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A Case Study: Transitioning Business Processes to the Cloud for Small Enterprises

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A Case Study: Transitioning Business Processes to the Cloud for Small Enterprises

by

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A creative component submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Information Systems

Program of Study Committee:
Anthony Townsend
Sree Nilakanta

Iowa State University

Ames, Iowa

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DEDICATION

This paper is dedicated to Daisy, who had to endure my long absences away from home while attending evening classes and working on this project.

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ABSTRACT

With the advent of cloud-computing, small and medium-sized enterprises have begun taking advantage of available software as a service solutions to manage their business processes. Understanding the implications of employing SaaS into their business process or workflow, SEMs can make better decisions on when and how to transition to a cloud-based model. This case study analyzes a small organization's current business process and provides recommendations for business process improvements as they transition to a cloud-based software application. In addition, the study utilizes a hybrid Waterfall/RAD development methodology to develop and employ a reporting system and database to support and manage the organization's programmatic activities. The Waterfall/RAD approach was successfully used in this study. The approach allowed for flexibility during development without affecting current business operations and an iterative introduction of the software application to external users. The results of this analysis may assist small and medium-sized enterprises transitioning to cloud-based solutions in order to improve the efficiency of their current business processes.

Keywords: software-as-a-service, small and medium enterprises, efficiency, collaboration, networks, cloud computing, cloud platforms, business models, business frameworks, virtual collaboration, e-collaboration, rapid application development, waterfall methodology, hybrid methodology, business process

CHAPTER 1: INTRODUCTION

With the advent of cloud-computing, small and medium-sized enterprises have begun taking advantage of available software as a service solutions to manage their business processes. Software as a Service (SaaS) providers deliver centrally hosted applications via the internet, or as a service, and frees customers of the need to manage complex software and hardware systems (Salesforce, 2018). The products offer a wealth of benefits, such as cost flexibility, faster adoption of new technology, and external capability (collaboration) to name a few (Marshall, Kesterson-Townes, Srivathsa, & Berman, 2012; Vasiljeva, Shaikhulina & Kreslins, 2017). In addition, SaaS service providers manage the security, availability, and performance of the software application (Salesforce, 2018), freeing SEMs of the need to manage the application internally.

Understanding the implications of employing SaaS into their business process or workflow, SEMs can make better decisions on when and how to transition to a cloud-based model. Insights into the amount of time needed to develop and manage the systems will help SEMs to determine if current staff are able to develop and maintain the SaaS model or if hiring a consultant or IT professional should be considered.

The purpose of this case study will be to analyze a small organization's current business process and provide process improvement recommendations as they transition to a cloud-based software application. In addition, this study will include the implementation of a new business model and the development of a reporting system and database to support and manage the organization's programmatic activities. The recommendations and experiences that surface from this case analysis may aid small and medium-sized enterprises transitioning to cloud-based solutions in order to improve the efficiency of their current business processes.

CHAPTER 2: LITERATURE REVIEW

The National Institution of Standards and Technology (Swensen, 2011) defines cloud computing (CC) as, " a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." Cloud computing service types include information as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). However, as the cloud-computing market grows, so are the types of services available and how those services are delivered (Gartner, 2012).

As small and medium-sized enterprises shift to SaaS solutions to improve data collection, data management, and information sharing activities, it will inevitably require them to adapt their business processes and organizational framework based on the methodology used by the SaaS provider (Murphy, 2015). However, moving to an electronic or cloud-based solution will not only streamline paper-based workflows (Arinze, 2012), but potentially improve the efficiency of data collection, data maintenance, and information sharing.

Much like many businesses in today's technological environment, SEMs collaborate with various partners or other organizations to meet business objectives and goals. Often times, these partnerships exist off-site or remotely. Cloud computing can facilitate not only inter-organizational collaboration in business processes, but allow cross-enterprise information sharing and collaborative work to enable people from different locations and enterprises to share a single workflow (Balina, Baumgarte & Salna, 2017). In fact, a survey of industry executives conducted by Marshall et al. (2012) found that the top reason enterprises adopt cloud services is due to the external capability, or increased collaboration with external partners.

Research centers and federally funded programs at research 1 (R1) universities are no stranger in this regard. Research 1 universities are defined as doctoral universities with very high research activity (The Carnegie Classification of Institutions of Higher Learning, n.d.). In recent years, these organizations have turned to cloud-based SaaS products to help them address data collection, data management and information sharing with external partners. Federally funded programs or research centers at R1 universities often rely on partnerships with a large network of organizations outside of their institution, and prior to cloud-based technologies, faculty and staff at academic institutions primarily resorted to email with attachments to manage information sharing and data collection (Arinze, 2012).

Due to stringent security restrictions imposed by the R1 universities, external partners of these federally funded programs and research centers are unable to access information stored on the lead institution's servers. Sharepoint and similar products come with their own set of problems, including accessibility issues for external users because of the security infrastructure at the university. In addition, some software programs lack intuitiveness, which for external users unfamiliar with the software application or who are not technologically adept, further exacerbates the challenges for data collection and information sharing. As these enterprises or organizations transition their business processes to the cloud using SaaS solutions, it will be imperative they understand whether or not these solutions improve the efficiency of data collection, data maintenance, and information sharing with external users. In addition, SEMs will need to explore how best to transition their legacy (paper-based) business models to electronic, cloud-based processes.

When moving towards implementing SaaS solutions, SMEs must consider a number of variables during the transition. This includes the financial costs, development and deployment,

changes to its business processes and workflow, management and continuous improvement, and security. SEMs are restricted by the number of employees they can afford to hire, if they can afford to hire skilled IT professionals, and the amount of time they can dedicate to the development and continued improvement of their IT systems.

Vasiljeva et al. (2017) found that the biggest obstacles to adopting IT for SMEs was the search for skilled workers, the costs of maintaining skilled workers, and the cost of developing an IT infrastructure. Information technology allows enterprises to change their traditional organizational structure to accelerate business processes and link to the needs of their internal and external users (Burdienė & Zalieckaitė, 2012). Therefore, enterprises with limited funding tend to try out free of charge solutions before making a major investment in full-scale cooperative solutions (Balina, Baumgarte & Salna, 2016) For SMEs, SaaS allows them to adopt cheap and affordable IT solutions that are easy access, easy to use, and work perfectly (cited from Budrienė & Zalieckaitė, 2012). In a recent study conducted by Kim et al. (2017) SMEs reported they adopted SaaS primarily to improve business processes above other qualifiers, such as quality improvement and cost. In addition, management support was more important to the SMEs than having the IT capacity for the adoption of SaaS.

CHAPTER 3: CASE STUDY

The Organisation for Economic Co-operation and Development (OECD, 2018) defines SEMs as companies or organization that employ fewer than 250 individuals. However, the United States sets its threshold at 500 employees. Small enterprises range from 10 to 50 employees, while medium-sized enterprises range from 51-250 (OECD, 2018). A review of the research studies discussed in the literature review section of this paper followed similar perimeters (Kim, Jang & Yang, 2017; Clarke, 2017; Vasiljeva, Shaikhulina & Keslins, 2017; Budriene & Zalieckaita, 2012). Likewise, for the purposes of this study, we will use the same ranges as defined by the OECD for small and medium-sized enterprises.

