Turkish Journal of Computer and Mathematics Education *Vol.12 No.14(2021), 4380- 4390*

Research Article

Information System Development with MVC Approach: A Case Study On Team Communication Strategy

Nur Syufiza Ahmad Shukor[a], Nur Razia MohdSuradi[b], ZahrulAzwan ABSL KamarulAdzhar[c], Zuraidy Adnan[d], Norhawani Ahmad Teridi[e], Muhammad Fairuz Abd Rauf[f], TaufikRidzuan[g], Khairul Annuar Abdullah[h], Mohd Azril Amil[i], Nasrudin Md Rahim[j], SuzanaBasaruddin[k], Wan Azlan Wan Hassan[l], Azilayati Osman[m]

[a,b,c,d,e,f,h,k,l,]Lecturer Department of Computing, Faculty of Communication, Visual Art and Computing, Universiti Selangor
[g,i,j]Lecturer Department of Engineering, Faculty of Engineering and Life Sciences, Universiti Selangor
[m]IT Officer,Centre of Information and Communication Technology, Universiti Selangor

Abstract: In any project whether IT or non-IT based, communication plays an important role. Communication in an IT project would be dealing with among others communication between the project management office (PMO) and the stakeholders and also communication among the team members of the project. According to Project Management Institute (PMI) report on 2017, inadequate/poor communication contributes 30% of the project's failure. Working on a project with diverse members' background and limited experiences would be challenging, especially the window for the project time frame is not that big. This paper presents a case study of IT project development and highlights the experience of a PMO strategizing to improve communication among team members to bridge the gap between them. Both conventional and unconventional methods were applied for the team to achieve their project goals especially when working on the project during the Covid-19 pandemic. At the end of the paper some reflections of how the effective communication processes contributed to a higher chance of project success are shared.

Keywords: RAD, web application framework, Laravel framework, project success

1. Introduction and Problem Background

Data has become a commodity. Those with data will have knowledge and knowledge leads to wisdom and wealth. Data could be derived from three major components of an information systems namely people, process, and procedure. On the other hand, it is important for an organization to be able to produce reliable, accurate, precise, and timely data to the stakeholders through state-of-the-art information system. This would also help to portray positive image for any organization. Thus, a workable information system is a must have, whether the application is to be developed in-house, outsourced, jointly developed, or customized from the shelves; whichever fits the stakeholders' requirements and budget.

The decision on whether the information system is developed in-house or outsourced will determine the organizational structure of the project. The task of managing the project regardless of the scale and size ischallenging. Based on the report by the Standish Group released in March 2020 (Chaos, 2020), only 35% of projects were fully successful with respect to time and budget. The report also stated that 19% of projects will be cancelled before they get completed, and that 47% of projects arechallenged (i.e., over budget, behind schedule, low quality deliverables). Building a good system involved high-cost implications in maintaining and operating the systems and services offered. Moreover, integrating all services into one portal is a complex and time-consuming task (Nawi et al. 2015), thus planning for the project success is important.

Project Management Body of Knowledge (PMBOK) defines project management as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements (Duncan, 2005). A project should be governed by the PMO and the core processes are as follows; strategic alignment, roles, responsibilities and accountability, decision making structures and authorities, risk management, communication management and stakeholder management (PMI.2016). In a report by the PMI, inadequate/poor communication contributes 30% of the projects started in organization in the past 12 months that were deemed failures (PMI, 2017). It states the fact that good communication is one of the elements required in order for the project to be successful. Another recent article by Mashiloane and Jokonya (2018),also highlighted weakness in communicating within the project environment as a prominent issues reported by their respondents. On the other hand, Chmielarz and Zborowski, (2018) also concluded that from their survey the most significant factor of IT project management is good communication between contractors and recipients.

The important factors associated with the knowledge required for the success of an IT enterprise, apart from change and risk management include the skills related to modelling processes in the project (Chmielarz and Zborowski, 2018), which also requires communication management in order for all related stakeholders stay on the same page in project delivery. However, working with a team that has various team members' background and level of involvement in a project might have complex communication issues. This article will discuss the experience of communication strategy in system development using MVC framework for institute of higher education. The strategic communication must be in place to tackle the communication management issues as opined by Pacagnella et al. (2019), projects with effective communication processes will have a higher chance of success.

2.Literature Review

2.1Overview of MVC

The Model-View-Controller or famously known as MVC is a software design pattern and is a software design pattern and is currently widely use in the web design architecture Jeng et al. (2021). Due to its ability to clearly distinguish the roles of data, display, and logic, it has made why MVC is widely adopted by the practitioners in the industry (Jeng et al. (2021); Falana et al. (2021); Hadiwijaya and Octafian (2021)). The MVC is based on the concept that was introduced by Trygve Reenskaug in the 1970s at the Xerox Parc for the Smalltalk-80 application (Pop and Altar, 2014) and served as the central concept behind the Smalltalk-80 user interface development (Burbeck, 1992). According to (Burbeck, 1992), the use of MVC has made the application as an elegant and simple, but quite unlike the approach of traditional application programs during that time. It was also regarded as a flexible and powerful system then.

