3.1, Typical Structures in the Projects. Project team structures are composed as described in Figure A3.1(b), led by a project manager (PM), whether this set-up is an Office or Home Base Structure or a form of Virtual Structure.

Office Base Structure

This type of structure is very common to all project and construction companies. It should say it is a very efficient and productive structure. However, the

cost is very high. Each team member is dedicated and subjected to doing an individual task in the project as in a single assignment task per discipline. This is the primary project management concept, as shown below in Figure A3.2 (Typical Project Structure). Both Figure A3.1 and Figure A3.2 may not have a good setup, which may cause and lead to a loss of competition in the Bidding stage.

Most project owners will evaluate the technical and commercial side of the bidding execution and processes. It includes bidder office visitation as bidders' office address submitted and site visitation, even technical proposes. A typical setup of Bidders has enough personnel and staff, ensuring the Project Company or Owner that the Bidder is capable in a large/massive volume of work such as LNG Industry sectors, but not limited to businesses.

Some project contractors will do a multi-task set-up organizational structure to get more profit in the project and get more projects as much as possible, but still, in the office base set-up, see Figure A3.3.

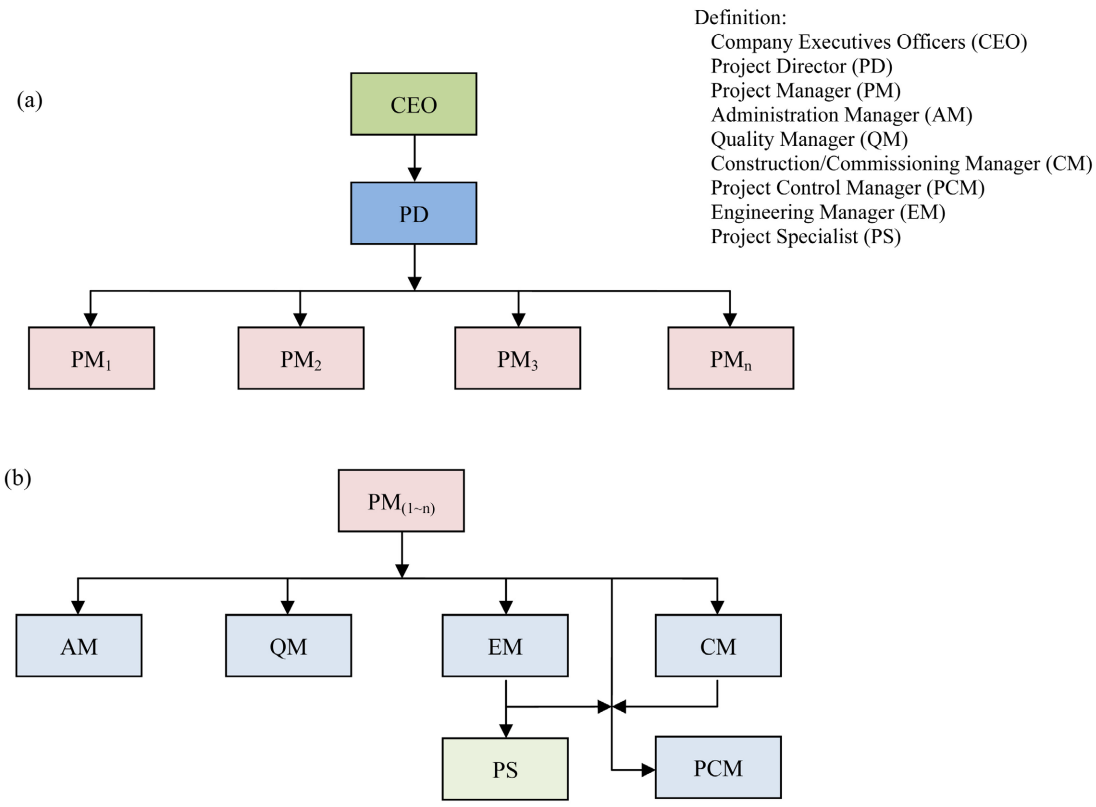

Figure A3.1. Typical project organization.

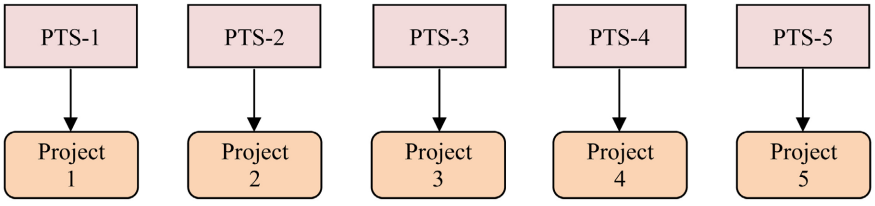

Figure A3.2.Typical project structure. Project Team Structure (PTS).

This structure is cheaper compared to Figure A3.2. Thus, this type is precisely done by most Small-Medium Project Construction players. Figure A3.4 is more reasonable than Figure A3.2 and Figure A3.3; however, more complicated and may be less efficient and productive. Figure A3.3 set-up is more costly than a virtual platform.

Considering that Figures A3.2-A3.4 are in the actual execution, the facilities set-up needs more expansion, and the project contractor will expect additional costs in this set-up. Nowadays, most Engineering companies will have high-rise buildings as their Head Office; if needed, they will be expanded to different locations. Some are local, and some are abroad nearest, such as in Southeast Asia, for a cheaper place.

Virtual Base Structure

A virtual type of structure is rare for full-scale range projects such as this LNG construction project, which has never heard of so far, and that's the reason why the researcher pursues this study. Since a full-scale project is rare on a virtual platform, the researcher will focus only on this sector since the researcher was experienced and involved in this type of project. However, this is not limited to this sector. Only virtual platforms can be applied to any industry, depending on the researcher's capability.

The researcher will direct to a Figure A3.5 illustration of the virtual structure so that it will compete with the home base set-up. However, many factors need to consider and develop a more efficient and productive output. For example, to maximize the volume of projects handled by the virtual team, as indicated in three (3) Cases 1, 2, & 3 of Multi Structures-Scale's (MSS) research study (Ybañez & De La Cruz, 2022).

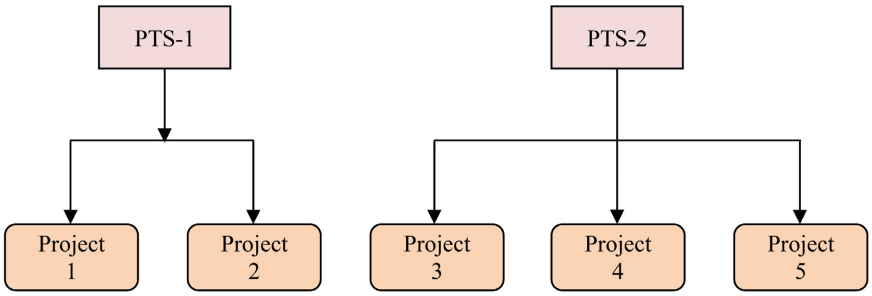

Figure A3.3. Multi-task project structure. Project Team Structure (PTS).

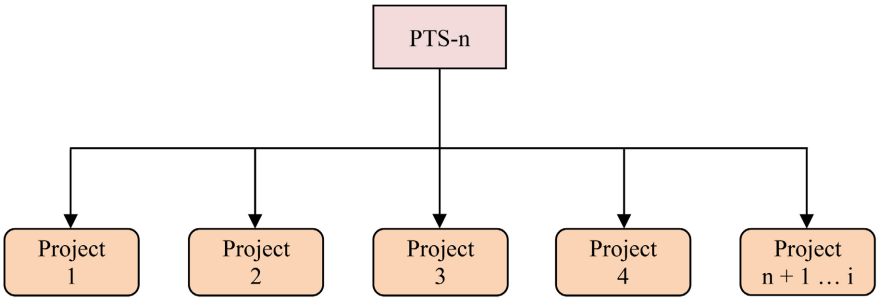

Figure A3.4. Multi-task full-scale project structure. Project Team Structure (PTS).

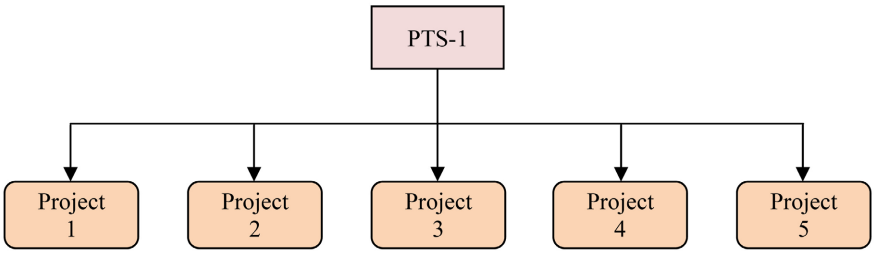

Figure A3.5. Virtual team structure. Project Team Structure (PTS).

