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Teaching Case
Integrating Systems at We Build Stuff: Analysis and Design Case

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ABSTRACT

This teaching case presents a cross-team systems analysis and design case requiring integration of multiple, interdependent systems. Case deliverables are a mix of both traditional and agile methodologies. Students are introduced to methodology tools and techniques including data flow diagrams, use case diagrams, user stories, and entity-relationship diagrams as they complete the planning, analysis, and design steps for a new information system. Most Systems Analysis and Design textbooks include a stand-alone, independent system case to enhance learning for students. In the presented case, once the main steps are completed, student teams are then combined to integrate multiple interdependent systems for a company. This case emphasizes that most companies are moving toward a centralized data repository in systems development and that most systems within the company use the same data to accomplish different tasks. Teaching notes with student assignments and solutions are available through the JISE website.

Keywords: Systems analysis & design, Teaching case, System development tools & methods, System development life cycle (SDLC), Agile

1. CASE SUMMARY

The project presented in this case is built upon the idea of integrating data across multiple systems within an organization. We base it on the idea that many companies either have or are moving toward a centralized data repository. One of the challenges of big data is the integration of data from multiple sources (Cai & Zhu, 2015). There are a variety of ways organizations have integrated stand-alone systems in the past: building custom interfaces, adopting an Enterprise Resource Plan (ERP) system, or using application tools to integrate systems. A discussion case using enterprise application integration (EAI) tools to integrate systems highlights issues surrounding EAI adoption (Lam, 2007). Rather than a discussion case, this project emphasizes learning core systems analysis and design tools and techniques first. Other published Systems Analysis and Design (SA&D) teaching cases require students to work within a team to solve a system problem using SA&D tools and techniques, but teams do not typically work with other teams (cf, Miller & Dunn, 2018, Mitri, 2015, Mitri et al., 2017). Yet, industry professionals and academics would agree that most, if not all, information systems do not exist in a vacuum. A large portion of companies' systems interact with each other. In this case, teams first learn SA&D techniques and tools to plan, analyze, and design a single system. They then work in cross-level teams and use the knowledge they have acquired to integrate multiple systems for a single corporation. This project exposes students to the idea of data integration in the SA&D process. It provides a foundation on which students can build skills such as database design, data analytics, and systems analysis. The case is designed for an undergraduate Systems Analysis & Design (SA&D) course. Our students take SA&D as a 200-level class and have completed one semester of a programming language before taking SA&D. It is one of the first classes they take in the program and is a prerequisite to our database management systems course. In this case, we present a scenario for We Build Stuff (WBS). The background given to students about this fictional company is that the top managers at WBS are in need of new information systems.

At the beginning of the semester, we teach the students the main phases of the Systems Development Life Cycle (SDLC) while also explaining that many companies use other methodologies to build information systems. The SDLC is one of the earliest and most common methodologies used for system development. This traditional methodology is composed of four main phases (planning, analysis, design, and implementation) which are completed in order. Traditionally, each phase must be complete before the next phase commences (Hoffer et al., 2014). The case can be taught using any methodology. We stress that the main phases of PLANNING, ANALYSIS, DESIGN, and IMPLEMENTATION are needed regardless of methodology. While we start by focusing on the SDLC, throughout the semester students have weekly stand-up meetings within their groups to mimic daily stand-ups used in the agile methodology. While agile development uses the same four phases as described by the SDLC methodology, the emphasis in agile is to focus on the software and addressing changing requirements. In the SDLC, changes are restricted after the planning phase; in Agile, changes are encouraged at any time. In the SDLC, a working system is delivered, complete, at the conclusion of the implementation phase; in Agile, the software system is delivered continuously in partial iterations throughout the process (Dennis et al., 2015). In these weekly meetings, teams are told to answer the following three questions:

- What two things did we accomplish last week?
- What two things do we want to get done this week?
- Are there any obstacles that might keep us from meeting our goals for this week?

By having teams execute weekly stand-up meetings, we begin introducing agile techniques early in the process.

Deliverables for the project include both traditional SDLC deliverables as well as agile methodology deliverables as are defined in the Teaching Notes available from the journal. The three systems needed by WBS are a Financial Information System (FIS), an HR System (HRS), and a Production & Order Processing System (POPS), with each written so they contain approximately the same number of processes and data files. Additionally, each of the three systems also include sub-systems within them. Our Systems Analysis and Design courses typically have enough students in each section for nine teams with three to four students assigned to each team. With nine teams, each system is assigned to three teams. At the end of the semester, the nine teams are combined into three large teams, with each large team encompassing one team from each of the three subsystems to merge their work. Once this is completed, students can see how different systems for the same company utilize the same data and interact together.

2. CASE TEXT

We Build Stuff is a local company that started by simply using excel sheets to track financials, employees, and production. But, with increased growth, the company has found excel sheets will no longer suffice. Your team's task is to focus on the FIS, HRS, or POPS (as assigned by the instructor) and to plan, analyze, and design a new information system to take the place of the Excel spreadsheets.