In the MVC paradigm the user input, the modeling of the external world, and the visual feedback to the user are explicitly separated and handled by three types of objects, each specialized for its task. According to (Burbeck, 1992), each of the components (shown in Figure 1) that made up the MVC has the following purpose:

1. The model manages the behavior and data of the application domain, responds to requests for information about its state (usually from the view), and responds to instructions to change state (usually from the controller).
2. The view manages the graphical and/or textual output to the portion of the bitmapped display that is allocated to its application.
3. The controller interprets the mouse and keyboard inputs from the user, commanding the model and/or the view to change as appropriate.

The MVC behavior is then inherited, added to, and modified as necessary to provide a flexible and powerful system of Smalltalk-80 then (Burbeck, 1992); and it continues to become the basis of the modern-day system development framework. This concept of MVC has helped others in Web Application framework. A more simplified characteristics of the MVC is presented by (Verma, 2014) as follows:

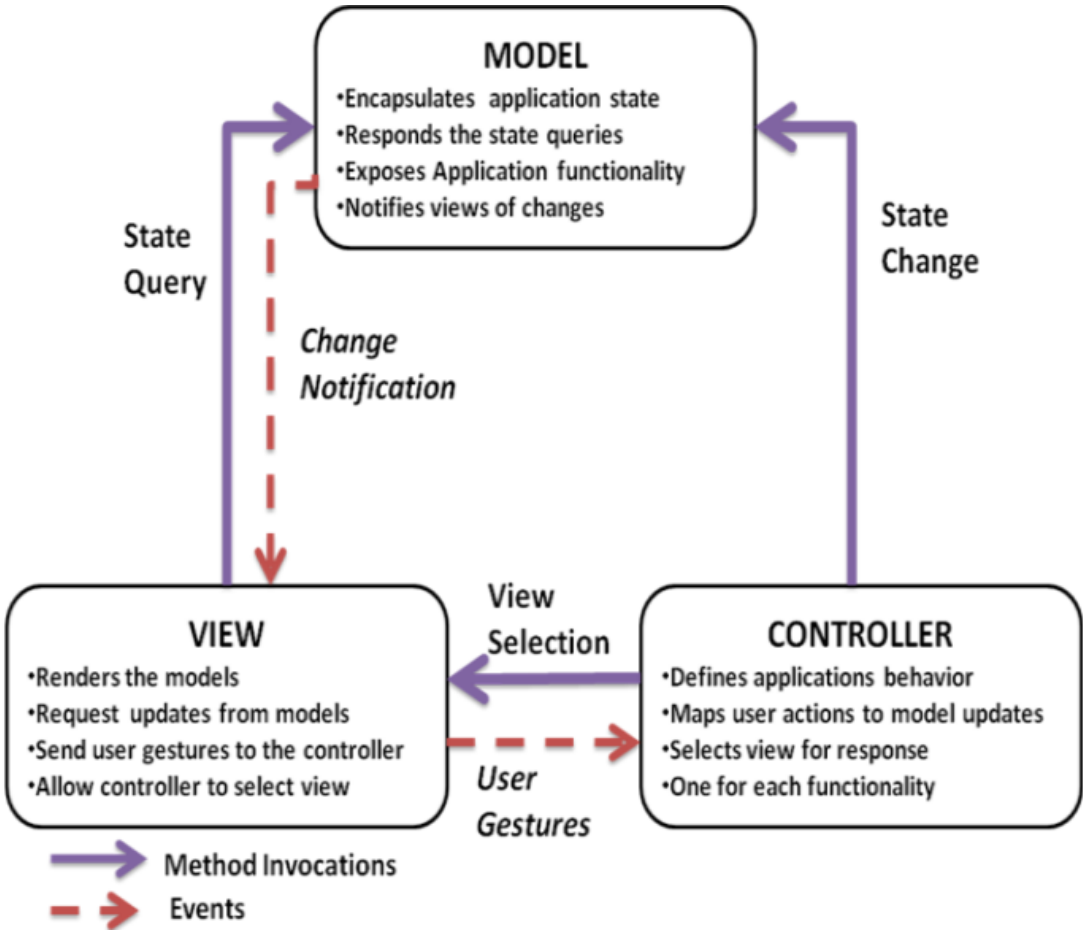
1. The Model – The model is the part that interacts with the database to handle the data, logic and the rules
2. The View – The view forms the part that interacts with the user by displaying the output and accepting the input in various forms.
3. The Controller – The controller sends commands to the model to update the data as well as send commands to the view to modify the data being accepted or displayed.

Given the above characteristics of the MVC, obviously it is highly suitable for rapid Web Application development(Pop and Altar, 2014). Currently, MVC has become a common design pattern that exists in many Web Application frameworks such as ASP.net, CakePHP, Laravel, Ruby on Rails, Spring MVC and Strut (Verma, 2014) or Zend (Yadav et al., 2019). It is mostly used as it could structure user-oriented applications (meaning applications that have a Graphical User Interface – GUI) easily. In recent years we can see more articles showed case the use of MVC for web application development on different framework such as Laravel, Java, PHP, CodeIgniter. Among works available are Inventory Management System (Pratama, 2021); Online Shopping System (Mahmood and Ashour, 2019); Web Based Learning System (Turnip, 2021); Ticketing Reservation Systems (Kayode and Alabi, 2021); Institutional Repositories (Kumar et al., 2016);(Kajitori and Aoki, 2016); Online Collaborative Discussion [22]; and Internship Monitoring System (Anif et al., 2017).