A3.2. Principle of VPM

Project Values: During project execution, there are times that the project may occur difficulties due to delay. Technical personnel, either in the project site or the project contractor's home base, will suddenly quit their responsibilities due to several personal reasons; this scenario is evitable for every project company. Virtual execution is not exempted from this problem; the resources such as Manpower (technical personnel and staff), Machines (equipment or devices), and other Accessories play significant roles in this virtual platform.

Both conventional or traditional and virtual environments are alike in the execution processes. They are all the same except for location and workforce; it is virtually operated. For example, progress meetings will regularly be conducted in project status to control and monitor the possibility of delays and even problems and operations.

In principle, processes may go like this depending on each contract, as described in Figure A3.6. However, as shown in Figure A3.7, the virtual environment is subject to follow or not, if they can provide the documents, drawings, and reports indicated in the Master Deliverable List, see Table A3.1 and Table A3.2 for FS/BD/CD project execution, and Table A3.3 for FEED project execution.

These four (4) project values, *Scope*, *Cost*, *Time*, and *Quality*, will vary depending on the hired technical personnel and the devices/equipment used (Jackson, 2010). In addition, those values depend on each other and interconnected processes to pursue the virtual environment, see Figure A3.6. First, however, it categorized seven (7) project values, including risk, a sequential flow by typical bidding contractor selection such as: 1) Cost, 2) Time, 3) Quality, 4) Safety, 5) Scope, 6) Function, and 7) Risk.

In project values, the cost in the project contract is one factor that the contractors get and obtain the awarded project. Therefore, let a virtual project manager do the operation if you can minimize the facilities or other workforce in the headquarters and reduce costs in general.

In the project and project team structure (PTS) concept, most project costs can be classified as shown in Figure A3.7 graph indicated. The constraint values are cost, time, and scope; the scope is the main deliverable among the project values. Therefore, we can say the price per scope or time per scope; in other words, how much we must receive and how long going to end.

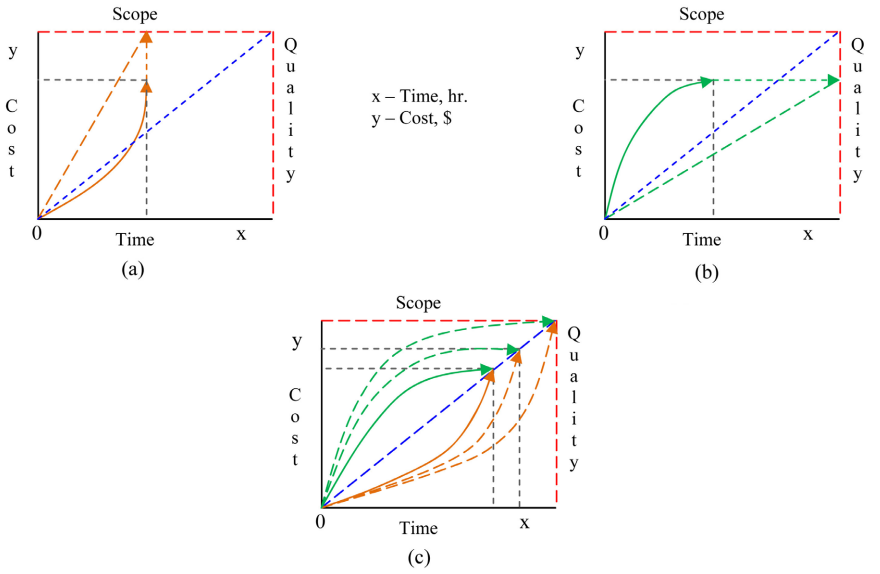

Figure A3.6. Fundamental project values in the construction.

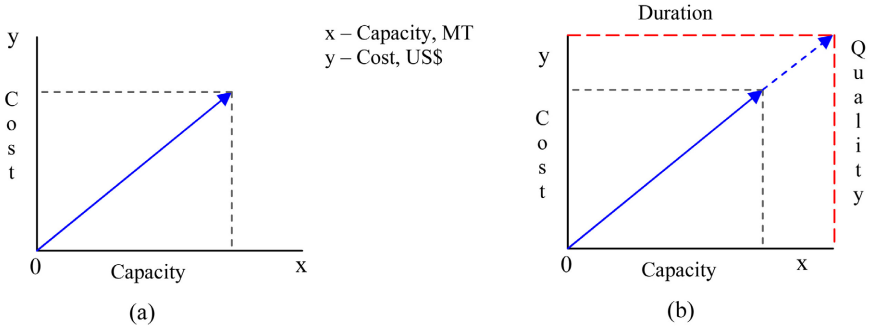

Figure A3.7. Capacity-cost concept of the project.

Table A3.1. Virtual team involvement matrix in any project stage.

Virtual Project Management (VPM)						Project Stages[1]				
									(E/P) of EPC	
Virtual Team (VT)	Location					BD/CD	FS	FEED	E	P
	A	B	C	D	E					
1	x	y	z	x	x	(+)	(+)	(+)	(+)	(+)
2	y	z	x	y	y	(+)	(+)	(+)	(+)	(−)
3	z	x	y	z	z	(+)	(+)	(+)	(−)	(−)
4	x	x	x	y	z	(+)	(+)	(−)	(+)	(−)
5	y	y	y	z	x	(+)	(+)	(−)	(−)	(+)
n … (n + 1)	z	z	z	x	y	(+)	(+)	(−)	(+)	(+)

Note: 1. Assumed the different projects involved by each virtual team. Legend: (+): Awarded project (whole/entire contract); (−): Bid ongoing; x: Location of each virtual team (1 - 5); y, z: 2nd and 3rd location or Option of a virtual team (1 - 5).

Table A3.2. Sample deliverable in FS/BD/CD project execution.

Description	No. of Item	Schedule (Plan/Actual)
General		1 week after
Coordination Procedure	1	
Document Control Procedure	1	
Document Numbering System	1	
Document Control Index	1	
Equipment Numbering System	1	
Bi-Weekly Report	1	2 weeks after
Project Management		1 week after
Project Description	1	
Project Schedule	1	
Project Execution Plan	1	
Applicable Codes and Standards	1	
Study, Review, and Report		
Site Survey Result Report	1	
Calculation and Simulation Result Report	5	
Additional Document in Total	8	
Process		1 week after
Process Basis of Design	1	
Process Description	1	
Process/Utility Flow Diagram	2	
Additional Document in Total	5	
Mechanical		1 week after
Tank Type Selection Report with GA Eng'g. Drawing	2	
Maintenance and Sparing Philosophies	1	
LNG shipping and Tank Capacity Study Report	1	
Additional Document in Total	7	
Piping		1 week after
Piping Design Philosophy	1	
Piping Routing Plan	1	
Additional Document in Total	2	
Electrical		1 week after
Electrical Design Philosophy	1	
Cables Routing Plan	1	
Additional Document in Total	3	

Continued

Instrumentation and Controls		1 week after
Instrument & Control Philosophy	1	
Fire & Gas Detection Philosophy	1	
Overall Instrument & Control System Diagram	1	
Additional Document in Total	3	
Civil and Structural		1 week after
Civil and Structural Design Philosophy	1	
Plant Layout Philosophy	1	
Overall Plot Plan	1	
Additional Document in Total	5	
Marine	10	1 week after
Architectural	3	1 week after
Fire Fighting	3	1 week after
Safety	4	1 week after
Cost Estimation	1	last week
Schedule (EPC)	1	last week

Table A3.3. Sample deliverable in FEED project execution.

Description	No. of Item	Schedule (Plan/Actual)
General		1 week after
General Project Requirement	1	
Basis of Design	1	
Additional Document in Total	27	
Bi-Weekly Report	1	2 weeks after
Study, Review, and Report		1 week after
LNG Vessel Information	1	
Additional Document in Total	26	
References		1 week after
Mitigation Plan from EIA Report	1	
Additional Document in Total	13	
Process		1 week after
Process Narrative (Scope of Works)	1	
Process Description	1	
Process/Utility Flow Diagram including P & ID	4	
Additional Document in Total	19	

Continued

Mechanical		1 week after
Mechanical Narrative (Scope of Works)	1	
Additional Document in Total	84	
Piping		1 week after
Piping Narrative (Scope of Works)	1	
Additional Document in Total	67	
Electrical		1 week after
Electrical Narrative (Scope of Works)	1	
Additional Document in Total	110	
Instrumentation and Controls		1 week after
Instrument & Control Narrative (Scope of Works)	1	
Additional Document in Total	162	
Civil and Structural		1 week after
Civil & Structural Narrative (Scope of Works)	1	
Additional Document in Total	29	
Marine	47	1 week after
Architectural	37	1 week after
SHE	41	1 week after
Cost Estimation	1	last week
Schedule (EPC)	1	last week

The cost can be determined depending on the difficulty level and the type of deliverables needed for specific projects. They are identical but not the same, so virtual team (vT) members can classify the differences, and the cost will also be different for each item.