This case study will analyze the current business processes of Science Bound, a pre-college program at Iowa State University, as it transitions its business model to Smartsheet, a cloud-based software as a service platform. Even though Science Bound is not a federally funded program, the characteristics of its staffing model is comparable to that of other state and federally funded programs and centers at Iowa State University and R1 universities. These programs often have a small workforce whose time is specifically devoted to tasks that support the goals and objectives of the project or grant. Rarely do their budgets include funding to hire or contract IT professionals to build or implement solutions for the project. In addition, many of these programs face challenges when collaborating with external partners, especially as it relates to data collection and file sharing.

Science Bound

Founded in 1990, Science Bound aims to address the need for increased worker diversity in ASTEM (agricultural, science, technology, engineering, and mathematics) at the state and

national levels. An Iowa State University chemistry professor and a Missouri-based high school to college bridge program spurred the creation of Science Bound at Iowa State University. The National Science Foundation, whose vision to increase diversity in the STEM workforce aligns with Science Bound's mission, provided funding for the pilot program. Since then the program has been self-sustainable through institutional funding and corporate sponsorships (Science Bound, 2015).

The pre-college program engages middle school and high school students from Denison, Marshalltown, and Des Moines (Iowa) who participate in a nine-year program, beginning when students enter the eighth grade (Science Bound, n.d.). Students are exposed to STEM disciplines, content, and careers and equipped with the knowledge and skills needed to succeed at a 4-year institution. Upon successful completion of the middle school and high school program, students earn a 4-year tuition scholarship at Iowa State University towards an STEM degree. Science Bound is a partnership between community school district teachers, students and families, businesses and corporations, and the Iowa State University community of faculty, staff, and students (Science Bound, 2015).

The Science Bound (SB) management team includes eight full-time staff and three graduate students. The Science Bound Director is the project sponsor and champion for the development of the database and reporting system. As the champion for the project, the director will ensure team members are devoted to and highly involved in the development process. The director will determine which database and reporting system features are required, provide direction on the order in which features are constructed and tested, and serve as the final decision-maker on the systems and their features.

The SB management team will provide information regarding their role in the organization, how they interact with internal and external users, what types of data they collect, and report on the challenges within the current business model. They will be involved in the review and development of new business processes and provide a wish list of features they would like included in the database and reporting system. Each team member will be deeply involved to improve workflow for tasks directly related their functional area. They also will be highly involved in the testing and deployment of the new database and reporting system and will participate in training sessions to learn how to maintain the system long-term.

Smartsheet

Founded in 2005, Smartsheet delivers a cloud-based platform that allows organizations to plan, collect, track and automate work, resulting in more efficient processes (Smartsheet, n.d.). The platform is commonly referred to as a project management tool that increases work agility and collaboration, allowing organizations to make and execute decisions quicker. The company serves over 76,000 customers in 190 countries, including 96 Fortune 100 companies.

Iowa State University recently purchased an enterprise license for Smartsheet. Numerous departments, programs, and centers at Iowa State University are implementing the tool in various capacities and are actively sharing their knowledge of specific features and capabilities. After reviewing how other programs are utilizing the tool, Science Bound decided to restructure their business processes using Smartsheet as the delivery mechanism. Even though resources are available through these various on-campus departments and Smartsheet customer support services, consulting on how best to transition legacy business processes to the cloud-based platform is absent.

Nature of the Problem and Opportunity

Science Bound has been operating at Iowa State University for more than 15 years. During this time, personnel have established sound procedures and protocols for collecting and managing student information, tracking student participation and programmatic activities, and maintaining student records. Unfortunately, the program has not maintained an internal procedures manual or documentation outlining their business processes. Their procedures have not utilized advances in information technology to improve workflow and efficiency.

The program primarily uses Microsoft Excel, Qualtrics, and Box (referred to as Cybox at Iowa State University) to manage a majority of business practices. Physical files store student artifacts, such as research posters, publications, and articles. Paper forms collect student information, including registration information for programmatic activities. Administrative personnel are responsible for data entry into the student database and multiple personnel are responsible for updating and maintaining the various databases. These methods create multiple challenges, such as:

- **Accessibility:** Permissions are set to allow only one user at any given time to access Microsoft Excel files, thus affecting productivity when multiple users need to access the file to add, edit, or update information.
- **Organization:** Personnel have difficulty locating files in Cybox and distinguishing current files from previous versions. This is particularly an issue as it relates to the student database, which is composed of multiple Excel files and stored in Cybox.
- **Inefficiency:** Information is store in multiple locations, which requires team members to locate other files to retrieve and copy the information. Compacted

with the disorganization of Cybox, team members spend additional time trying to locate the files they need before they can copy data to another file.

The Smartsheet platform has the potential to address many of the accessibility, organization, and efficiency problems the Science Bound program currently experiences. However, Science Bound lacks the expertise and professional IT staff to assist in the transition of their legacy systems to Smartsheet. While Science Bound has ideas regarding how to implement or utilize particular features within the platform, the program needs direction when it comes to creating a holistic structure that improves efficiency across all areas or all departments.

CHAPTER 4: METHODS

Participatory Action Research

Due to the complexity of the transition process and lack of internal resources, Science Bound invited me to serve as the consultant and developer as they transition their business processes to Smartsheet and to create a database and reporting system for their program. This will be a participatory action research project, in which the professional researcher and stakeholders both play an active role in the process (Greenwood & Levin, 2007). The SB management team will be actively involved in each step of the process to ensure the final product meets their requirements and is sustainable long after the completion of the project.

This strategy requires that action, research, and participation are all present during the process. Action refers to altering a situation toward a more self-managing state. In this particular project, it refers to creating more efficient and manageable business processes that utilizes a cloud-based software as a service solution. Research is using and creating knowledge, theories, and methods to generate new research knowledge. This project will apply several research methodologies to explore how best to design, develop, and deploy a reporting system and database. Lastly, participation means all parties (researcher and stakeholders) are highly involved in the process and are committed to its success (Greenwood & Levin, 2007). Science Bound will engage as collaborators to inform the project design, propose methods, facilitate project activities, and evaluate the process and final product.

Implementation Methodology

The project will explore using a hybrid of two Software Development Life Cycle (SDLC) methodologies for the planning, development, and implementation of Science Bound's cloud-based systems, which includes a series of databases for each programmatic area and a reporting

system for external users. The Software Development Life Cycle framework speeds up the software development process in a deliberate, structured, and methodical approach, with each step carried out sequentially. Seven SDLC models are in existence today: (a) Waterfall; (b) Iterative; (c) V model; (d) Spiral; (e) Rapid Application Development; (f) Incremental; and (g) Agile (Stoica Ghilic-Micu, Mircea, & Uscatu, 2016).

Recent studies indicate that hybrid software development approaches are becoming more popular regardless of industry sector or company size (Kurhmann et al., 2018), particularly with utilizing both traditional (Waterfall) and Agile. Hybrid software development is any combination of “agile and traditional (plan-driven or rich) approaches that an organizational unit adopts and customizes to its own context needs” (Kurhmann et al., 2018). Recent studies on the effectiveness and prominence of hybrid software development in industry has specifically focused on Waterfall/Agile approaches (Salinas & Boyne, 2012; Kurhmann et al., 2018; Stoica Ghilic-Micu, Mircea, & Uscatu, 2016). However, the hybrid Waterfall/Agile approach is problematic for this particular project or case study due to the need for flexibility and the small size of the project team. Agile requires a dedicated project team consisting for a Product Owner, Scrum Master, and Scrum team and requires product completion within a specific timeframe (Stoica Ghilic-Micu, Mircea, & Uscatu, 2016). Waterfall, alone, follows concise steps that require all planning to be completed before development begins (Salinas & Boyne, 2012).