2.2Laravel Framework

This section explains system design using MVC method on Laravel framework. The main architectural concept in this system as discussed above consists of three components such as Model, View and Controller. The component created through MVC architecture are independent of each other. However, this feature helps the developer to reuse the component and code easily and quickly in any development framework.

Figure.1. Showing the MVC architecture concept adapted from (Burbeck, 1992).



Given the above characteristics of the MVC, obviously it is highly suitable for rapid Web Application development (Pop and Altar, 2014). Currently, MVC has become a common design pattern that exists in many Web Application frameworks such as ASP.net, CakePHP, Laravel, Ruby on Rails, Spring MVC and Strut (Verma, 2014) or Zend (Yadav et al., 2019). It is mostly used as it could structure user-oriented applications (meaning applications that have a Graphical User Interface – GUI) easily. In recent years we can see more articles showed case the use of MVC for web application development on different framework such as Laravel, Java, PHP, CodeIgniter. Among works available are Inventory Management System (Pratama, 2021); Online Shopping System (Mahmood and Ashour, 2019); Web Based Learning System (Turnip, 2021); Ticketing Reservation Systems (Kayode and Alabi, 2021); Institutional Repositories (Kumar et al. (2016); Kajitori and Aoki (2016)); Online Collaborative Discussion (John and Sam, 2018); and Internship Monitoring System (Anif et al., 2017).

Laravel is a free, open-source PHP web framework, created by Taylor Otwell and intended for the development of web applications following the MVC architectural pattern. Laravel is a framework development purposively for web application which consists of HTML scripting language, JavaScript and CSS. The Laravel framework is easy to understand and powerful, the framework itself provides authentication, routing, session manager, caching, IoC container and tons of most used component, also amazing database migration tools and integrated unit testing support, all these tools give developers the ability to build complex applications (Chen et al., 2017).

Laravel has been designed to improve the quality of the software by reducing initial development costs and repair costs to improve the application by providing expressive syntax that explains and installs core devices that will save implementation costs (Parkar et al., 2016).

Among the advantages of Laravel has are:

1. It provides modular packaging system with a dedicated dependency manager (Chen et al., 2017).
2. Applications that required obscure backend is more suitable to make with Laravel whether large or small in scale (Yadav et al., 2019).

3. A vagrant box, homestead pre-packaged is there in Laravel that made it easier to operate (Yadav et al., 2019).
4. Speed, security and seamless information relocation (Yadav et al., 2019).

2.3Communication Strategy for Project Success

According to (Whyte et al., 2016), a system that enables the organization to maintain data integrity and consistency is required, transmitting, and storing such data to facilitate the processing of change requests, control mechanisms, lessons learned, and configuration management is required. That is especially true when delaing with complex projects in which a large volume of information needs to be managed. Author like Chmielarz and Zborowski (2018) stated that the important factors associated with the knowledge required for the success of an IT enterprise, apart from change and risk management include the skills related to modelling processes in the project. In a project that has multiple people from various and diverse background and expertise would require strategic communication within the development team.

Another author Cervone (2014) emphasized that without strategic communication mechanism that works well for the team members, a project is doomed to fail. He also added that in IT project, different team would require different communication techniques. There is no one size fits all type of communication techniques when it comes to handling people working together. Different groups communicate and work differently. What works for the programming team probably does not work for the design team. Similarly, what works for the design team probably will not work for mid-level managers. Therefore, the project team cannot expect to work with stakeholder groups the same way they work internally. A wide variety of techniques will be needed to reach out and effectively work with various stakeholder groups, techniques that may force the project team to bend and flex their own styles of working. For example, a communication plan that relies solely on a 75 Communication for project success communication mechanism that works well for the project team, such as a blog or an e-mail for example, may not be culturally acceptable to others.

According to (Salman et al., 2021), the responsibility of initiating the communication doesn't always fall into the project managers' shoulders. The customer should also initiate communication with the project manager, and the project manager should start a proper communication with the product development team. In another study by Durmic (2020) showed that good communication also helps to make the problem solving easy and efficient. That is why strategizing for the best suited communication techniques that cover all stakeholders in IT project is important. The following section will provide important background information pertaining the IT project handled by the project team and how strategic communication helped they achieved their project goals.

3.The Case Study

The focus of this case is on the in-house development of integrated information systems for a higher education provider (HEI) in Malaysia. The information system development is led by the Centre for Information and Communication Technology (CICT) of the HEI. In general, the CICT is responsible for the planning and implementing ICT infostructure & infrastructure for the HEI. It also responsible to support of the use of ICT to implement all academic functions and the HEI administration as well as the ICT development and consultation. The roles of the CICT are as listed:

1. To manage ICT helpdesk report
2. To plan, develop & implement integrated web-based application.
3. To apply new ICT technology.
4. To review, plan, upgrade and maintain ICT services to make sure everything operates smoothly and always meet current needs.
5. To provide ICT consultation among the HEI members and community.
6. Responsible for the planning, development, provision, supply, management, and maintenance of the campus network including branches campuses.
7. Responsible for planning, managing, maintaining, and monitoring the Data Centre.