Project Team: Virtual project contractor classifies the differences between existing to new, utilizing devices/equipment, and even retaining trusted technical personnel who successfully did previous projects (Nuells, 2013).

The virtual team member can classify as a company or individual if they mutually agree and understand the contract between parties. Sub-Contractors (SubCon) of the project may not be included in the virtual team because the project owner already knows and will select based on the scope of work in the project, or the Sub-Contractor (SubCon) may establish another Virtual Team, as shown in **Figure A3.8** the Flow of Project Coordination.

The virtual team may involve in other projects (Oberlender, 2000). However, project contractors with contracts for a specific project cannot demand priority or prioritize any of those they contracted. However, they can only be bound to deliver the document according to the delivery date schedule set by the contract.

Like the conventional setup, the individual in a team should provide the paper according to the specified program.

The successful project team member can always be a candidate for the next project (or the future). Both project members are recognized as Project Company employees; some of this virtual team is disclosed by project contractors due to disputes. Same with the Sub-Contractor Company, the set-up of virtual members is an employee, but they are not categorized as ghost employees; they are virtual team (vT) members, see Figure A3.9.

A virtual team should come when the Project Contractor calls an urgent meeting aside to progress the monthly meeting or even with the Project Owner's meeting; they represent the company as part of the project team, and the information they have as if in one location.

Note: Each member should understand the side of the project contractor, and information should be disclosed to others, especially to the project company or owner.

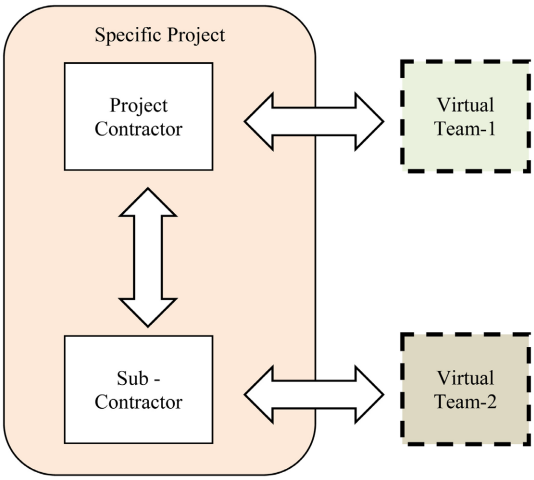

Figure A3.8. The flow of project coordination.

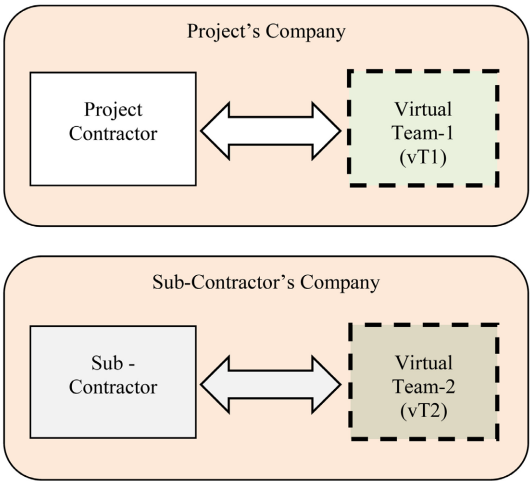

Figure A3.9. Virtual team interfaces.

In Figure A3.10, the virtual team location may not be the same place or within the city or the Country. However, if the exact location is more advantageous than any popcorn location, within the Country or the City is better. The place for regular progress project meetings will be agreed upon and conducted before contract signing, with a shared understanding of each virtual team. The proposed meeting location rotation is much better, as stated by each member.

A3.3. Methodology of VPM

Project Stages: In addition, as described in Figure 2, virtual project management can operate on any stage as stated in Figure 2, except C for EPC and COM since they need an actual appearance of the project; however, from a virtual team, the project contractor can pick up or outsource to conduct those stages.

Below Figure A3.11, possibility and assumption are considered in this study for virtual operation; however, but not limited as described.

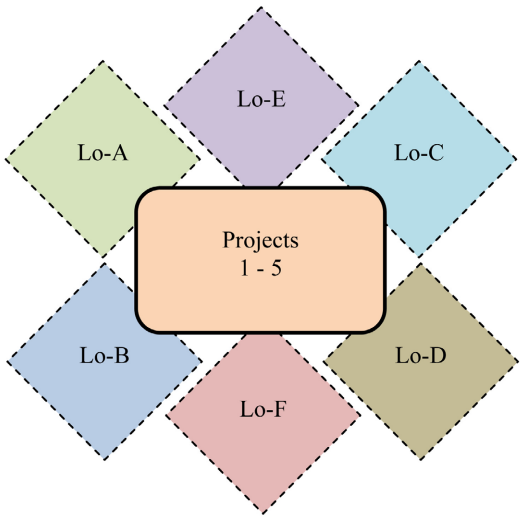

Figure A3.10. Virtual team location. Team Member Location (Lo).

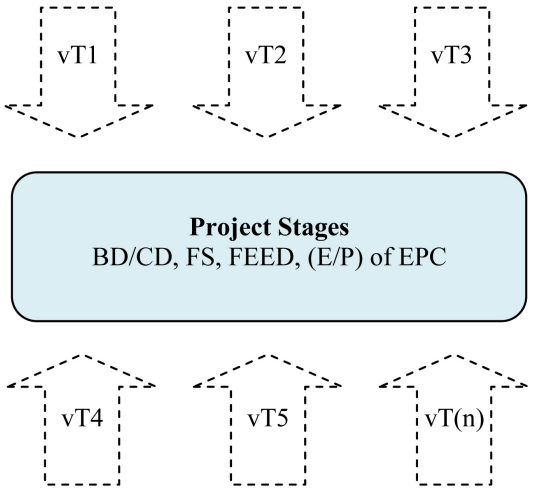

Figure A3.11. Project stages for Virtual Team (vT).

Project Deliverables: In Table A3.1, each stage, as described in Table A3.2 for FS/BD/CD, Table A3.3 for FEED, and EPC stages, are 2 - 3(x) times FEED deliverable volumes. A virtual project manager (vPM) should assign a project controller to control and monitor each deliverable given to each team member as per the contract and in every detail, including the schedule to avoid delay.

After FS/BD/CD (assuming the LNG Receiving Terminal project) was carried out by Project Company/Owner, EIA, and others, the acquisition of land or land ownership must also confirm, and several documents must also submit to Government Authority for further permit issuance and requirements; that is FS contract stage.

The selection of FEED contractors will be the next step for this cycle. Assuming the same Contractor conducted in FS/BD to execute FEED works. It is straightforward to conduct VPM operations if the workload flow is continuous (Table A3.3).

Each discipline must submit progress reports and incorporate them as a Virtual Team-1 (vT1) as described in Table A3.1. Since the bulk of documents is required in the project, vPM should control and monitor each depending on the deliverable item contracted by the team. If additional or changes of deliverables occur during execution, it should be reflected in the contract agreement as "Change Order" or "Additional".

Project Meetings: The team should determine and allocate available time for any meeting the project owner sets, whether it requires clarification or information for further detailed design. The virtual team should represent as project contractor; however, whether partial or permanent employment status, the team should act or describe the contractor throughout the project duration.

During Bids, most of the scheduled meetings, an attendee are project directors and managers or virtual project managers (vPM), seldom to each engineering discipline. However, clarification may occur during the bid so that some selected fields may attend an intended meeting; the virtual team (vT) must consider the possibility of unexpected encounters.

Table A3.4. Technical deliverables for each project stage.

Project Stages	Technical Items	Progress Report[2]	
	Eng'g. Discipline[1]	Bi-Weekly Report	Monthly Report
1) BD/CD	~67 (more or less 80)	~30	3 - 6
2) FS[3]	~238 (more or less 250)	~70	12 - 14
3) FEED	~731 (more or less 750)	~60	6 - 12
4) EPC	~from FEED docs[4]	~150	30 - 36

Note: 1) All engineering disciplines required for the project; 2) Including S-Curve and Master Schedule Report Level-3 in Monthly Report; 3) For Some projects, FS included BD/CD and Pre-FEED data as a package; 4) Almost 2 - 3x of FEED documents due to vendor print data, drawing, and additional.

