

# Developing a Standards Based Project Management Information System<sup>1, 2</sup>

## Part 1: Motivation, History, Design<sup>3</sup>

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### Introduction

This article describes the development of a project management information system (PMIS). Using the design science research methodology, I created an artifact, and that artifact is the research contribution. In the following pages, I describe the motivation for creating the PMIS, the history of its development, and the details of its design. I conclude with future direction and pending questions. My hope is to spark interest and engage project management practitioners in the project.

### Motivation

Two specific motivating factors contributed to the development of the PMIS. The first came from my experiences with managing projects. Nearly twenty years ago, I worked as a programmer developing custom software for small- and medium-sized businesses. As I took on more responsibilities in that job, I managed projects. I found that I was very good at managing projects when I was the one doing the programming, but my project management success was intermittent when I managed a team of developers. After earning a Project Management Professional (PMP) certification, I understood that many of my errors could have been solved by using good methodology. I saw tremendous value to the content and structure of the standards documented in “A Guide to the Project Management Body of Knowledge,” more commonly known as the PMBOK® Guide (Project Management Institute, 2017); however, the thought of implementing those standards was overwhelming. I was afraid it would take more time to create

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<sup>1</sup> This series of articles describes the development of a new standards-based project management information system by Dr. Jeremy Bellah at the University of Oklahoma. Dr. Bellah is a Lecturer of MIS and the Director of the Center for MIS Studies at the University. He teaches courses related to programming, web development, data analysis, and project management. See Dr. Bellah’s background at the end of this article.

<sup>2</sup> As this is an ongoing development project, the author would welcome comments, feedback or suggestions. Please email your thoughts or ideas to [jbella@ou.edu](mailto:jbella@ou.edu)

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and organize the project management documentation than it was worth. What I needed was a tool to make it easier.

The second motivation emerged during my second career – higher education. Teaching project management to both graduate and undergraduate students was enjoyable, but I hated using Microsoft Project to support class projects. My students were more confused about advanced topics like earned value analysis after using the software than they were before. I realized I would need to either spend significant time teaching the tool or use a better tool. What I needed was a tool with a structure that matched the content I used in class.

## History of Development

I decided to create the tool I needed. I was an experienced software developer, and I was far enough removed from that career to forget how much time and effort it takes to build even a simple application. Had I known how much it would take to build, I am not sure I would have started. I used the break between the fall semester in 2015 and the spring semester in 2016 to begin development. I hoped to use the PMIS for class projects in a graduate project management class that semester. It was not ready for use in classes in spring 2016, but I used it in fall 2016 to support both graduate and undergraduate project management classes. In addition, I conducted research with the students and found that they understood core concepts better when using the PMIS (Zimmer et al, 2019). That version of the PMIS had the following functionality:

- Charter (defined fields and multiple database tables to handle things like objectives, milestones, and requirements)
- WBS
- Activity List with time estimates integrated with the WBS
- Resource List
- Activity Resources with cost estimates integrated with Activity List and Resource List
- Activity progress updates
- Activity Resources cost updates
- Earned Value Analysis automatically calculated from information in the system
- Lessons Learned Register

In the spring of 2017, I worked with a local home builder to extend the functionality. I thought that was a good industry to target because my parents had a bad experience with the management of their home building process. Although they got the house they wanted, the schedule and budget were not managed well. I added specific functions that the home builder and I thought would be useful:

- Stakeholder Register
- Stakeholder interface with the following functionality:
  - Schedule view showing planned and actual schedule, as well as probability distribution for completion date

- Ability to approve change requests formally
- Ability to view progress reports
- Resource interface allowing workers and subcontractors to update progress and costs
- Critical Path Method (CPM) showing which activities were on the critical path
- Program Evaluation and Review Technique (PERT) showing probability distribution for completion date
- Change Management process requiring the user to enter a reason when modifying the schedule or budget which allowed for the reporting of schedule and budget changes showing date of change and reason for change

I accepted a position at a different university in 2018 and quit working on the project for a year. In the fall of 2019, I was introduced to a new software development tool – a low code tool called Mendix – and began re-developing the PMIS using that tool. I found that I could develop 5-10 times faster using Mendix than I could develop with any tool I had ever used. Because I began with a clean slate, I organized the system differently. My original vision for the PMIS was to “operationalize” the PMBOK® Guide, but I was unable to do that because it would require too much work. Instead, I focused on building the functions and interfaces that were essential to supporting the core concepts I needed for teaching. When re-developing the PMIS, I decided to build it the way I envisioned. In the next section, I describe the design.