In place of Agile in the hybrid approach, the Rapid Application Development (RAD) model has shown success among small organizations (Beynon-Davies, Carne, Mackay & Tudhope, 1998). However, very little research is available on the RAD model in combination with Waterfall or another SDLC models. Rapid Application Development shares some

similarities with the Agile approach, but is more flexible and better suited for small team sizes.

Common components of RAD include:

- Small development teams of 4-8 people who are empowered to make decisions. This includes both the developers and users.
- Projects are small scale and completed in short duration, typically two to six months.
- Incremental prototyping and phased deliverables are used during development. Each incremental cycle is completed at least three times or until the user is satisfied with the system or product (figure 4.1).
- Projects should be of low complexity and not large-scale.
- Two types of projects, intensive or phased, may be used. Intensive projects requires the developers and users to commit significant time to the completion of the project, whereas phased projects occurs over time.
- Timeboxes are used to ensure deadlines are met. Requirements are reduced to fit a specific timeframe if unable to meet a pre-determined deadline (Beynon-Davies, Carne, Mackay & Tudhope, 1998).

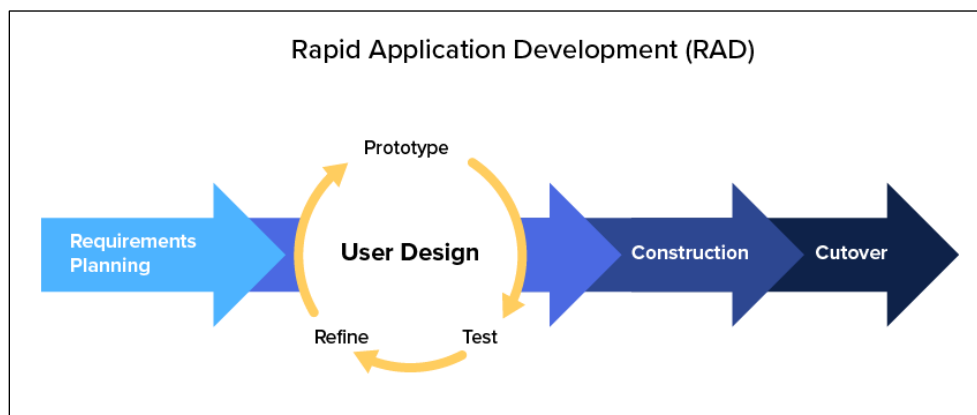


Figure 4.1. Rapid Application Development Process (KiSSFLOW, 2018)

To address the needs of this project a hybrid Waterfall/RAD development methodology (figure 4.2) was created using a combination of both approaches. Waterfall is applied at the front-end of the process, while RAD is used during development, testing, maintenance, and integration phases. During the requirements and planning phase, performance criteria are collected and a gap analysis is conducted to determine the feasibility of the project. A gap analysis is used to assess the current As-Is process and to develop a To-Be process (Business Dictionary, n.d). Unique to this method, is the introduction of User Stories to collect the performance criteria and design features. User stories, originally developed for Agile Scrum, guides the client to concentrate on defining the design features they want incorporated into the system under discussion (Rehkoph, n.d.). For the consultant, collecting user stories from clients ensures all performance criteria and design features are included, or at least considered, when developing the To-Be process.

During the next phase of the Waterfall/RAD methodology, prototypes are designed, built, and demonstrated to the clients and internal users. This process is repeated up to three times or until the client is satisfied with the final product. Testing involves the client, external users, and the project team. Initial testing is performed between the clients and project team, before a final test is performed with external users. Deployment refers to releasing the final product to external users for actual use (go-live). This serves as the final test, even though the product is formally in operation. It is important to note that assessing risk prior to deployment will ensure that little to no adverse effects will take place. The system is pilot-tested in a live setting to capture any unforeseen issues that need addressed prior to releasing the product on a larger scale. In addition, it allows the client to witness and/or experience the product from an external user, in-the-moment perspective.

While the first prototype is going through the testing phase, the next prototype begins development. In addition, any changes that need incorporated into an earlier prototype are implemented at this stage. The purpose of this dual build-modify approach is to speed up the development process. Because the design, build, and demonstrate phase takes longer, the dual build-modify approach takes pressure off the clients and internal users when they cannot dedicate significant time to the project. In other words, the clients and internal users can choose their level of involvement during the design, build, and demonstrate phase of the project.

Once each final product is officially released, the maintenance phase begins. This step includes collecting actual cases and making minor adjustments based on the data collection results. Maintenance also includes the general monitoring of the product.

Unlike most models, the integration phase takes place last or at the tail end of the project. During this phase, autonomously operating systems are combined into one complete system or process. The process takes place once actual (live) cases are collected by each system, thus allowing for easier integration on the backend. Actual case data that needs automatically synced with other systems are linked, so that information flows freely between systems.