Upon receiving the notice of award (NOA) during execution or after project awards, the virtual team must primarily attend the meetings with the project owner or project contractor head office. Refer to below Table A3.5 for more detail in the forum.

Project Flow Sequence: The team should understand the flow sequence, particularly each stage, and how it works with or without information on deliverables or before KOM. A virtual team may ask or not ask that flow sequences be known to each project member.

In Table A3.6, the flow sequence for virtual works in every assigned project (assuming the project is LNG Receiving and Regasification Plant, although almost the same as other sectors) must know and visible to all project members, including virtual.

Table A3.5. Technical meeting[1].

Type of Meeting	Description	Attendee's	Initiator	Notes
Bid Meeting	Conducted Meetings during project bid.	Project director, PM or/with vPM and EM	Project Owner	Schedules are already known to the bidders, and they should submit the requirements accordingly.
KOM	A week or two after the project is awarded by the owner.	A project team, including virtual	Project Contractor	The detailed requirements should be presented to the project contractors.
Clarification or Face-Face	Set by project contractor or owner for further clarification.	Technical Individual	Project Contractor or Project Owner	Clarify the requirements in detail.
Monthly Progress	Set by the project contractor to know the status of the project.	Project director, PM or/with vPM and EM	Project Contractor	Includes EPC Progress Report.
Reports Presentation	Set by project contractor as part of milestone schedules.	A project team, including virtual	Project Contractor	Classify according to stages of the project and each report.

Note: 1) All meetings require MOM before the session adjourns or ends.

Table A3.6. Flow sequence for virtual works[1].

Flow Sequence	BD/CD	FS	FEED	E/P (EPC)
0 Bidding	1) Preparation 2) Submission 3) Presentation	4) Clarification 5) Meeting 6) no.2, 3, 4, 5	7) Final	
1 KOM(1)	1) Presentation - Clarification of detailed approaches	- Detail project requirements - Any adjustments or changes	2) Agreement 3) MOM 4) Final	
2 Meeting(2)	1) Presentation - KOM review - Deliverables approaches	2) Agreement 3) MOM 4) Final		
	- For project Deliverables, see Table A3.2 and Table A3.3	- Individual Discipline Task	- Clarification - Meeting	- Submission
3 Operation	Reports - QRA - HAZID - Biweekly - Final	Reports - QRA - HAZID - Biweekly - Final	Presentation and reports - QRA - SIL - HAZOP - 3D Model - Biweekly - Monthly - Final	Presentation and reports - QRA - SIL - HAZOP - SIMOPS - SURGES - 3D Model - Blast Report - Biweekly - Monthly (EPC) - Final
4 Final	Presentation and reports - Final Submission - Final Report	Presentation and reports - Final Submission - Final Report	Presentation and reports - Final Submission - Final Report	- Erection and Installation - Inspection & Testing - Proceed to commissioning works

Note: 1) Meeting with the project owner and contractor, assuming the project is awarded. 2) Meeting with the project contractor and other team members or project in-charge.

A3.4. Procedure of VPM

Flow procedures will drive the basic concept of virtual operation thru steps to pursue the realization of the environment. As stated in the contract, the milestone payments will indicate how virtually the cost to the vT member was received—knowing these operational steps and the procedure to conduct this virtual environment, as you will see in the above sections, such as Principles and Methodology Operation. It discusses, moreover, the basic concept of this virtual platform.

Operational Steps: Seven (7) steps need to be considered in operation; howev-

er, they are not limited to Figure A3.12. For example, a virtual concept may come into reality if the following steps of flow procedures below figure should be implemented such as this: 1) contact, 2) contract, 3) conceptual, 4) communicate, 5) coordinate, 6) contribute, and 7) cooperate.

See Figure A3.12; the below steps are essential for every virtual environment, even though we can categorize those steps for all projects. Motivation is crucial for them to continue, e.g., to the new vT member of the project organization. However, this is neither assurance nor mutual; it needs a solid agreement that binds the project contractor and the virtual team.

It is company inter prerogative on items 1 - 3, while items 4 - 7 are the inter-personnel relationship. Even though there is no project generating, the communication still penetrates each discipline member to avoid misconception and misunderstanding.

The typical operational steps for virtual set-up are described below but are not limited to the following,

1) *Contact*

Contact, Call for Meeting; contact all you know in the field, Technical Engineers, and staff may need in the project. Make sure PM or vPM explain the overview and intention of your calls. PM or vPM may meet with other technical staff if they agree. Even sending emails as information is enough for existing members (old-timers, not first-timer).

2) *Contract*

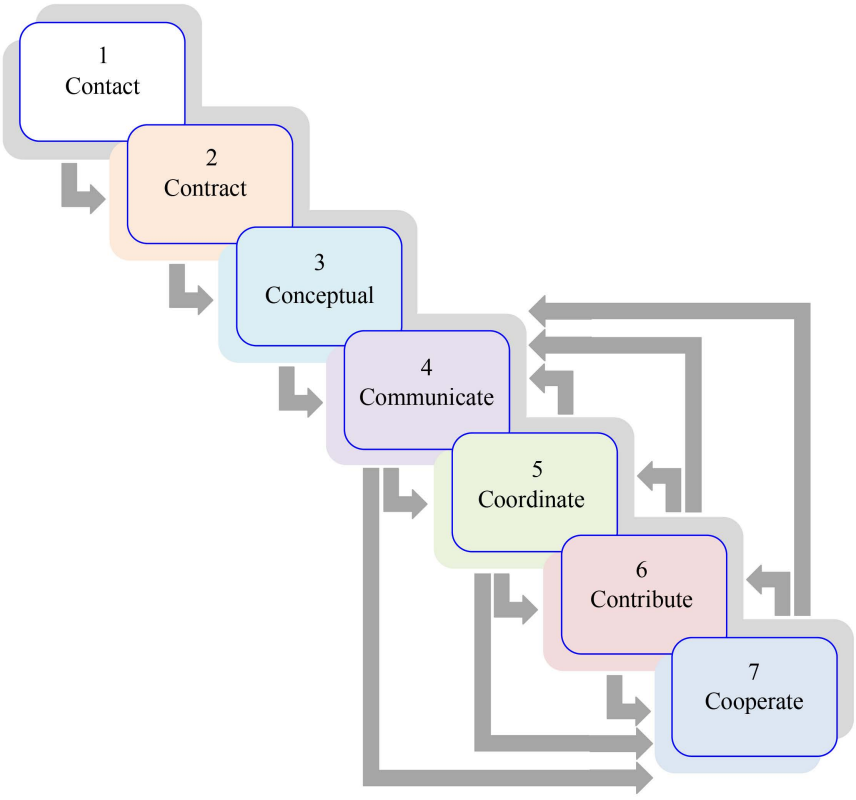

Figure A3.12. Operational steps for virtual set-up.

Contract Signing; the binding agreement is safe, or any contract may be used to deal with the project's terms. Milestones, including the date of payment and deliverable items, should specify the time's effectiveness if the project contractor received the task in the agreement. Deal professionally; no hassle occurs during operation, e.g., payments set-up. Use the conventional project contract as a reference in the agreement.

3) *Conceptual*

Conceptual Set up; the project member has a significant role in the project, such as a specialist or leader in the team. Try once the team station in the head office, then later do virtually. This could happen if the virtual team (vT) member is new to the project organization.

4) *Communicate*

Communication for System (Lee, 2014); the team needs to set up the IT configuration using networking. Access and data storage; filling an e-form of progress and biweekly reports. This could happen if a vT member is new to the project organization. The old vT member will only inform thru email after steps 1, 2, & 3 are done.

5) *Coordinate*

Coordination with the Project In-charge; every project has its In-charge; see that the contact and interfaces with every project in charge of the specific project will coordinate accordingly. Communicate from time-time to the project in direction, e.g., straightforward task.

6) *Contribute*

Contribution to the System: The team must interact to build a strong relationship. Sharing new ideas, rules/regulation, and tools/techniques during the pre-operation of a virtual platform of the project are highly appreciated. Since virtual, their sharing must happen only when a progress meeting is scheduled; all vT members join.

7) *Cooperate*

Cooperation in the Project; vT member needs to cooperate and follow the project specification and requirements. The project in charge knows in detail for further information, e.g., additional changes. Avoid dispute in the project, a risk may come higher impact if severe, and that causes the project to shut down.