## **Design of the PMIS**

### **User Roles**

Most applications are built according to user roles. An Administrator might have one interface, while a User would have a different interface. One complicated aspect of the PMIS is that the user’s role depends on the project. One can be a Stakeholder in one project and a Project Manager in another project. For this reason, a logged in user has access to all interfaces, but the projects that appear for each interface are based on the user’s role in that project. The main menu is organized according to the possible roles:

- Project Manager
- Program/ Portfolio Manager
- Subcontractor
- Team Member
- Stakeholder

The Project Manager interface is the core of the PMIS. That functionality is explained in the following paragraphs. Although I plan to build out interfaces for the other project roles, I have done nothing more than creating buttons with the names of the roles.

## Structure

I created the menu structure according to the process groups and processes in the PMBOK® Guide. Figure 1 shows a portion of the design of the menu. Once a project is selected, a Project Manager can use the menu to perform work in specific processes. When I started designing the system, I had the idea that I would have sequential links between processes. For example, the Sequence Activities process cannot begin until the Define Activities process is finished. That works well for some processes but not for others. It turned out that it made more sense to link processes through documents. That fits the structure in the PMBOK® Guide better. Each process in the PMBOK® Guide has Inputs, Outputs, and Tools & Techniques. The Inputs and Outputs are documents. A document can be an Output for one process and an Input for another process.

Caption	Action	User Roles
☰ Projects	📄 Open page 'PMIS.Projects_Overview'	Administrator, User
☰ + Initiating		
Develop Project Charter	▶ Call microflow 'Act_GotoDevelopProjectCha...	Administrator, User
Identify Stakeholders	▶ Call microflow 'Act_GotoIdentifyStakeholde...	Administrator, User
☰ ☰ Planning		
Develop Project Management Plan	▶ Call microflow 'Act_GotoDevelopProjectMa...	Administrator, User
Plan Scope Management	▶ Call microflow 'Act_GotoPlanScopeManage...	Administrator, User
Collect Requirements	▶ Call microflow 'Act_GotoCollectRequirements'	Administrator, User
Define Scope	▶ Call microflow 'Act_GotoDefineScope'	Administrator, User
Create WBS	▶ Call microflow 'Act_GotoCreateWBS'	Administrator, User
Plan Schedule Management	▶ Call microflow 'Act_GotoPlanScheduleMana...	Administrator, User
Define Activities	▶ Call microflow 'Act_GotoDefineActivities'	Administrator, User
Sequence Activities	▶ Call microflow 'Act_GotoSequenceActivities'	Administrator, User
Estimate Activity Durations	▶ Call microflow 'Act_GotoEstimateDurations'	Administrator, User
Develop Schedule	▶ Call microflow 'Act_GotoDevelopSchedule'	Administrator, User
Plan Cost Management	▶ Call microflow 'Act_GotoPlanCostManagem...	Administrator, User
Estimate Costs	▶ Call microflow 'Act_GotoEstimateCosts'	Administrator, User
Determine Budget	▶ Call microflow 'Act_GotoDetermineBudget'	Administrator, User

Figure 1: PMIS Project Manager Menu (partial)

I designed each process page to have links to input documents and output documents. All of the output document links are visible for a process, and clicking the link will bring the user to the interface for creating that document. For input documents, only the documents that exist are visible. To illustrate, Figure 2 shows the design of the page for the Create WBS process, and

Figure 3 shows how it appears to the user in a project where the only input document that was created was the Project Scope Statement.