At present there are two major systems for students that cover the academic and non-academic processes. On the other hand, another two information systems supported the administration and operation of the HEI. The systems are currently running on a very good infrastructure with bandwidth of 40 MBps per device access, and 100Mbps VPN. The network runs on the backbone that support up to 10G. Installed with appliance firewall and Internet access management for ensuring the security of the network. However, the current systems for students could no longer cater for the changes in the current business process and procedures. The system that was developed in the mid of 2000s is having some challenges as both the technology and requirements changed. Thus,

the management of the HEI had supported for the CICT proposal for new information systems to be developed to replace the current student's management system. The student's management system is then categorized into the academic and non-academic related system. The proposal also included a few other HEI administrative and supporting systems such as help desk system, facilities management system, asset and inventory management system and the research management system.

The newly proposed information system project that will be referred as SPKB in this paper was given a green light by the top management and the board of director has the following directions: the SPKB will be developed using the PHP and admin LTE template that runs on the Laravel Framework; the Microsoft Server SQL Server will serve as the database; a total of five information systems will developed in phases. All development should be completed in 2 years with a limited budget.

Initially, CICT only has one Application System Unit (known as USA) that consists of two system analysts, one database administrator, one programmer and one data migrator. All six of them are responsible to both maintaining the existing system that was built by third party and at the same time involve in developing new application requested by users. One big challenge that the CICT can immediately identified was the fact that the current manpower was not enough for the team to move fast with the development. Another challenge that would hinder them would be the familiarity of the programmers and system analysts with the technology proposed for the system development, which is Laravel. Even though the CICT management aware about this huge challenge, the team chose to proceed with Laravel as the features served by this technology overweight the challenge the team is facing. The framework offers a set of tools and application architecture that combines many of the best features of frameworks such as CodeIgniter, Yii and ASP.NET MVC (Santoso et al., 2021). In achieving the project goals, CICT rolled-up plan to invest on human skills and talent recruitment as it was one of the critical success factor of the project.

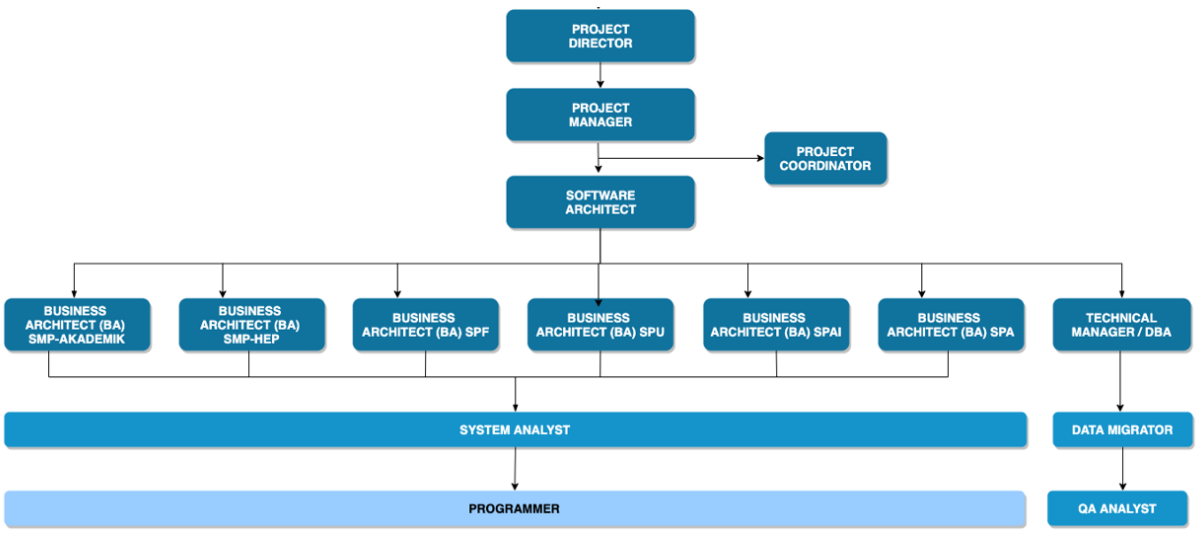
With that, the USA has also rebranded into new department instead of a single unit in the CICT. CICT has reshuffled the USA and increased the team's manpower. The management decided to engage seven business architects (BA), three system analyst (SA), two quality analyst (QA) and another seven new programmers into the team. They have also structured the organization of the SPKB in such a way that all the six systems to be developed adopting the agile methodology, will be reported to one project management office (PMO) and assisted by one Project Coordinator. Each of the systems is led by business architect. The software architect will help to oversees the technical aspect of the development holistically so that every team will have same idea and understanding on the project development especially when it comes to code development. The programmers are assigned to the respecting system and will take lead from the SA and BA. Table 1 summarize the team and Figure 2 shows the organizational chart of the project team.

Table.1. describing the SPKB team members, their roles and responsibilities.