Operational Payments: As shown in **Table A3.6**, a flow sequence for virtual works, item (3) Operation, some reports consider milestone payments. The project contractor must monitor this item, and those reports should be submitted before demanding payments; however, vT members are not obliged; if the document or reports are already submitted to the project owner and approved, then vT members will demand payment from the project contractor according to contract specified.

The milestone payment schedule is the reference of vT members for their service payment. Each vT member can follow up and inquire about the project in charge of the contractor's head office. Sample milestone payments in FEED work; see **Table A3.7** for reference.

Table A3.7. Sample milestone payment for FEED works[1].

No.	Weeks	Milestone[2]	Payment Percentage
1	7	Design Basis Submission	10%
2	14	HAZOP Completion	35%
3	17	LNG Tank MTO Submission	60%
4	24	FEED Design Package Submission	85%
5	27	Submission of EPC Bid Package (ITB)	100%

Note: 1) Reference only; it depends on the agreement stated in the contract; 2) for some projects, the FEED contract stated the percentage of down payments.

A3.5. Design Input Data

In the virtual team, the project company or contractor will set their structure as contractual or project employment status; this is only intended for a specific project, so no work, no pay. However, since corporate policies for employment, the employed position is visible together with the facilities in any company location.

As part of management strategy, know your team and below Figure A3.13. As described in Figure A3.13, the PMCC and EPCC Company should maintain the virtual team (vT) inter-relationship by involving or providing jobs, even small-large capacity projects the project company does have. This is the only way a virtual team can survive in terms of employment, and most of these are interconnection with each other.

In another way, this could build a relationship such as practices in communication, coordination, contribution, and cooperation, as described in Figure A3.12, operational steps for a virtual setup.

Assuming all of these are on the shelf and the desk is ready to configure the model, we can construct the structures of the model to analyze the concept. The researcher will use the basic flow of analysis, such as the D5 Model, referring to Figure 3 and Figure A3.14, as described in detail.

This model analysis will analyze using the D5 Model (*Define* à *Design* à *Develop* à *Diagnose* à *Desired*) flow process, so we know how it will work the VPM in the case of the assumed project, LNG Receiving, and Regasification Terminal.

The virtual concept may only operate if the project team is established and founded in this project: LNG Receiving and Regasification Plant or LNG Treatment and Liquefaction Plant. However, this model will allow newcomers or new group members. For example, in Figure A3.15, the initial set-up analysis assumes the virtual concept, and the team already has an idea, e.g., the conventional approach to project management.

Inputs

As initial input in the model, a virtual team needs to understand the operational concept by principle, methodology, and procedure, as described in Figure A3.15. This is essential for performing virtual platforms, even if the vT member is new in the virtual environment.

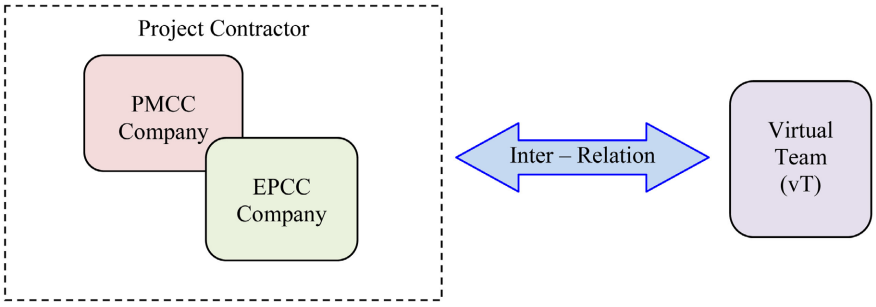

Figure A3.13. Project company.

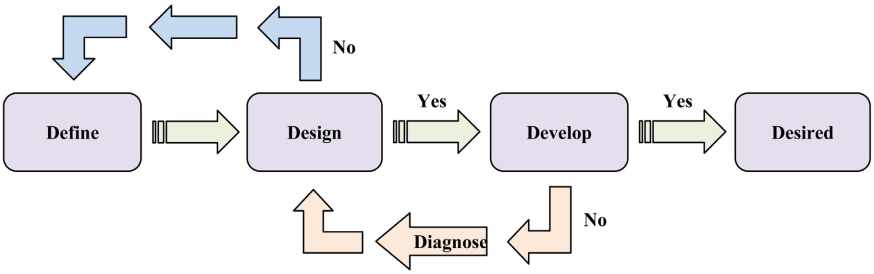

Figure A3.14. D5 Model flow analysis.

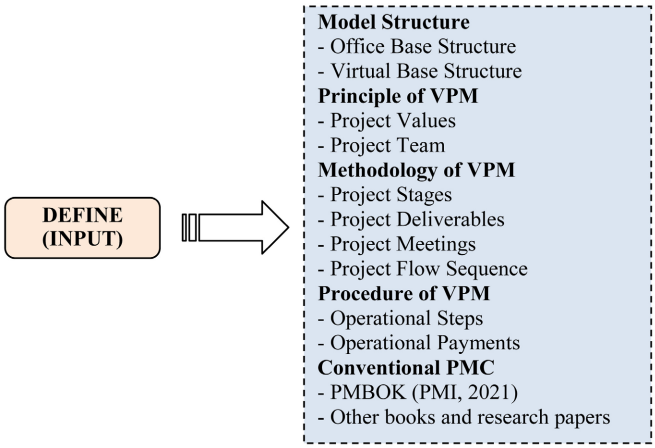

Figure A3.15. Initial inputs.

Each project member should be known and oriented as much as possible; with the model structures, principles, methodology, and procedures of VPM, it should not be far from the conventional concept of project management.

Figure A3.15 considers input data to make this environment possible and workable for these dedicated projects. To verify the checklist of the initial inputs, see Table A3.8.

As a result, the relationship and significance of each model are calculated using percentiles.

$$\% = \left(\frac{y}{n} \times \% \text{ weight} \right) \times 100$$

where:

Table A3.8. Checklist of initial inputs.

No.		Description	Status	Notes
		Model Structure	5%	
1	-	Office Base Structure		Information only
	-	Virtual Base Structure		Appendix 3
		Principle of VPM	20%	
2	-	Project Values		
	-	Project Team		
		Methodology of VPM	50%	
	-	Project Stages		
3	-	Project Deliverables		
	-	Project Meetings		
	-	Project Flow Sequence		
		Procedure of VPM	20%	
4	-	Operational Steps		
	-	Operational Payments		Information only
		Conventional PMC	5%	
5	-	PMBOK (PMI, 2021)		
	-	Other books and research papers		Information only

% = sample model;
y = score result;
n = no. of item;
% weight = see Table A3.8, Checklist of Initial Input.

Appendix 4: D5 Model—Design (Process Analysis)

A4.1. Process Analysis through PPR Model

The PEA, PMP, and REST are performed periodically, neither annual nor monthly checking and evaluation, but rather per project accomplishment.

The success or failure of each project was attributed to the contractor in virtual project management (VPM). However, the virtual platform may be unaffected due to the nature of the operation. On the other hand, the project's ongoing relationship with the VPM team may be jeopardized or severed. As a result, the PEA concept will apply even in a virtual environment; each project team member must go through this appraisal (Figure A4.1).

Performance Appraisal: Human Resource Management that the appraisal should take by an employee, whether by a year or by month. It depends on company policy. However, each vT member means the virtual platform needs to include and understand why the project contractor should do such an appraisal. It improves

the project outcome, and in the following projects, it will be implemented by both the project contractor and the project company/owner.

Productivity Approach: The appraisal intends to evaluate the production outcome for each vT member for the specific project. The project contractor is held responsible for every product or result in the project. The project in charge will set approaches as standards and specifications for the tasks to meet the client's expectations (Table A4.1).

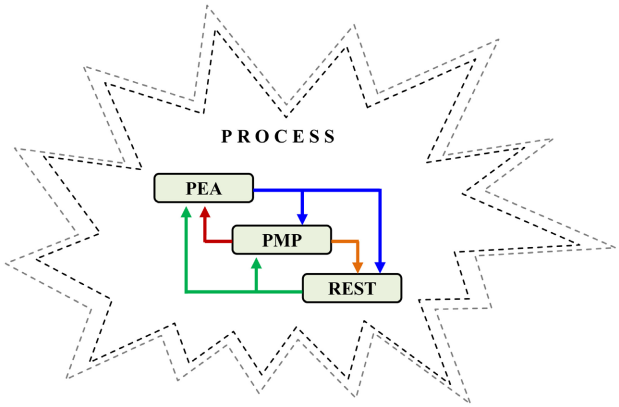

Figure A4.1. PPR process.

Table A4.1. Sample appraisal for team evaluation form.