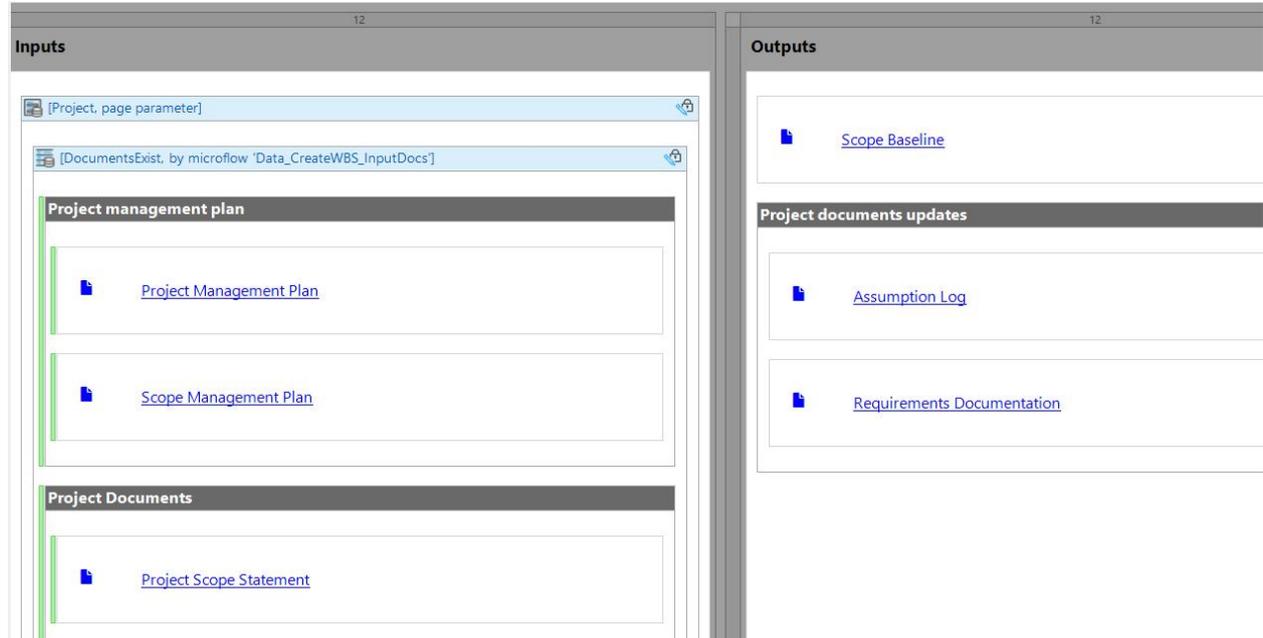


Figure 2: Design of Create WBS Page

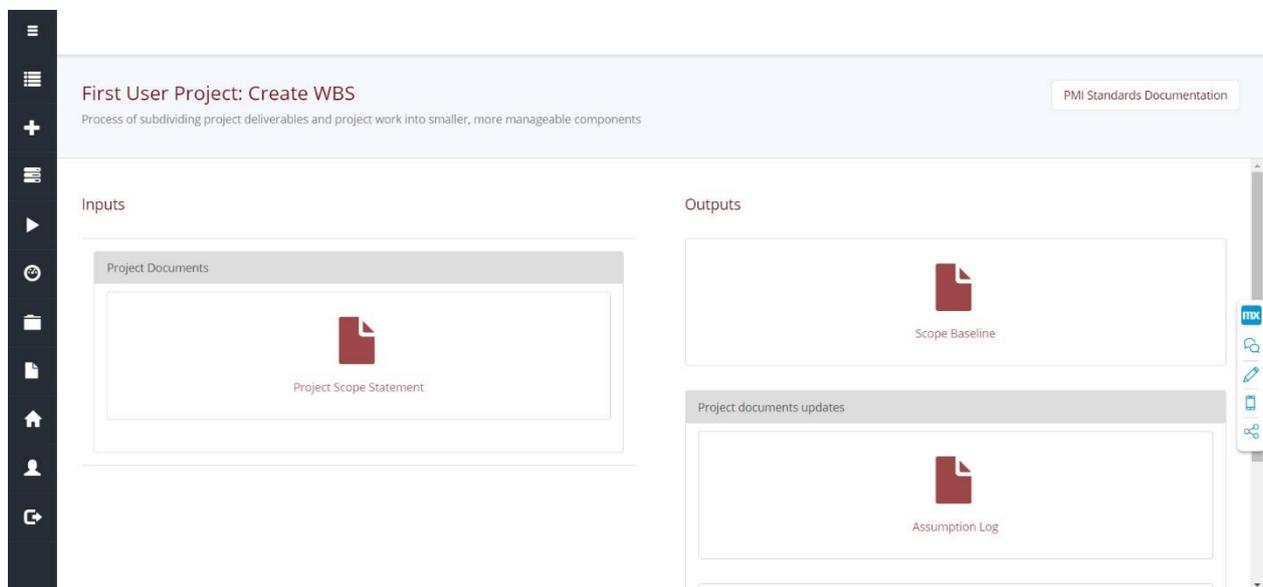


Figure 3: Create WBS Page in Runtime

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## Project Management Process Integration

Most of the documents in the PMIS are generic. The user can type anything into the text area and save the document. However, some of the documents are integrated into the system using database tables. For example, the Work Breakdown Structure (WBS) is created using a database table. The user can create multiple WBS Items and can decompose the Items as well (using a self-referencing relationship). One benefit of this functionality is that the numbering of WBS Items can be handled by the system.