Team	Role	Responsibility
Project Management Office (PMO)	Project Director – 1	▪ Responsible for overall project management ▪ Oversee project managers
	Project Manager – 1	Planning, executing, monitoring, controlling, and closing projects
	Project Coordinator – 1	Coordinate project communication activities among team members
	Software Architect – 1	▪ Design the overall project development ▪ Verify UI & DB development ▪ Documentation of project design
Technical Architect	Technical Manager / DBA - 1	▪ Responsible in the technical aspect of the system especially on the info structure
	Data Migrator – 1	▪ Planning, executing and monitoring data migration of the project ▪ Setup the development environment of application and database ▪ Solve technical issues during development
	QA Analyst – 1	▪ Planning, executing and monitoring test to assess functionality, performance, reliability, stability and compatibility with other systems. ▪ Finding bugs and suggest the best practice solution

Team	Role	Responsibility
Business Architect (BA)	Business Architect (BA)- 9	▪ Elicit user requirements ▪ Document the User Requirement Specification (URS) ▪ Design the UI based on the URS ▪ Develop the SRS ▪ Act as team leader for the module/ system
	System Analyst – 3	▪ Assist BA in transforming URS into automated UI ▪ Assess the suitability of information systems in terms of their intended outcomes ▪ Assist programmer for better understanding of URS & SRS
	Programmers – 7	Develop and coding the UI functionality according to URS & SRS

Figure.2. Showing the SPKB project organization chart and channel of communication



4.0 Problem Solutions

The SPKB has a value of 20 for its total specific workforce for development. Two of them reside in the PMO. Programmer used to code the system, BA used to plan and to match user requirement with the system, and PMO used to manage programmer, BA and other resources required to develop the system. One of the problems to manage programmer and BA is on the gap of age between programmer and BA. BA age ranging from 41-50, while all programmer age range 20-27. The differences include communication and problem-solving method on practical problem. Research indicates that performance on the practical problems increased to a peak in the 40- and 50-year-old groups (Denney and Palmer, 1981). Its shows that the age BA group is suit to their role in this SPKB development, while programmer group requires guidance to solve practical problems from BA. However, in emotional salience situation, from adult developmental perspective, passive-dependent and avoidant-denial strategies were used more by older adult than younger age group (Blanchard-Fields, 1995). This shows even though BA group is blessed with wisent from their age, it is also can be used to avoid the task given to them and transfer it to the programmer that craving for their guidance!

Apart from that the team also adopting the agile development method. Prototyping is opted as the development approach to produce good results, as suggested by Omidvarkarjan et al. (2020). According to (Salman et al., 2021), communication in agile product development is among most critical point. Having said that, the PMO has decide to tackle the communication issues from the very beginning of the project. The following are the strategic

action taken by the CICT to address all the problems related to communication in ensuring the success of project implementation and deliverables:

1. Structured various communication channels
2. Team empowerment
3. Face-to-face communication
4. Documentation to map the MVC
5. Developing communication structure through intellectual capital

4.1Structured various communication channels

To address the issue of communication gap between various professional background of the team members, the PMO of SPKB play its role with managing the resources more effectively by assigning the role for personnel based on their strength and weaknesses. This is done through meticulous observation of every personnel involved in this project. This project also has Technical Committee and Steering Committee that can be referred to in the event of an unmanageable incident. The structure also supports the team empowerment spirit whereby decision making is shared through proper communication channels (Kirkman and Rosen, 1999). Apart from that the teams were also advised to utilize the formal communication channel established by the PMO especially the emails, announcement board and document sharing in Microsoft Teams, update meetings and technical meetings physically and virtually through Google Meet, Zoom or Microsoft Teams.

Team members are kept posted with the updates of the project progress and able to rise any issues or concerns about the project through these formal communication channels. It is the responsibility of project manager to ensure that effective communication between team members is facilitated. This could be supported by providing different communication channels that would lead to achieving the desired goals and project's vision (Sweis et al., 2018). SPKB project manager did just that. Any issues encountered were discussed through update meetings or technical meeting as and when it requires attention.

Apart from that the team also utilizing the Microsoft Teams as their knowledge repository and knowledge sharing platform. Usage of technology-based knowledge repositories and institutionalized the knowledge deemed to be one of the good moves for good coordination between team members (Sablis et al., 2021). In fact, the team used GitHub as collaborative software development tool. The use of GitHub for open-source development enables among others, the tracking progress on project board, checking the milestones progress, tracking progress and repositories of codes. GitHub would address the common problem in collaborative software development issues such as cultural, inadequate communication, knowledge management and desynchronization (Golombeck et al., 2018). In addition, the use of GitHub would also benefit both the newbies (new programmers) and expert programmers (Liu et al., 2018) and could also be more efficient when working in team (Al-Badareen et al., 2021) as the team apply the reusable components of GitHub.

4.2Team Empowerment

One of the brilliant strategies taken by the PMO is practicing team empowerment for this development. Team empowerment is derived from the empowerment theory and can be defined as a set of structures, policies, and practices designed to decentralize power and authority throughout the organization, enabling employees at lower levels to act appropriately (Lin et al., 2017). Researchers like Hempel et al., (2012) summarized that based on the previous researchers, team empowerment is conceptualized as a shared team perception of collective empowerment. According to Kirkman and Rosen (1999), team empowerment is increased task motivation resulting from team members' positive orientation to their work role. There are four dimensions involved in team empowerment namely autonomy, potency, impact, and meaningfulness. They further implied that the team empowerment will enable the team members to regard each task handed to them is meaningful and has an impact on the organization.

In more recent research by Grass et al. (2020) concluded that there are certain recommended actions could be taken by the contributors in making the team empowerment a success. The four important entities are the agile team; leaders; customers; and organizational context. All the four entities are required to accomplished managerial actions to ensure the team empowerment is delivered. The SPKB PMO ensured that all suggested actions are accomplished. List of the accomplishments are as listed in Table 2. Table 2 provides the activities taken by SKPB in order for them to adhering to the team empowerment concept.