Description	Action		Year	Problem Encounter	Counter Measure
	Plan	Actual			
1) Project Accomplishment	14 *Days*	7 *Days*	2018	*Pump Alignment*	*Insp. & Test*
2) Company Activities	7 *Days*	5 *Days*	2019	*Construction Safety*	*Training*
3) Other Activities (*Mat'l. Receiving*)	3 *Days*	2 *Days*	2019	*Difference Mat'l.*	*Visual Insp.*

The following set list of work approaches,

- ✓ Guidelines: may contain the guide works in each item.
- ✓ Procedures: may have philosophy and principles of work.
- ✓ Standard: may have the detail and exact specification requirements in the projects.

Note: This should take a long-term approach every time project is performed.

A4.2. Performance Evaluation and Analysis (PEA)

PEA will help the Project Company/Owner understand the virtual setup. After each project accomplishment, this can be for technical staff and devices; only project meetings will happen. Technically, as far as company IT is concerned, the following set-up needs to confirm access and security of data storage, PC email, network pop-up, and phones; see Table A4.2, Checklist of Performance Evaluation.

Table A4.2. Checklist of performance evaluation.

No.		Description	Evaluation	Remarks
1		Technical Staff/Personnel	<Done>	Lectures and Training
	-	Projects	ok	Recently project or previous; background and overview.
	-	Model Structures	ok	
	-	PMP	ok	
	-	PEA, REST, CMAE, and PEP	ok	
2		Technical Devices	<Done>	Dry Run and Testing
	-	Data Storage	ok	Both access and security,
	-	Personal Computer (PC) email	ok	
	-	Phones	ok	
	-	Network pop-up	-	Option

Note: The project contractor will explain the virtual operation to the project company/owner if this will introduce during the bidding stage since the project cost decreases drastically. Moreover, the project contractor is liable and responsible for every operation, whether virtual or conventional, set up of PMC as stated in the project contract.

A4.3. Principle, Methodology, and Procedures (PMP)

PMP is the fundamental concept of the remote platform as part of the orientation stage for new vT members, which allows and assists the Project Company/Owner in understanding the virtual set-up and technical project members; see Table A4.2, Checklist of Performance Evaluation.

Note: If the virtual environment is introduced, the project's cost may be reduced, and the Project Company/Owner may become aware of the setup. The Project Contractor, on the other hand, is liable and responsible for this virtual setup and function throughout the execution.

A4.4. Reliabilities and Strategies (REST)

The REST method ensures the model consistency of an operation with as few errors as possible. If the model sample fails during the test-run process of any virtual devices, the remote setup may result in increased inconsistency.

Improve the system's reliability by developing a strategic plan and implementing each function regardless of the system's consequences. However, this only occurs when there is little or no design in the virtual environment; reliability approaches will help to understand and avoid system misconceptions.

The following three (3) essential elements of reliability approaches,

✓ Identify and prevent the occurring problem.
✓ Range and tolerance of errors/faults.
✓ Repair and recover from possible failures.

Test-Retest reliability test is one way to ensure the individual model will give

higher performance and reliability to the virtual platform. Strategized and documented the PMP in each result to be analyzed and evaluated once it's run-in operation; see **Figure A4.2** Model REST Test.

If the measurable individual model (Attridge, 2018) from PMP data occurs too many and activities are more than once, it can be simplified as follows, (**Figure A4.3**).

As a virtual team as individuals, the strategic plan must be in our heads if we engage in business. However, taking into a sectional side, SWOT Analysis and Plan-Action List are enough for this virtual relationship; listing ahead of time and putting in the report such as bi-weekly, monthly, or yearly will allow backing on track.

The two (2) strategic views such as the following,

✓ SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis.

✓ Plan-Action List.

REST concepts are Project Contractor goals and projections. Every client or customer has expectations, thus, to virtual concepts from each vT member. The project contractor needs to deliver the document on time. Suppose the problem occurs during operation, e.g., in the technical devices. In that case, the vT member will contact the IT department at the project contractor's head office for further changes or fixes. During a project or monthly progress meeting, all concerns, such as defaults and debugs, must be fixed and brought to the project in charge's attention.

Note: The project Contractor will highlight and itemize the concern for further PEA.

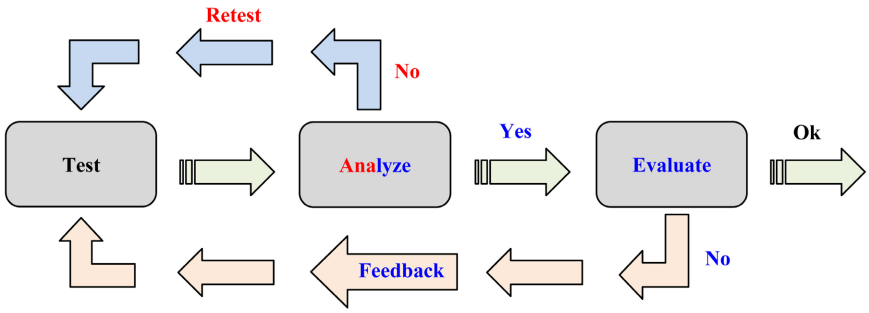

Figure A4.2. REST test.

$$X_m = \frac{1}{n}\sum_{i=1}^{n} X_i$$

$$X_m = \frac{X_1 + X_2 + X_3 + \cdots X_{n-1} + X_n}{n}$$

$$SE = \frac{SD}{\sqrt{n}}$$

$$SD = \sqrt{\frac{(X_1 - X_m)^2 + (X_2 - X_m)^2 + (X_3 - X_m)^2 + \cdots + (X_{n-1} - X_m)^2 + (X_n - X_m)^2}{(n-1)}}$$

$$SV = \left(\sum_{i=1}^{n} X_i^2 - \frac{1}{n}\sum_{i=1}^{n} X_i\right) \Big/ (n-1)$$

Where:

X_m = mean sample model (PMP)

$X_1 \ldots X_n$ = sample data

SE = standard error

SD = standard deviation

SV = sample variance

Figure A4.3. Model equation.

Appendix 5: D5 Model—Develop (Process Test)

A5.1. Model Simulation

As an initial result of dry-run mode, see Figure A5.1, we can quickly determine and evaluate a partial conclusion in a virtual environment for several days of operation. The project contractor can add a 1-week dry-run operation for technical communication evaluation. However, this is the only option since a 2-days dry-run operation is enough to evaluate the environment. Furthermore, examination and testing will allow the environment and the concept to be an operable virtual platform.

However, if the result needs to be better, refer to Figure A3.14, D5 Model Flow Analysis for other routine flows. In Figure A4.2, the REST Test of every model will allow the Test to be more accurate. If the error occurs, Test-Retest the model as described. The actual results are described in Table A5.1 and Table A5.2 model results, and Figure A5.2 model graph.

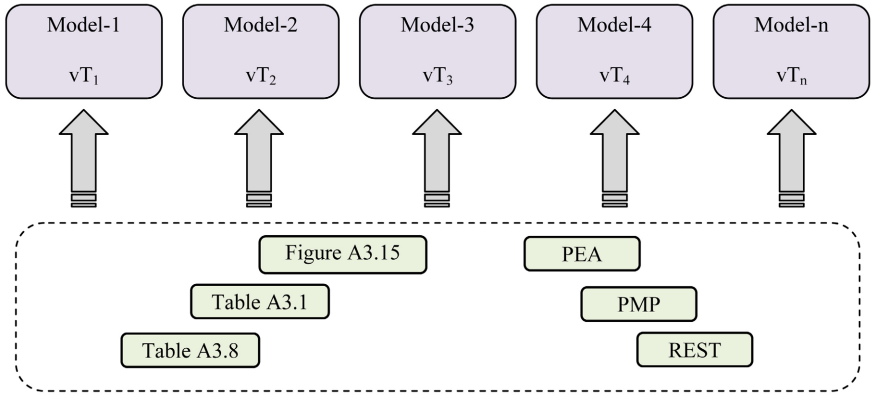

Figure A5.1. Sample model.

Table A5.1. Detail result from each project model (%).