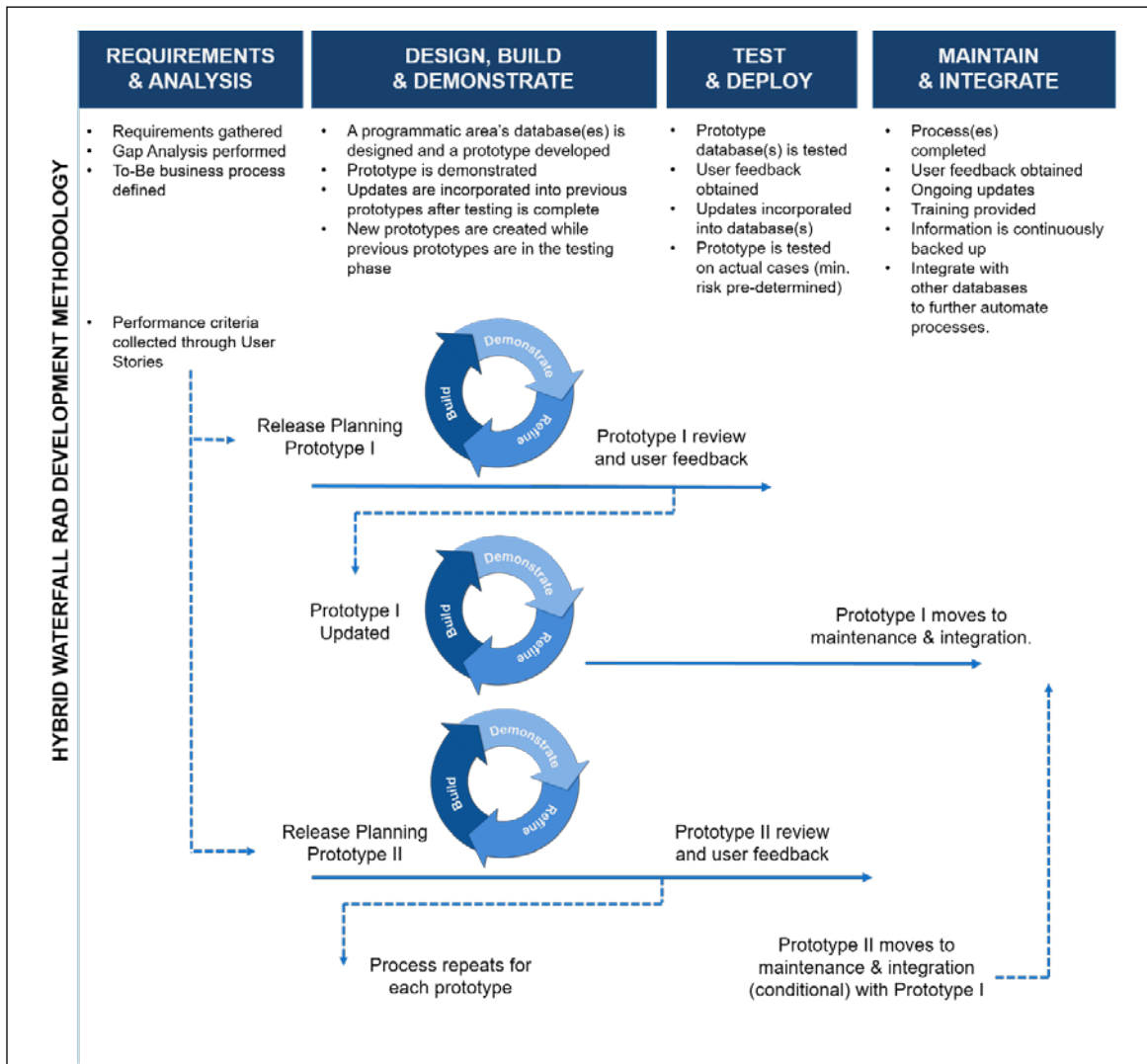


Figure 4.2. Hybrid Waterfall/ RAD Development Methodology. Adapted from "Hybrid waterfall agile development for the federal space," by E.M. Salinas and L. Boyne (2012). Paper presented at PMI® Global Congress 2012–North America. Copyright 2012 by Erica Salinas and Loraine Boyne.

Phase I: Planning & Feasibility

The Science Bound management team pre-identified the programmatic areas they wanted transitioned to the Smartsheet platform and the potential outcomes. Data from each of the programmatic areas intersects with other areas, except in the case of the Teachers Manual. For the purposes of this project, the programmatic areas of emphasis were:

- Middle and High School (MS/HS) Program: At each district, middle school students are recruited into the Science Bound program when they enter eighth grade. These students remain in the program throughout high school and are expected to enroll at Iowa State University after graduation.
- Student Experiences: Middle school and high school students engage in a series of activities and events to prepare them for college.
- Teachers Manual: The manual or handbook guides each teacher's involvement and defines expectations for teachers in each district.
- Iowa State University (ISU) College Program: Once students are accepted into college at Iowa State University, they are required to participate in activities their freshman year and are encouraged to remain engaged in the program until they graduate.

An initial consultation with the SB management team was conducted to determine what current processes exist, how information is shared and stored, what outcomes or solutions did the team what to achieve, and what is each team members' role within the organization. During the interview, the SB management team reported that current business processes are not formally documented even though the team operates under a clear set of procedures. As such, a preliminary business case was developed to guide the project, ensure current processes were defined, define performance criteria, identify solutions to bridge capability gaps, and create a new set of processes utilizing the Smartsheet platform and integrating the software's features to improve workflow.

Defining a Business Case

Individual interviews with team members provided insight into how information flowed to and from their functional areas to other areas within the organization. Specific document and file details were collected, such as document type, data maintenance, file and data location, and who accessed the information on a regular basis. This included whether or not someone else in the organization added or edited information stored in the file, specifically as it relates to the student databases (Excel files). Each individual team member provided a preliminary list of preferences (i.e. solutions) they hoped to achieve from the transition to Smartsheet.

A gap analysis was used to evaluate the business processes for each programmatic area. This type of analysis allows businesses to determine what steps are needed to move (or transition) its business model from its current state (As-Is) to a future state (To-Be). The stages of a gap analysis involve reviewing the current process (As-Is) and identifying performance criteria (desired outcomes), comparing the current model against the To-Be model to identify and consider how to bridge any capability gaps, and finally implementing solutions (figure 4.3). To formalize the process, The Gap Model (figure 4.4), drove the assessment for each programmatic area. The Gap Model is a problem-solving tool used to identify the difference between what is occurring now and the desired outcome (Harmon, 2014).

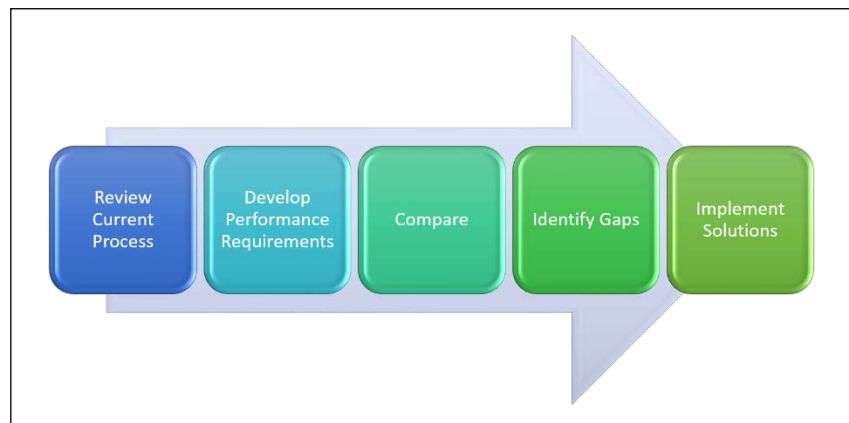


Figure 4.3. Gap Analysis Stages

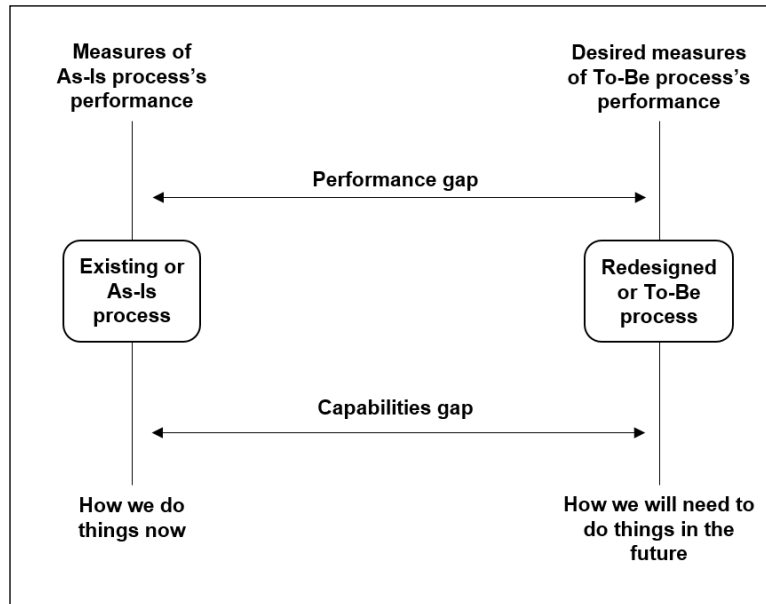


Figure 4.4. The Gap Model (Harmon, 2014)

As-Is Processes

Each programmatic area's As-Is process was mapped and reviewed by the SB management team before proceeding to the next stage. These models were revisited during subsequent meetings or as Science Bound team members identified additional steps or communication pathways that were unintentionally omitted. These models were finalized before developing the To-Be process models.