2.1 Financial Information Systems (FIS)

WBS needs a computerized financial information system that will include purchasing, accounts payable, and accounts receivable processes. The current system of using excel spreadsheets is cumbersome and there is no way to check to see if WBS is paying the best price for raw materials from vendors, paying bills on time to vendors, or sending timely bills to customers. As part of improving efficiency at WBS, purchasing and accounting functions are to be centralized in a Financial Management department. Veronica Wright has been named the new Director of this department.

2.1.1 Automatic Reordering/Vendor Relations. Raw materials are part of the backbone of WBS. As such, vendor reps for WBS must establish and maintain relationships with the organizations who supply those raw materials. These raw materials (such as nails, screws, brackets, wood – things the company will use to make finished products) are ordered when someone notices there is not enough in inventory. While finished products are made in a just-in-time method, raw material items should be available at all times. These raw materials are all that is required to produce the finished product. When the company was small and there were fewer orders, this was not a problem. But now, with orders skyrocketing, the current system using excel spreadsheets to track raw material is not working. Not only is WBS not certain if they are purchasing raw materials at the best price, but there have been times when WBS had to delay production of orders because they ran out of certain needed raw materials.

Veronica envisions the new system as containing information on all vendors currently being used and the prices for the raw materials bought from vendors. Since it is possible no one notices that a raw material item is running low, quantities on hand may not be sufficient if WBS gets a large order. This then leads to a delay in production of a finished product. Veronica is hoping your team can come up with a way that raw material items are automatically ordered anytime the stored inventory of raw materials falls below a certain threshold. As these raw materials are used, the new production & order processing system (POPS) will update a raw material file, but the FIS will need to read this file to know when to automatically reorder items. As new supplies are delivered from vendors, the POPS will record the addition to the raw material file but bills from the vendors will come to the FIS to be recorded and paid.

2.1.2 Accounts Payable Processes. Currently, invoices from vendors are stored in a central location at WBS. Since no single person is tasked with keeping track of invoices, the department heads that ordered raw material from vendors are in charge of paying vendors. Unfortunately, no one is notifying the department heads when invoices are due. Often, an invoice sits in the centralized location and is not paid. This results in overdue charges and bad relations with vendors. At least one vendor will no longer work with WBS because of their poor track record of paying vendors on time (or at all). Veronica knows this is something that must be improved so that WBS can have excellent relationships with vendors (and hopefully, discounts). Veronica would like a new accounts payable subsystem in the FIS. Invoice information should be input when received by vendors and the system should automatically generate payments at the appropriate time so invoices are paid

on time. In addition, the system should record when each invoice was paid. Data on the date the invoice was due, the date it was paid, as well as the total amount paid should be stored in the system. Reports on Accounts Payable will allow Veronica to track whether invoices are being paid on time.

With the new FIS, it has been decided that the FIS department should handle paying employees. Veronica rightly believes that centralizing all financial aspects to her department will be a positive for the company. Currently, employees are all paid by check. But several employees have requested direct deposit of their checks into their bank account. While this is a small thing, keeping employees satisfied lowers turn-over. Thus, Veronica would like your team to investigate the possibility of including direct deposit of pay. The HR department will record hours worked by employees in a file called *emp_sched* and prepare a payroll file. The FIS is responsible for accessing the payroll file and sending salary amounts to employees either directly deposited to their bank or in the form of a check to the employee. Employees who currently receive their pay by check and would like to change to automatic deposit should have the means to do this through an online method.

2.1.3 Accounts Receivable Processes. Customers are billed when their order is shipped. Currently, the salesperson who took the order from the customer is responsible for sending the customer bill when the order has been shipped and is also responsible for recording incoming payments. But, WBS has no coherent strategy to make sure salespeople know when orders have been shipped. When the company was just starting out, salespeople were able to keep track of their orders fairly well, but with the increased popularity of the company's products, numerous errors are occurring. The lack of defined processes has led to customers not being charged at all, or receiving their bills so late, that the customer has forgotten they never paid. This has caused a lot of customer dissatisfaction, and a lot of anxiety for the sales team. Then, when payments have come in, it is up to each individual salesperson to record this, but again, WBS has no way of making sure the information goes to the right clerk.

In the new system, Veronica would like to see an efficient and accurate way of recording customer bills and payments. All accounts receivable should be streamlined through the FIS system. The FIS will not add orders to the Accounts Receivable (A/R) file, the sales team in the Production department will do this through the new POPS. However, the A/R file should be read by the FIS to generate bills to be sent to the customer. This means salespeople can focus on selling and let the computer system do the work of sending out bills.

When payments are received from customers, the FIS should check the payment against the A/R file and record the amount paid. Customers may submit a partial payment and this partial payment should be recorded with the date it is received.

2.1.4 Reports. Veronica would like the new system to generate several reports. The first is a report that lists all vendors used by the company. Veronica would like a monthly report showing accounts paid and a weekly report showing new orders that have been delivered. Finally, a report on accounts receivable should also be created. Based on other aspects of the FIS that Veronica would like, your team may find additional reports that would be helpful to her.