Model	Project Model				
	Project-1	Project-2	Project-3	Project-4	Project-5
vT_1	**98.3**	**96.6**	**97.9**	**98.7**	**99.5**
	$19.7^{(1)}$	$19.3^{(1)}$	$19.6^{(1)}$	$19.7^{(1)}$	$19.9^{(1)}$
vT_2	**94.9**	**90.2**	**98.3**	**98.9**	**95.3**
	$19.0^{(1)}$	$18.0^{(1)}$	$19.7^{(1)}$	$19.8^{(1)}$	$19.1^{(1)}$
vT_3	**99.4**	**96.8**	**96.6**	**98.0**	**92.4**
	$19.9^{(1)}$	$19.4^{(1)}$	$19.3^{(1)}$	$19.6^{(1)}$	$18.5^{(1)}$
vT_4	**99.0**	**97.5**	**95.6**	**99.3**	**93.8**
	$19.8^{(1)}$	$19.5^{(1)}$	$19.1^{(1)}$	$19.9^{(1)}$	$18.8^{(1)}$
vT_5	**97.9**	**94.4**	**92.2**	**97.5**	**93.6**
	$19.6^{(1)}$	$18.9^{(1)}$	$18.4^{(1)}$	$19.5^{(1)}$	$18.7^{(1)}$

Note: 1) 20% weight for each project (1 - 5 projects); the percentage refers to Table A3.8.

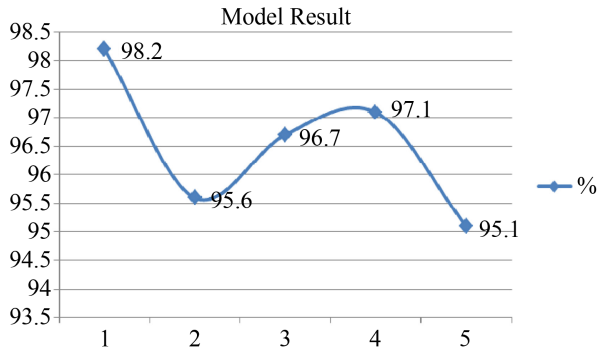

Figure A5.2. Model graph.

Table A5.2. Model result[4].

No.	Model	%[1]	[3]Mean	[3]Std. Error	[3]Std. Deviation	[3]Sample Variance	Judgment	Model Result by Project[2]
1	vT_1	**98.2**	19.64	0.0946	0.2115	0.0447	90 ≤ OK	**19.7, 19.3, 19.6, 19.7, 19.9**
2	vT_2	**95.6**	19.10	0.3095	0.6920	0.4789	90 ≤ OK	**19.0, 18.0, 19.7, 19.8, 19.1**
3	vT_3	**96.7**	19.33	0.2344	0.5241	0.2747	90 ≤ OK	**19.9, 19.4, 19.3, 19.6, 18.5**
4	vT_4	**97.1**	19.41	0.2074	0.4638	0.2151	90 ≤ OK	**19.8, 19.5, 19.1, 19.9, 18.8**
5	vT_5	**95.1**	19.02	0.2225	0.4975	0.2475	90 ≤ OK	**19.6, 18.9, 18.4, 19.5, 18.7**

Note: 1) 20% weight for each project (1 - 5 projects); the percentage refers to **Table A3.8**. 2) Detailed result of each project (1 - 5 projects), 20% weight refers to **Table A5.1**. 3) Refers to REST of VPM. 4) The model equation refers to **Figure A4.3**.

A5.2. Performance Effectivity and Productivity (PEP)

PEP is an expected result considering the strong impression of the virtual model conducted; risk possibility is higher but lower, and moderate effect of financial demand.

Effectiveness is the degree of goals or objectives achieved and intended to target without knowing the cost outcome (UoM, 2016). However, the purpose of virtual concepts and the environment is to reduce costs. Therefore, on the technical side, virtual must be effective. Moreover, it is doing the right thing. There are ten (10) steps in measuring the effectiveness in the field (Waters, 2017); however, in the virtual concept, the following three (3) steps are enough to measure the efficacy of the system.

There are three (3) steps toward effectiveness,

✓ Track the virtual system.
✓ Ensure client satisfaction.
✓ Repair the errant during operation.

Likewise, productiveness produces goods or services with outstanding achievement (UoM, 2016); it is more on capability and capacity in operation to conduct the project through a virtual environment.

There are four (4) steps towards productiveness,

✓ Plan time and manage.
✓ Fair and increase the monetary level.
✓ Provide and support the need of the team.
✓ Encourage and respect as individuals.

Effective and productive vT members will determine later in the stage of the virtual operation; however, for old vT members, this will allow the project contractor to look further from previous projects, either to retain the project team or not.

IT team considers and evaluates the possible four (4) process areas: Scope, Cost, Time, and Quality. In assessing the effectiveness and productiveness of virtual platforms, only two process areas will need to consider, 1) Time and 2) Quality of deliverables based on their scope (list of deliverables); on the contrary, delayed delivery and poor quality of output.

A5.3. Cost & Manhour Allocation Effectiveness (CMAE)

CMAE is, one way or another, budgetary for virtual operation. When allocating the budgets for execution purposes, understand the volume of deliverables for each virtual team member within the specific projects. The sample below is assigned per deliverables in Table A5.3 Sample Allocated Cost per MH.

Table A5.3. Sample allocated cost per MH.

Discipline	BD/CD[1]	FS[1]	FEED[1]	E/P(EPC)[1]
- ***General*** - ***Process*** - ***Mechanical*** - ***Piping*** - ***Others***	TSDoc, 8 MH[3] *15$ per MH* Report, 16 MH *45$ per MH* Survey, 24 MH *75$ per MH* Calc, 8 MH[3] *75$ per MH* Dwg, 4 MH[3] *45$ per MH*	TSDoc, 8 MH[3] *15$ per MH* Report, 16 MH *45$ per MH* Survey, 24 MH *75$ per MH* Calc, 8 MH[3] *75$ per MH* Dwg, 4 MH[3] *45$ per MH*	TSDoc, 8 MH[3] *45$ per MH* Report, 80 MH *200$ per MH* Survey, 36 MH[2] *350$ per MH* Calc, 16 MH[3] *200$ per MH* Dwg, 4 MH[3] *150$ per MH*	TSDoc, 8 MH[3] *45$ per MH* Report, 120 MH *450$ per MH* Survey, 80 MH[2] *500$ per MH* Calc, 24 MH[3] *350$ per MH* Dwg, 4 MH[3] *300$ per MH*

Definition: 1) BD/CD, Basic Design or Conceptual Design Stage, 2) FS, Feasibility Study Stage, 3) FEED, Front-End Engineering Design Stage, 4) EPC, Engineering, Procurement, & Construction Stage. Note: 1) Deliverable items such as Tech Specs (TS) Doc, Report, Survey, Calculation, Drawing, and others. 2) It depends on the nature of the survey; the above charges are for the cost of services, and others are excluded. 3) Tech Specs (TS) Doc, Calculation, and Drawing are standard for Virtual deliverable items.

Compared to conventional project management, cost gap comparison is a higher set-up cost figure than virtual. For example, Figure A5.3 shows an almost 20% - 50% cost gap between conventional and virtual setups for project management and design execution.

We will consider the following two expenditures to evaluate the cost of this set-up (Navidi, 2011), conventional vs. platform set-up.

CAPEX: Capital Expenditure (Capital Expenses), a financial acquisition, monetary spending, and an initial investment by the company to set up the new property, equipment, and system, such as conventional or virtual project management set-up. The CAPEX will also be linearly high if the system set-up is too big. The higher the system, the higher the CAPEX will also be.

OPEX: Operational Expenditure (Operating Expenses), a financial flow in a long-run operation of equipment or system; it is cash flow during the process. The financial statement will track an overall operating income and expenses during the property, equipment, and system operation, such as conventional or virtual project management setup. Lowering the OPEX of the system without compromising the quality and safety will significantly impact the cash flow, cutting operational expenses such as labor lay-off, high maintenance corrective and preventive, and others.

$$\text{Cash Flow (CF) Ratio} = \frac{\text{OPEX}}{\text{CAPEX}}$$

Note: The higher ratio of more than 1 means the company's operation generates more cash flow needed to fund the system.

The CAPEX of conventional set-up is almost the same or maybe lower than virtual, the lower CAPEX if the equipment and space area are available. The lowering CAPEX of traditional is only delaying since it will not pay the labor simultaneously. Unlike in virtual, the initial set-up cost is higher than conventional if the equipment and space area are already allocated; however, if the case is reversible, both traditional and virtual are almost identical CAPEX, if not very small difference.

OPEX of conventional is higher than virtual, considering maintenance of equipment, space allocation, labor cost, monthly expenses, and the additional miscellaneous cost.

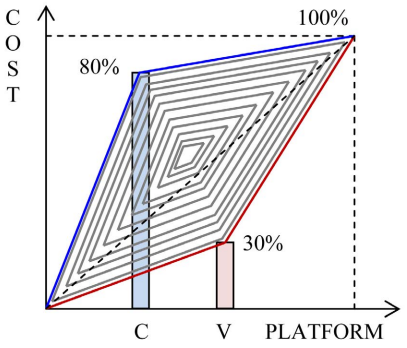

Figure A5.3. The cost gap between Conventional (C) and Virtual (V) set-up.