Science Bound creates and shares hard copies of their Teachers Manual with each teacher in the three community school districts. Teachers review the manual and keep it on hand as a reference guide. Templates are included in the materials, such as a teacher information form that each teacher is directed to complete when they join the program. Hardcopies of the teacher information form are collected and manually entered into an Excel database. As teachers update their contact information, they contact the Science Bound office to inform them of the changes. The Science Bound administrator manually updates the teachers' contact information in the Excel database (figure 4.5).

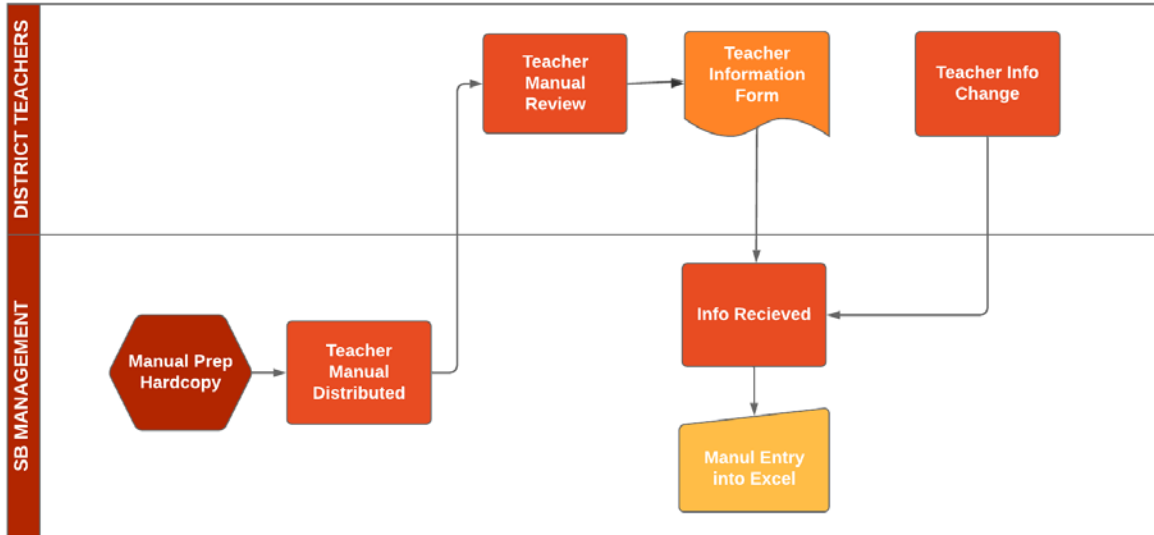


Figure 4.5. Teacher Manual As-Is Process

The second programmatic area of focus is the MS/HS Program (figure 5.6). Students enter the program at either the eighth or ninth grade level and remain with the program through college completion, as long as they continue to meet the requirements of the program each year. Teachers at each of the community school districts compile a list of Science Bound eligible students. This list is sent to Science Bound for review and manually entered into a Excel database. Students who meet the minimum requirements are issued acceptance letters. If a student accepts the invitation and terms of the program, a contract is initiated and signed between the student, the student's parents or legal guardians, and Science Bound. Once the contract is signed, the student's assessment information is entered into an Excel database specific to the student's graduation year and district. As students progress through the Science Bound program, they are required to participate in activities. Student participation is tracked and their scores are entered in a separate Excel database that is directly related to programmatic activity before being transferred to the main student database (Excel file). Artifacts, such as personal statements or presentations, are collected and stored in physical files.

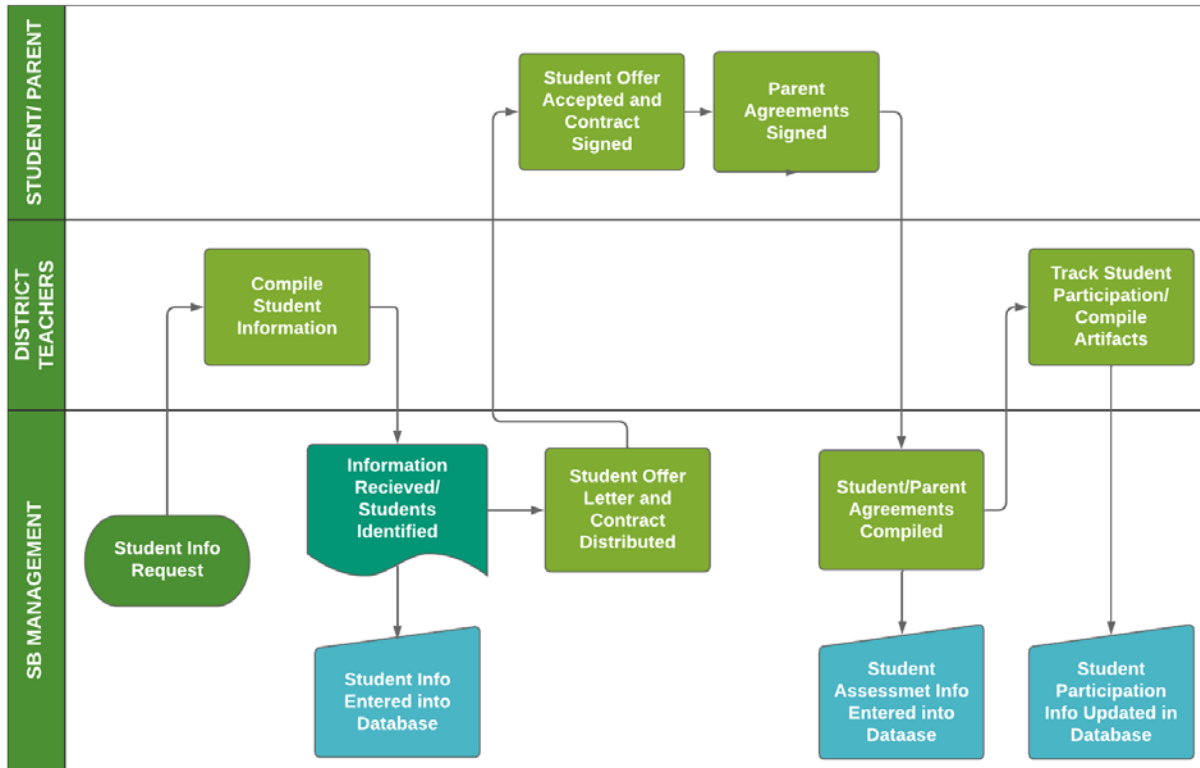


Figure 4.6. Middle School/High School Program As-Is Process

Student Experiences include multiple programmatic activities. However, for the purposes of this case study, student experiences will focus on the process for eighth grade essays and high school oral justifications (figure 4.7). The Science Bound management team visits each district to meet with and evaluate each student's performance. Students are required to submit a written personal statement and give a presentation to the Science Bound management team. Physical copies of each student's personal statement (or artifacts) is collected from the student and stored in physical files as part of the student's Science Bound record. After each presentation, Science Bound staff members meet one-one-one to evaluate the student's progress in the program. Evaluations are recorded using Qualtrics, an online survey instrument. After the event, scores are downloaded from the Qualtrics platform into an Excel file and manually entered into the main student database (Excel file).