4.3Face-to-face Communication

According to Kirkman and Rosen (1999), to increase team empowerment, individual empowerment needs to be decreased. This could be accomplished through shared decision making within teams. In order for the team to be able to reach to that, face-to face interaction plays a very important role. According to Zahn (1991) the face-to-face interaction covers both the formal and informal communication between individuals or among the teams. It ranges may include emotional information and social support as well as task information.

In SPKB, the face-to-face communication are encouraged by PMO apart from having the emails and messages sent via the WhatsApp group created. Even through the pandemic, the team managed to have a frequent scheduled and unscheduled face-to-face meeting within the team members as well as with the clients. This was done with the help of technology. The teams have been given access to Microsoft Teams, Google Meet and Zoom; whichever suitable for communicating the project related issues. The frequent face-to-face team meetings that being utilized effectively is one of the keys for good team engagement (Sweis et al., 2018), as it would provide an avenue for giving constructive feedbacks and discussing for alternatives on issues encountered by the team.

4.4 Documentation to Map MVC

The team also find ways to expedite the knowledge transfer process of the BAs who are responsible in eliciting and documenting the business process into "easily understood" documentation for the programmer to understand and to start development with. The team came up with the idea of communicating the business process and translate into design visual documentation to represent the MVC framework. This approach is also aligned with (Omidvarkarjan et al., (2020); Khan et al., (2020)) whereby the agile approach concentrates on the rapid development of software, where the requirements and solutions are determined through cooperation between project teamwork. In order to do that the team decide to communicate the business process (URS) by translatingthem into design visual documentation to represent the MVC framework.

The component created through MVC architecture are independent of each other. However, this feature helps the developer to reuse the component and code easily and quickly in any development framework. Based on the architecture, the Model may be a single object or structure of objects. In this case, the model is explained as the module/function to be developed. The 'View' is a visual representation of the MVC architecture. It simply can be the part of user interface (UI) or user's screen to interact with the system. A view is connected to its model and get what necessary data for the presentation by asking certain question or message. All interactions within the UI are sent back to the model in such an easy terminology that can easily understand the information sent by controller. The 'Controller' will interact between the screen (View) and process while the Model is associate to the data properties. It also acts as 'brain' of the entire MVC architecture. Thus, for the team to grasp the idea of the MVC quickly, the interactive interface stating all the MVC components were developed by the BAs with assistance from the SAs.

4.5 Developing Communication Structure Through Intellectual Capital

Communication is needed to access and use social and intellectual capital through exchanging information, identifying problems and solutions, and managing conflict (Jianbin et al., 2014). Intellectual capital (IC) could be referred to knowledge and knowing capability of a social collectivity, such as an organization, intellectual community, or professional practice (Nahapiet and Sumantra, 1998). There are few studies agreeing that IC impacted the project success such as opined by works of Handzic and Durmic, (2015), Handzic et al. (2016), Milošević et al. (2018) and Rusan and Oleksandr (2021).

IC could decrease the communication gap (Fazlagić and Windham, 2016) because the communication barriers which exist due to limited access to intangible information tended to narrow the understandings of intangibles (such as tacit and explicit knowledge (Chen, 2014). Thus, developing IC is needed. Training and staff development in the areas they are lacking is one of the measures taken to develop the IC. IC has a positive impact on project success, and thus may be a good indicator of future projects' performance (Handzic et al., 2016). The project team need to be developed and nurtured so they could be able to have a coordinated knowledge of the projects they are working on. New knowledge creation is also developed throughout the process and add more value to the IC development of the organization. This team has undergone few series of trainings and workshops which contribute to the development of the IC as reflected in Table 2 of the action taken.

5. Reflections and Conclusion

Working in a system development team that consists of team members from various background and skills is very challenging, especially it involves a complex and high-profile project. One of the key factors for project success is through effective communication between the team members and the stakeholders, especially users. In article by PMI (2021) mentioned that team members should elevate the power skills to ensure effective leadership and communication—including collaborative leadership, empathy for customers and colleagues, innovative thinking, and the ability to build trusting relationships to ensure project success. The approaches taken by the PMO of SKPB shown that they have the communication part covered by taking the necessary actions including having a structured various communication channel; practicing team empowerment; promoting face-to-face communication; and closing the communication gap through creating the documentation template to map the MVC and developing communication structure through intellectual capital. As a result, the PMO, development team and users were able to endure the communication challenges throughout the development process

thathappened during the Covid-19 pandemic. The project was a success as all current modules are delivered on time.

Acknowledgement

The authors wish to express their gratitude to the management of Universiti Selangor for funding this research through TCMS grant scheme. Many thanks also go to all personnel and departments involved in the process of eliciting the requirements and development of the system.

References

Al-Badareen, A. B., Saleh, A. M., Abuaddous, H. Y., &Enaizan, O. (2021). "In The Process of Software Development: Available Resources and Applicable Scenarios", Journal of Theoretical and Applied Information Technology, 99(1).

Anif, M., Dentha, A., &Sindung, H. W. S. (2017, October). Designing internship monitoring system web based with Laravel framework. In 2017 IEEE International Conference on Communication, Networks and Satellite (Comnetsat) (pp. 112-117). IEEE.