For most projects, contractors look forward to awarding and optimizing the design or reducing the workforce to minimize the project's overall cost (Table A5.4).

A5.4. Initial Set-Up for VPM Operation (Sample)

Tables A5.5-A5.7 shows the optimal cost and typical set-up for a newly VPM business or company-diversified group in PMC operation. The data is only a sample, for the time being, however, the actual cost might varies depending on the time setup (Figure A5.4 and Figure A5.5).

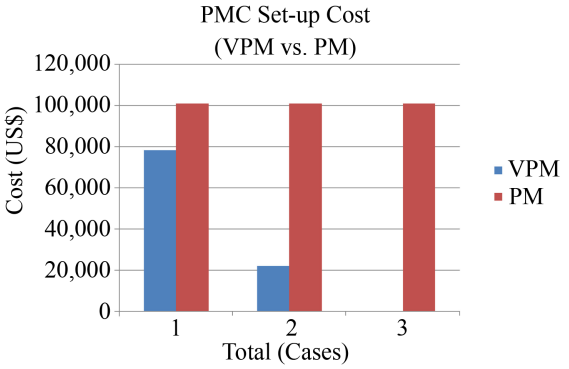

Figure A5.4. Graph project management cost set-up.

Table A5.4. Typical project management cost for conventional platform.

Project Stages	Typical Charges for PMC Services	Technical Deliverables [1]	Bi-Weekly Reports [2]	Monthly Reports [2]
BD/CD	7 ~ 16 Million US$	~67 (more or less 80)	~ 30	3 ~ 6
FS [3]	17 ~ 24 Million US$	~238 (more or less 250)	~ 70	12 ~ 14
FEED	25 ~ 30 Million US$	~731 (more or less 750)	~ 60	6 ~ 12
EPC	31 ~ 50 Million US$	~ from FEED docs [4]	~ 150	30 ~ 36

Note: 1) All engineering disciplines that required for the project. 2) Including S-Curve and Master Schedule Report Level-3 in Monthly Report. 3) FS included BD/CD and Pre-FEED data for some projects as a package. 4) Almost 2 - 3x of FEED docs due to vendor print data, drawing, and additional.

Table A5.5. Typical minimum set-up for Project Management Consultancy (PMC) operation.

Platform Type	Staff		Equipment			Accessories			
	Tech.	Mgt.	PC	HD Storage	Table	Internet	Software	Email	Others
Virtual	20	-	20[1]	20[1]	-	20[1]	20[1]	20[2]	20[2]
Conventional	20	4	24	20	24	24	24	24	24

Definition: 1) HD, Hard Disk Storage (at least 1TR Bytes). 2) Tech., Technical/Functional Staff, performing technical project deliverables. 3) Mgt., Management/General, performing administration works, and others. Note: 1) It may charge to virtual members' expenses. 2) Virtual member or company (set up by Project Contractors).

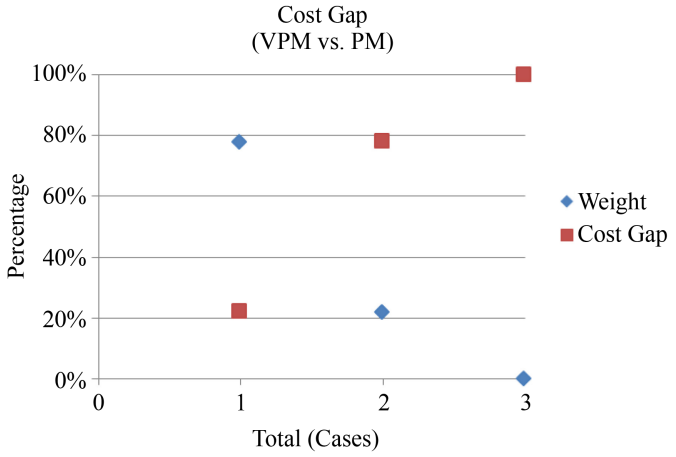

Figure A5.5. Cost gap set-up.

Table A5.6. Initial cost for Project Management Consultancy (PMC) Set-up[5].

Item	Description	Required		Unit Cost (US$)	VPM (US$)	PM (US$)
		VPM	PM			
Equipment	PC	20[4]	24	1000	20,000	24,000
	HD Storage	20[4]	20	100	2000	2000
	Table	-	24	100	-	2400
	Chair	-	24	50	-	1200
	Telephone	-	24	150	-	3600
Accessories	Internet	20[1]	24	120	2400	2880
	Software	20[2]	24	1200	24,000	28,800
	Email	20[2]	24	1000	20,000	24,000
	Others	20[2]	24	500	10,000	12,000
Total					78,400 22,000[2,3] 0[4]	100,880

Note: 1) Virtual member or company provided (mobile WIFI) per month. 2) Virtual member or company (set up by Project Contractors). 3) If accessories are excluded from the company CAPEX set-up. 4) If each Virtual member provides everything equipment and accessories. 5) Refer to Table A5.5.

Table A5.7. Cost gap for project management set-up[1].

Item	VPM (US$)	PM (US$)	Weight (%)	Cost Gap (%)
Case 1	78,400	100,880	77.72	22.28
Case 2	22,000	100,880	21.81	78.19
Case 3	0	100,880	0	100

Note: 1) Referring to Table A5.5 and Table A5.6.

Appendix 6: Abbreviation and Definition

List of Abbreviations, Acronyms, and Definitions

ACES	Ability, Completion, Efficient, and System
ASEM	American Society of Engineering Management (US)
BD	Basic Design
BIM	Building Information Model
BPO	Business Process Outsourcing
BORE	Budget, Operation, Risk, and Explore
CAC	Cost Analysis and Control
CAPEX	Capital Expenditure (Capital Expenses)
CD	Conceptual Design
CF	Cash Flow
CMAE	Cost & Manhour Allocation Effectiveness
COM	Commissioning, Operation, and Maintenance
D5	Define—Design—Develop—Diagnose—Desired
DI	Data Integration (The document is placed in DMS and can be commented on by the technical team simultaneously.)
DMS	Data Management System
EIA	Environmental Impact Assessment
EM	Engineering Manager
EMBOK	Engineering Management Book of Knowledge by ASEM
EPC	Engineering, Procurement, and Construction (It's the main physical execution and implementation of the project.)
EPCC	EPC Contractor (The principal or general contractor of the project.)
FEED	Front-End Engineering Design
FS	Feasibility Study
GVT	Global Virtual Team (It's a similar term to vTO.)
HAZID	Hazardous Identification
HAZOP	Hazardous Operation
HD	Hard Disk (External) (Potable Storage)
IPO	Input—Process—Output
IT	Information Technology
ITB	Invitation to Bid
KOM	Kick-off Meeting
Lo	Team Member Location
LNG	Liquefied Natural Gas
LNGT	LNG Receiving Terminal and Regasification Plant
LPG	Liquefied Petroleum Gas
MH	Manhour
MOM	Minutes of Meeting
MSS	Multi Structures—Scales
MTO	Material Take-off
NOA	Notice of Award

OPEC	Operational Possibility, Effectivity, and Capability
OPEX	Operational Expenditure (Operating Expenses)
PC	Personal Computer
PEA	Performance Evaluation and Analysis
PEACE	Personality, Experience, Availability, Communication, and Engagement
PEP	Performance Effectivity and Productivity
PFD	Process Flow Diagram
P & ID	Process and Instrumentation Diagram (BD/CD & FS) (Piping and Instrumentation Diagram (FEED & EPC))
Pm	Project Manager
PM	Project Management
PMA	Process Model Analysis
PMC	Project Management Consultancy
PMCC	PMC Contractor
PMI	Project Management Institute (US)
PMP	Principle, Methodology, and Procedures
PMBOK	Project Management Book of Knowledge by PMI
PMS	Project Management System
PTC	Project Triad Concept
PTS	Project Team Structure
QRA	Quantitative Risk Analysis
REST	Rest and Strategies
SIL	Safety Integrity Level
SIMOPS	Simultaneous Operation Study
STAFF	Structure, Train, Achievement, Flexibility, and File-Handling
SubCon	Project Sub-Contractors
SWOT	Strengths, Weaknesses, Opportunities, and Threats
VCPM	Virtual Construction Project Management
VDC	Virtual Design Construction
VPC	Virtual Project Coordination
VPM	Virtual Project Management
vPm	Virtual Project Manager
vT	Virtual Team (The project team member composed of GVT, vTO, and vTD)
vTD	Virtual Team (Domestic)
vTO	Virtual Team (Overseas)