Another benefit of using database tables is the ability to connect information in the system. Connecting information between processes gives the system power. The downside is that it limits the flexibility. For example, the Activity List is backed by a database table, and it has a relationship to the WBS Item table. This reflects the fact that Activities decompose Work Packages, which are the lowest level WBS Items, into schedule Activities. The structure allows estimated and actual costs and durations to be aggregated from Activities to Activity Groups to Work Packages to WBS Items, and ultimately to the project itself. However, it comes at a cost. The user cannot type the Activity List freely. The creation of the Activity List is constrained by the structure of the database; therefore, the system controls how Activities are entered and edited. Also, because Activities are linked to WBS Items, the Activity List cannot be created until the WBS is approved.

In developing the PMIS, I have been careful with the balance between power and flexibility. In early versions of the system, I used database tables to provide an interactive interface for creating the Project Charter. In the current version of the system, the interface for creating the Project Charter is free text because I do not want to limit the flexibility of the user. The benefit of the structure is not sufficient to justify limiting the user's flexibility.

## Conclusion

In this article, I avoided getting into the details of the functionality. This is the beginning of a series of articles, and I plan to go into detail with all of the functionality through those articles. What I hope to get out of this is feedback from you. In each article, I plan to ask for feedback related to specific design issues. The feedback will be used to improve the design of the system as it is developed.

I hope to have a functional application that anyone can use for free in about one year from now. In a previous career, I sold information systems – I have no desire to get back into that business. I want to use the PMIS to generate research related to project management. I also want university faculty to be able to use the system to support project management classes. By making it free to use, I remove barriers to collaboration. When I share details of the design through these articles, I do not worry about someone taking my ideas and developing their own system. While the feedback I receive is valuable, it does not need to have a monetary value because the system is not generating revenue. This allows us to collaborate and come up with the best ideas.

Following are the specific ideas about which I need feedback:

- How should the PMIS handle Enterprise Environmental Factors (EEFs) and Organizational Process Assets (OPAs)? In the PMBOK® Guide, EEFs and OPAs are often included in inputs and outputs, in addition to documents. My plan is to allow specific EEFs and OPAs to be defined at the Program level. Then I would allow the user to assign each EEF and OPA to specific project management processes.
- How should the PMIS handle Tools & Techniques? Originally, I planned to have a section in each process page for Tools & Techniques. This would make sense in a process like Identify Stakeholders that has things like Power/Interest Grid, Stakeholder Cube, or Salience Model. However, the Tools & Techniques for Create WBS are Expert Judgment and Decomposition. Because most processes are more similar to the second example, I chose to leave Tools & Techniques out.

I hope you enjoyed reading about the development of the PMIS. I look forward to hearing back from you. Please email me at [jbella@ou.edu](mailto:jbella@ou.edu) with feedback related to my specific questions or with general feedback. In the next article, I plan to go into detail with the scheduling functionality.

## References

Project Management Institute. (2017). *A guide to the Project Management Body of Knowledge (PMBOK guide)* (6th ed.). Project Management Institute.

Zimmer, J. C., Chen, L., & Bellah, J. C. (2019). PROJECT MANAGEMENT SOFTWARE: DEVELOPMENT AND EVALUATION OF THE PMIS. *Journal of Research in Business Information Systems*, 19.

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## About the Author



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**Jeremy Bellah** serves in a teaching position at the University of Oklahoma's Price College of Business. He teaches classes related to programming, web development, data analysis, and project management. Through an experiential learning teaching style, he coaches and mentors students to develop into successful working professionals. He also serves as the Director of the Center for MIS Studies, an industry-academic partnership within the MIS Division. In this role, he interacts with industry partners of the Division to facilitate input on curriculum, collaborative research projects, and engagement with students.

Prior to earning a Ph.D. and pursuing academic positions, Jeremy developed information systems professionally. Most of the systems were custom applications built for small- and medium-sized businesses. This experience gives Jeremy the ability to relate to industry professionals and to teach from a perspective of practical expertise, rather than academic training. Dr. Bellah can be contacted at [jbella@ou.edu](mailto:jbella@ou.edu).