Blanchard-Fields, F., Jahnke, H. C., & Camp, C. (1995). Age differences in problem-solving style: The role of emotional salience. Psychology and Aging, 10(2), 173–180. https://doi.org/10.1037/0882-7974.10.2.173

Burbeck, S. (1992). Applications programming in smalltalk-80 (tm): How to use model-view-controller (mvc). Smalltalk-80 v2, 5, 1-11.

Cervone, H. F. (2014). Effective communication for project success. OCLC Systems and Services: International digital library perspectives.

CHAOS 2020 Beyond Infinity, Standish Group Report, The Standish Group International, Inc., https://www.standishgroup.com/news/49

Chen, Lei, Jo Danbolt, and John Holland. "Rethinking bank business models: the role of intangibles." Accounting, Auditing & Accountability Journal (2014)

Chen, X., Ji, Z., Fan, Y., & Zhan, Y. (2017, October). Restful API architecture based on Laravel Framework. In Journal of Physics: Conference Series (Vol. 910, No. 1, p. 012016). IOP Publishing.

Chmielarz, W., &Zborowski, M. (2018). Determinants of using project management in the implementation of information systems. Procedia Computer Science, 126, 1224-1236.

Denney, N. W., & Palmer, A. M. (1981). Adult Age Differences on Traditional and Practical Problem Solving Measures1. Journal of Gerontology, 36(3), 323–328. https://doi.org/10.1093/geronj/36.3.323

Duncan, W. (2005). Project Management Institute. A Guide to the Project Management Body of Knowledge.

Durmic, N. (2020). Factors influencing project success: A qualitative research. TEM Journal, 9(3), 1011-1020.

Falana, O. J., Ebo, I. O., & Odom, I. S. (2021). Se-LMS: Secured E-Learning Management Systems For Smart School. International Journal of Software Engineering and Computer Systems, 7(1), 36-46.

Fazlagić, J., and Windham L. (2016) "Intellectual Capital and Public Services in Polish and us Counties." European Journal of Service Management 19, No. 3: 19-25.

Golombeck, M., Henning O., & Stefan T. (2018)."Collaborative Software Development with GitHub® Projects."

Grass, A., Backmann, J., &Hoegl, M. (2020). From Empowerment Dynamics to Team Adaptability: Exploring and Conceptualizing the Continuous Agile Team Innovation Process. Journal of Product Innovation Management, 37(4), 324-351.

Hadiwijaya, H., &Octafian, D. T. (2021, February). System Development Management E-School as a Students Information Media. In Journal of Physics: Conference Series (Vol. 1783, No. 1, p. 012026). IOP Publishing.

Handzic, Meliha, and NerminaDurmic. "Knowledge management, intellectual capital and project management: Connecting the dots." Electronic Journal of Knowledge Management 13, no. 1 (2015).

Handzic, Meliha, NerminaDurmic, Adnan Kraljic, and Tarik Kraljic. "An empirical investigation of the relationship between intellectual capital and project success." Journal of Intellectual Capital (2016).

Hempel, P. S., Zhang, Z. X., & Han, Y. (2012). Team Empowerment and The Organizational Context: Decentralization and The Contrasting Effects of Formalization. Journal of management, 38(2), 475-501

Jeng, S. L., Chieng, W. H., & Chen, Y. (2021). Web-Based Human-Machine Interfaces of Industrial Controllers in Single-Page Applications. Mobile Information Systems, 2021.

Jianbin, Chen, Guo Yanli, and Xu Kaibo. "Value added from knowledge collaboration: convergence of intellectual capital and social capital." International Journal of U-& E-Service, Science & Technology 7, no. 2 (2014): 15-26.

John, L., & Sam, A. E. (2018). An Online Collaborative Discussion Platform for Bridging a Technological Reliance Gap in Higher Learning Institutions in Tanzania, International Journal of Modern Education and Computer Science (IJMECS), Vol.10, No.11, pp. 29-35.

Kajitori, K., & Aoki, K. (2016). Implementation of a Simple Document Repository System. International Journal of Modern Education and Computer Science, 8(9), 12-19.

Kayode, A. A., & Alabi, A. O. (2021). Design and Implementation of a Simplified CodeIgniter Framework for Commercial Vehicles Ticket Reservation System. Asian Journal of Research in Computer Science, 1-12.

Khan, Fazal Qudus, Saim Rasheed, MagedAlsheshtawi, Tarig Mohamed Ahmed, and Sadeeq Jan. "A Comparative Analysis of RAD and Agile Technique for Management of Computing Graduation Projects." CMC-COMPUTERS MATERIALS & CONTINUA 64, no. 2 (2020): 777-796.

Kirkman, B. L., & Rosen, B. (1999). Beyond self-management: Antecedents and Consequences of Team Empowerment. Academy of Management journal, 42(1), 58-74.

Kumar, V., Kumar, A., Sharma, A. K., & Singh, D. (2016). Implementation of MVC (Model-View-Controller) design architecture to develop web based Institutional repositories: A tool for Information and knowledge sharing. Indian Research Journal of Extension Education, 16(3), 1-9.

Lin, M., Wu, X., & Ling, Q. (2017). Assessing The Effectiveness of Empowerment on Service Quality: A Multi-Level Study Of Chinese Tourism Firms. Tourism Management, 61, 411-425.