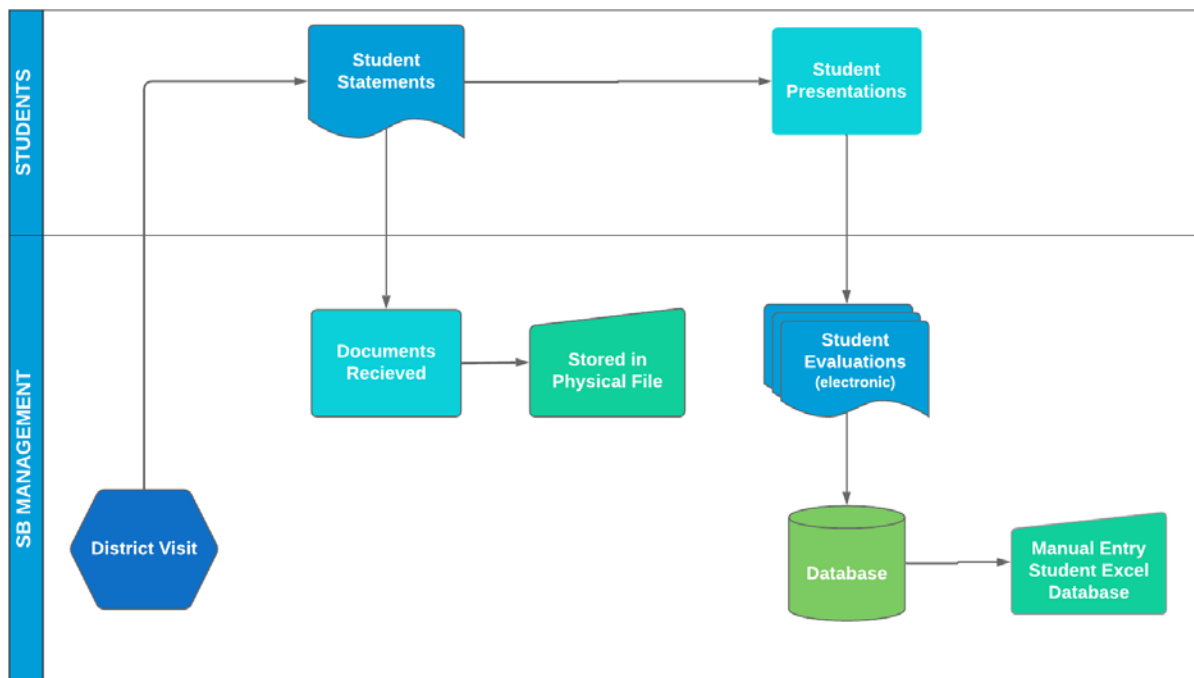


Figure 4.7. Student Experience As-Is Process

The final programmatic area is the Iowa State University (ISU) College program. Science Bound high school students who enroll at Iowa State University continue to participate in activities during their freshman year in college. When students enroll at Iowa State University they notify the SB management team of their decision. The SB management team verifies the student is enrolled at Iowa State University and has declared a STEM major. The student's Science Bound record is located in the MS/HS student database (Excel file) and manually transferred into the ISU College program student database (Excel file). ISU Science Bound students are required to track the amount of hours they spend mentoring or participating in activities. This information is collected and recorded using Qualtrics. Students are monitored to verify they are meeting the minimum program requirements. At the end of the semester, the students' hours are downloaded from Qualtrics as an Excel file and the scores are manually entered into the ISU College program student database (figure 4.8).

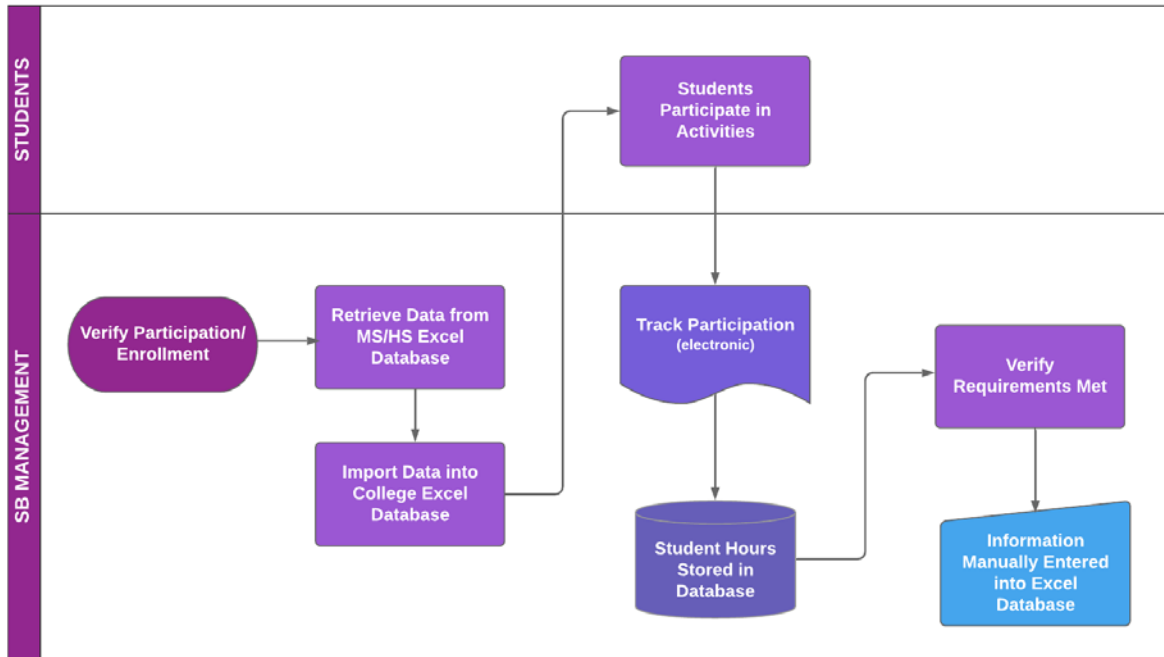


Figure 4.8. Iowa State University College Program As-Is Process

Performance Criteria

As noted earlier, this project will focus on improving business processes through the use of Smartsheet, therefore performance will be measured in terms of streamlining and/or automating their business processes. A set of performance criteria will be used to identify desired outcomes and guide the business process changes. The SB management team members communicated performance criteria through two methods: intensive interviews and user stories. Agile and Scrum methodologies utilize user stories to articulate a unit of work, expressed from the software user's perspective. The purpose of the stories are to determine an end goal or deliver value to the customer (Rehkoph, n.d.). User stories are written using the following format:

As a <user role> I want <activity> so that <business value>

For this project, user stories generated the performance criteria and recorded a list of Smartsheet features Science Bound wanted to incorporate into their workflow. Science Bound

team members were encouraged to generate and submit user stories on an ongoing basis until the development phase began. Several examples of user stories are provided in Table 4.1 and a list of performance criteria generated over the course of the project is provided in Table 4.2.

Science Bound User Stories		
User Role	Activity	Business Value
As an Administrator	I want to use forms	so that the student check-in process is more streamlined
As an Administrator	I want low GPAs flagged automatically	so that I can quickly identify students who are not meeting the minimum requirements
As an Administrator	I want the database to automatically pull in student event tracking information	so that I don't need to locate, open multiple files to obtain each students score.

Table 4.1. User Stories

Systems	Requirements	Details
All Systems	Easily accessible	<ul style="list-style-type: none"> Internal users can easily access the reporting system and database information. External users can easily access the reporting system and database information.
	Seamless Information Sharing and Editing	<ul style="list-style-type: none"> Assigning and monitoring permissions is easy to manage. Internal users can view edits to any of the databases in real-time.
	Automatic Information Linking	<ul style="list-style-type: none"> Information that appears in one database links to the same information in other databases. Information is updated in all databases simultaneously when changes or updates are performed.
	Reduced Time Expenditures	<ul style="list-style-type: none"> Time spent entering data is reduced. Time spent maintaining the databases are reduced.
	Meets security requirements	<ul style="list-style-type: none"> Meets ISU security policy for storing and maintaining student records. Verify data is secured based on ISU IT policy or requirements.
Teacher Dashboards	Provides information storage, access, and sharing	<ul style="list-style-type: none"> Stores relevant programmatic information for each of the three district's teachers.

	Tailored to district	<ul style="list-style-type: none"> Meets the needs of the specific district.
	Links and access to a database	<ul style="list-style-type: none"> Teacher contact information is stored in the database and is accessible by management team.
	Links and access to webforms for data collection	<ul style="list-style-type: none"> Provides links to electronic forms teachers will complete for data collection purposes.
Student Experiences Databases	Contains event webforms	<ul style="list-style-type: none"> Contains webforms internal users can use to collect event participant information.
	Allows for tracking participation across events	<ul style="list-style-type: none"> Columns provided for each database. Allows management team to indicate which students have participated.
Eighth Grade, High School, and ISU Programs	Meets FERPA requirements	<ul style="list-style-type: none"> Private Workspaces - Database access is restricted to the Science Bound management team and external users with permissions to access the workspace. Acknowledgment - Students acknowledge the program will be accessing their academic records for the purposes of the program.
	Contains webforms	<ul style="list-style-type: none"> Allows for collection of data directly from teachers, students, and students' parents.

Table 4.2. Performance Criteria

To-Be Process

To-Be processes were developed for the four programmatic areas. Of the four areas, the Teachers Manual To-Be process will remain an autonomous process. However, information will be collected and stored in a dedicated workspace (compilation of databases) directly affiliated with each teacher's community school district. Both the teachers (external users) and the SB management team will be able to access the database regularly and view data captured in real-time.

The To-Be process eliminates the need for a hardcopy manual. An electronic copy of the manual is stored in the workspace and on a dashboard that compiles important documents, templates, and any links the teachers need to access on a regular basis. Each teacher is provided permissions to access the Smartsheet workspace affiliated with their school district. After they

gain access to the Smartsheet platform, teachers are instructed to review the teachers manual and complete a teacher information webform. The webform collects each teacher's contact information, which is electronically recorded in the teacher information database in real-time. The SB management team receives a notification from the system when a new entry or changes have occurred in the database to allow for easier tracking and monitoring. Teachers may modify their existing contact information at any time, by accessing the teachers' manual database and updating specific information or completing another webform. Through the use of timestamps, the SB management team can monitor and/or determine when the most recent entry occurred (figure 4.9).

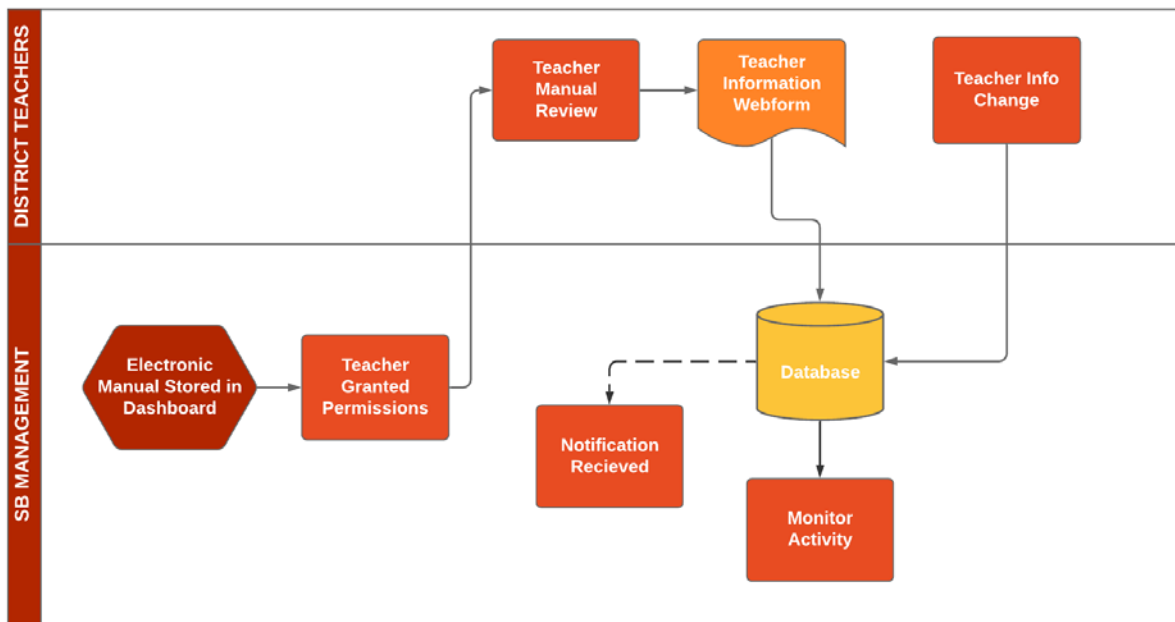


Figure 4.9. Teacher's Manual To-Be Process

The remaining three processes are combined to create an integrated process. Several steps were eliminated in both the MS/HS program and Student Experiences models. However, the ISU College Program's process remains roughly the same. The main differences between the As-Is and To-Be processes are:

- The master MS/HS Programs database is a compilation of all grades (8th-12th), rather than separate files for each grade.
- The master MS/HS Program database pulls in information from the Student Experiences database automatically, eliminating the need to manually enter the information. This reduces the time spent locating a specific Excel file and copying and pasting the data into a master Excel file.
- Webforms are used to collect student applications and to check-in students when they arrive at various student experiences events.
- Artifacts (presentation, research posters, personal statements, etc.) are collected and stored electronically. This reduces the need for physical storage space.
- Smartsheet webforms are used to collect evaluations reducing the need to use multiple software platforms (Qualtrics and Box) for programmatic activities.
- Student records located in the MS/HS Program are linked to the ISU College Program database for easier conversion of the student's record when the student transitions to the college program.

Figure 4.10 depicts how the three programmatic areas are now integrated. While the information from these programs are eventually linked (manually) in the As-Is process, the To-Be process allows this to happen automatically. Information flows more freely and is located in one central location for improved accessibility.