Liu, C., Dan Y., Xiaohong Z., Baishakhi R., and Md M. R. "Recommending github projects for developer onboarding." IEEE Access 6 (2018): 52082-52094.

Mahmood, M. T., & Ashour, O. I. (2019). Design and Implementation of Web Based For Intermediate Online Shop with Laravel Framework. Int. Journal of Comp. Science & Mobile Computing, 8(3), 124-133.

Mashiloane, R. E., &Jokonya, O. (2018). Investigating the Challenges of Project Governance Processes of IT Projects. Procedia computer science, 138, 875-882.

Milošević, Nela, Marina Dobrota, and S. BarjaktarevićRakočević. "Exploring the impact of intellectual capital components on project performance." European Project Management Journal 8, no. 2 (2018): 43-51.

Nahapiet, Janine, and Sumantra Ghoshal. "Social capital, intellectual capital, and the organizational advantage." Academy of management review 23, no. 2 (1998): 242-266.)

Nawi, H. S. A., Ibrahim, O., Shukor, N. S. A., Omar, S. F., Ishak, I. S., & Rahman, A. A. (2015). Understanding sustainability: An exploration of the is literature. Journal of Theoretical and Applied Information Technology, 73(3), 447-455.

Omidvarkarjan, Daniel, Ralph Rosenbauer, Daniel Kirschenbaum, Daniele Cipriano, David Ochsner, Harry Woodfin, Christoph Klahn, and Mirko Meboldt. "Prototyping strategies for the agile development of additive manufactured products: a case study from the COVID-19 pandemic." In Proceedings of the 31st Symposium Design for X (DFX2020), pp. 161-168. 2020.

Pacagnella Jr, A. C., da Silva, S. L., Pacífico, O., de Arruda Ignacio, P. S., & da Silva, A. L. (2019). Critical success factors for project manufacturing environments. Project Management Journal, 50(2), 243-258.

Parkar, V. V., Shinde, P. P., Gadade, S. C., & Shinde, P. M. (2016). Utilization of Laravel Framework for Development of Web Based Recruitment Tool. In National Conference On "Changing Technology and Rural Development (pp. 36-41).

PMI (Project Management Institute). (2016) "Governance of Portfolios, Programs, and Projects: A Practice Guide" [Online]. Available from: http://www.pmi.org/~/media/PDF/learning/portfolio-program-project-governance-practice-guide.ashx. [Accessed: 7th July 2021].

PMI (Project Management Institute). (2017). Success Rates Rise – Transforming the High Cost of Low Performance. Newtown Square, PA: Pulse of the Profession®. Retrieved from: https://www.pmi.org/-/media/pmi/documents/public/pdf/learning/thoughtleadership/pulse/pulse-of-the-profession-2017.pdf [Accessed: 6th July 2021].

PMI (Project Management Institute). (2021). Beyond Agility: Flex to the Future. Pulse of the Profession®.) [Accessed: 17:51 10th July 2021].

Pop, D. P., & Altar, A. (2014). Designing an MVC Model for Rapid Web Application Development. Procedia Engineering, 69, 1172-1179.

Pratama, D. A. (2021). Design of Fish Sales Information System In Pt XYZ Using Laravel Framework. Intelmatics, 1(1).

Rusan, Nadiia, and Oleksandr Voitenko. "Emotional Intellectual and Cognitive Factors of Success in Project Management." In ITPM, pp. 85-94. 2021.

Sablis, Aivars, Darja Smite, and Nils Moe. "Team- external coordination in large- scale software development projects." Journal of Software: Evolution and Process 33, no. 3 (2021): e2297.

Salman, A., Jaafar, M., Malik, S., Mohammad, D., & Muhammad, S. A. (2021). An Empirical Investigation of the Impact of the Communication and Employee Motivation on the Project Success Using Agile Framework and Its Effect on the Software Development Business. Business Perspectives and Research, 9(1), 46-61.

Santoso, G. B., Sinaga, T. M., &Zuhdi, A. (2021). MVC Implementation In Laravel Framework For Development Web-Based E-Commerce Applications. Intelmatics, 1(1), 37–42.

Sweis, R. J., Al Sharef, R., Jandali, D., Obeidat, B. Y., &Andrawes, N. (2018). The Relationship Between Project Team Members' Effectiveness and Acknowledgment of Talent: Team Members' Perspective. International Journal of Construction Education and Research, 14(2), 141-160.

Turnip, M. (2021). Web-Based Online Learning System MVC Method. JurnalMantik, 4(4), 2687-2690.

Verma, A. (2014). Mvc architecture: A comparative study between ruby on rails and laravel. Indian Journal of Computer Science and Engineering (IJCSE), 5(5), 196-198.

Whyte, J., Stasis, A., &Lindkvist, C. (2016). Managing change in the delivery of complex projects: Configuration management, asset information and 'big data'. International Journal of Project Management, 34(2), 339-351.

Yadav, N., Rajpoot, D. S., &Dhakad, S. K. (2019, November). LARAVEL: A PHP Framework for E-Commerce Website. In 2019 Fifth International Conference on Image Information Processing (ICIIP) (pp. 503-508). IEEE.

Zahn, G. L. (1991). Face-To-Face Communication in an Office Setting: The Effects 0f Position, Proximity, And Exposure. Communication Research, 18(6), 737-754.