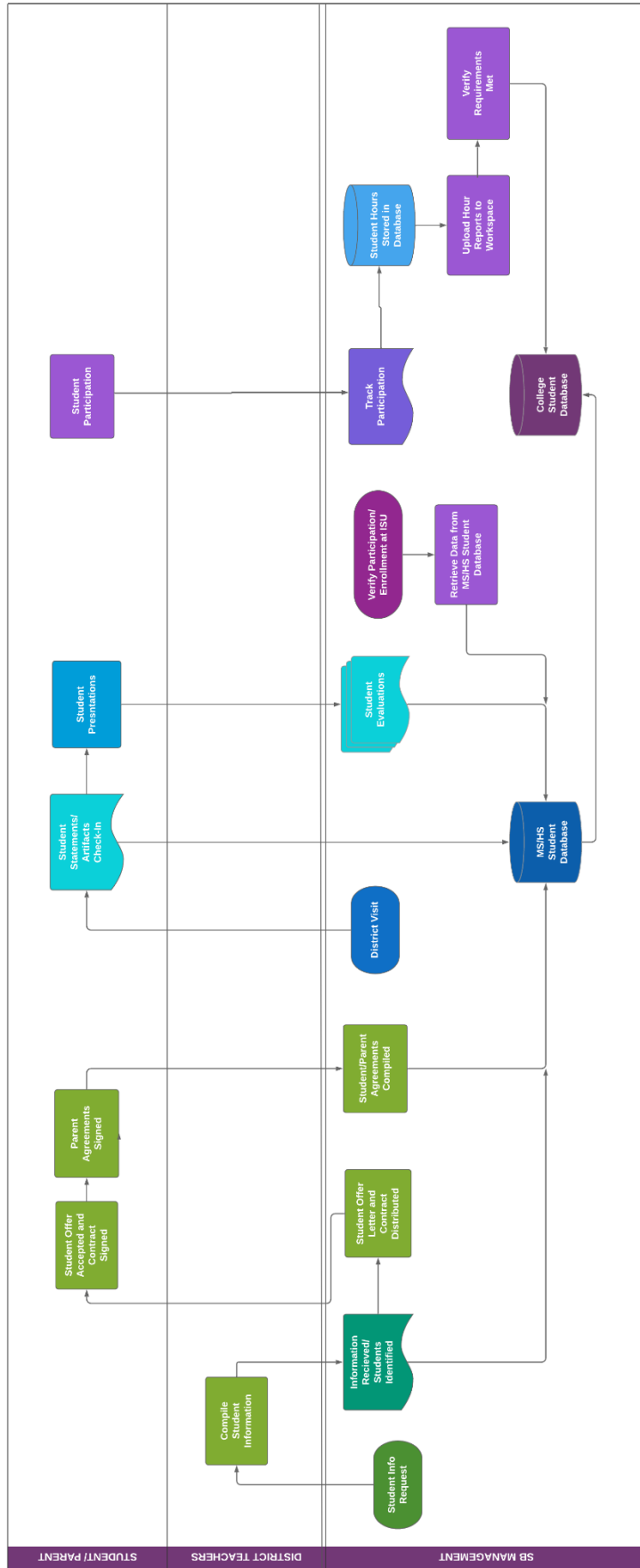


Figure 4.10. Combined To-Be Processes

Phase II: Implementation

After the SB management team reviewed and approved all of the To-Be processes, prototype development began. The SB management team played an integral part during this phase, as well. After each prototype was built, the SB management team would review the prototype, provide feedback, and once deployed, observe the prototype's functionality in a live-setting.

The Design, Build, and Demonstrate phase occurred in five separate cycles. The first cycle involved the creation of the first prototype, the Teachers Manual database and dashboard. Once the database and dashboard were completed, the prototype's functionality was presented to the SB management team. The SB team suggested updates and/or modifications to the system.

During the second cycle, two activities occurred simultaneously. The first prototype (Teachers Manual) was reviewed a second time and retested by several SB management team members (internal users). While the SB management team was testing the first prototype, the second prototype (MS/HS Program) was being built. Once both activities were completed, the project team would meet to discuss the results of the SB management team's second test of the first prototype. A demonstration of the second prototype would be introduced during the same meeting.

If approved, the first prototype would be deployed into a live setting. At this stage, external users would simultaneously use the system as intended while also testing the system for errors or other anomalies. If needed, the prototype would be updated a third time, tested again internally, then released for use by all three community school districts.

The third cycle would include a secondary test of the second prototype and the creation of the third prototype (Student Experiences). This same process continued throughout the

implementation of SB's database and reporting system. Typically, each cycle would occur over a 2 week period, or when schedules permitted.

Maintenance occurred immediately after each prototype was released into the live-setting. Minor changes were introduced at this stage, which includes updating webforms based on external user experiences at each of the community school districts. Maintenance will be a permanent activity across all databases and the reporting system.

Unique to the Waterfall/RAD methodology, integration occurs last and/or in conjunction with maintenance. This process allows each prototype to be released as it is developed. However, each prototype eventually needs to be integrated with one another for improved workflow. Student information between each of the worksheets or databases are linked to the master database. This can only occur after actual cases are collected. In other words, without actual cases, it is impossible to create the linkages needed to automate the transmission of students' scores from the Student Experiences database into the master database. Maintenance will also include ensuring linkages are working properly across all cases long-term and created for new cases.

CHAPTER 5: CONCLUSION

At the completion of the project, the databases and reporting forms for all four programmatic areas were completed, tested, and released. The hybrid method of development worked successfully in this situation in a multitude of ways. The process allowed for quick building, testing, and deployment of the databases and webforms (prototypes) when it was required. Both the developer and client could work on the project simultaneously, but separately from one another.

The performance criteria were met in all of the database and reporting systems, with one exception. A prototype webform was created for SB Saturdays, an event in which students from all three districts converge on the Iowa State University campus to participate in various workshops. It was determined that the previous method of using Qualtrics was a better fit for this event. Qualtrics has a feature called skip logic, which depending on how a person responds may skip over questions that are not pertinent to their situation. Smartsheet does not provide this feature in its platform. As such, results from the day's events will be downloaded from Qualtrics into an Excel file and electronically uploaded into the MS/HS student database. Scores will be linked to the master database.

This piecemeal deployment and integration method was intended to not impact current business operations and introduce the software application to external users quickly. External users would have time to become comfortable with using new webform or processes, before additional processes were introduced.

When necessary, the Waterfall/RAD model allowed for flexibility without significantly disrupting progress. If time could not be dedicated towards reviewing new prototypes and/or providing updates, each part of the team could pause development on their end while the other

project team could continue working on their activities. In other words, development or modifications of each prototype was not delayed until testing was complete. This was particularly useful considering both the SB management team and the developer were often side-tracked by external competing deadlines. If both groups were too busy to work on the project, the cycles would pause until time permitted. However, if only one group had to delay working on their piece, the other group could continue making progress.

It is common for a small organizations availability to ebb and tide depending on internal deadlines. Thus, having the flexibility to adapt their timeline is important, especially for projects not deemed critical compared to their everyday programmatic activities. Small team size and budget constraints play a large role their ability to take on new projects, even when it's merely writing down their processes or procedures, or creating new procedures to improve workflow and efficiency.

At the beginning of the project, substantial deliberation was given to maintaining a waterfall approach to developing, building and testing the databases and reporting forms for all four programmatic areas at once. However, the makeup of the Science Bound team and their limited availability gave way to considering a new approach and timeline for their project. Early on it was evident, that testing would be driven by programmatic deadlines. Thus, initial testing was done internally to verify databases and webforms were working properly. Secondary testing and deployment would take place at the same time. While this is a risky move, minimal risk was pre-determined and an alternative plans were already in place (revert to former process) in the event that the new process did not work in the live-setting.

Limitations

Researchers should be cautious generalizing the results of this study across all SMEs, as this study followed the experience of only one small enterprise located in an academic setting. Academic institutions usually implement higher standards on security policies, and thus many of the issues experienced by the external partners or users may not occur in other settings. In addition, the project focuses on the use of one SaaS solution, Smartsheet. Many other SaaS products exist and each comes with its own set of features. While Smartsheet may be an effective solution for the Science Bound program and research centers at Iowa State University, it may not be an effective tool for other organizations.

Not all small organizations or enterprises may find the hybrid Waterfall/RAD methodology beneficial for the development and implementation of their processes. Further research should be conducted to explore if this model can be used in other situations that concern small and medium sized enterprises or organizations. In addition, it is unknown how well the model will function with a larger development team.

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