2.2 Human Resource System (HRS)

The Human Resource department is headed by Seth Barnhart. You will be working with him to analyze and design a system to meet the HR department goals. Seth sees the new HR system encompassing three broad areas: hiring new employees, scheduling and tracking training courses for employees, and tracking existing employees.

2.2.1 Hiring New Employees. Seth has no automated information system to assist him in hiring new employees. When the company was small, this was not a problem. But given the meteoric increase in customers and orders, the company needs several new employees.

Currently, applicants can only complete applications by paper. This has limited the number of potential employees since so many people find jobs online. Seth would like an online presence so that potential employees can complete applications online.

Seth would also like an overhaul of the current processes in hiring a new employee. Because of the current, inefficient manual system, applications have been lost and it takes too long to hire employees. Managers provide Seth with information on new positions available and he must write up a description of the job and the characteristics needed in the new hire. Currently, Seth and the manager seeking a new employee, review applications together to compare the qualifications of the available pool of applicants with the characteristics of an open job. This initial screening is very time consuming since so many people are applying for positions; many applicants don't have the minimum qualifications necessary. Given the skills needed to create the products that WBS sells, each job could have numerous minimum qualifications and/or special certifications that are required for employment. A new HRS should be able to automate some of these processes so that applicants without the needed characteristics are removed before Seth and the manager review applications.

WBS has a part-time clerk go through applications that have been rejected and are more than a year old to purge them. However, since the clerk is part-time, mistakes are often made. Sometimes applications of good candidates are erroneously purged. Other times, the clerk just doesn't do the job. Seth believes this is another piece of the hiring process that can be automated. Finally, any new employee paperwork should be available to the applicant who is ultimately hired. When hired, new employees complete multiple documents with information to be stored. Employees complete insurance, health and benefit paperwork which should all be kept on file and this data is used when calculating payroll. WBS seems to be drowning in paperwork, and they may have to rent another facility just to keep all the paperwork stored. This is not only expensive, but it is time-consuming every time they need to go there to find the paperwork if it is required for some reason. Seth would like all of this paperwork digitized and new employees should be able to access the paperwork online.

2.2.2 Scheduling and Tracking of Employee Training. Besides the usual new-employee hire paperwork, new employees also go through a series of intensive training sessions to acquaint them with the products made and the processes used to make them. Seth would like the new HRS to

track when training sessions are scheduled, track employees signing up for the classes, and record completion of the classes.

2.2.3 Scheduling of Employees' Work Schedules. When WBS was smaller, employees were able to create their own schedule, and the production manager scheduled production for the days and times he had employees working. However, today, with orders tripling, the production manager has to know who will be in and when. He has often been left with too few employees on a shift with too many orders that need to fill. This has slowed production of orders.

Seth believes his department can assist with this if they have an information system to support the scheduling. After talking to the manager of production and employees, Seth knows that employees still want a certain amount of flexibility. Seth has decided that employees will be able to sign up on their own but will now commit to a minimum 6-hour shift. Each employee must work 36 hours per week. The company is open six days a week and employees should be able to sign up for any six-hour shift – Early Morning (6am-noon), Afternoon (noon–6pm), Night (6pm-midnight), or Night Owl (midnight-6am). Employees can sign up for a maximum of two back-to-back 6-hour shifts (a 12-work day – spread over at least three days), or they can work 6-hour shifts on six different days (or any combination of working 3-6 days as long as the total is 36 hours). Employees must be able to self-schedule their shifts using these scheduling rules.

Currently, the head of Production has manually tracked the hours each employee worked, but now that the company has grown so much, this is not possible. The Production manager has forgotten to record some employees – you can imagine how angry an employee is when he/she is not paid for all the hours worked. The new HRS will track the number of hours each employee works. Seth believes this can be done by using the schedules that employees use for signing up for work. The HRS will track all hours worked by the employees. Information calculated from hours worked, salary, benefits, insurance data, and other payroll information should be stored in a file called payroll. This payroll file is then used by the Financial Information System (FIS) to pay employees.

2.2.4 Reports. Seth sees several opportunities to create reports from an automated system. He would like weekly, monthly, and annual reports on hours worked by employees. Another idea is to gather data on the interview candidates: the percent who accept positions and the percent who turn WBS down. Salary information should also be tracked and reported as should completion of training courses. Based on all the information provided, Seth is eager to hear what other reports your team will be able to create for him to make his department more efficient.

2.3 Production & Ordering Processing System (POPS)

Aaron Thomas leads the Production department. You will be working with him to design a Production & Order Processing System (POPS) to improve WBS' tracking of products created. Aaron sees two opportunities for an information system to aid the department: order creation and manufacturing.

2.3.1 Order Creation. Aaron envisions the POPS automatically tracking orders. Customer orders are to be tracked through the creation of an order file. Currently, when a salesperson makes a new sale with a customer, they enter the information into an Excel sheet. The customer's name, address, and phone number and information on what the customer ordered (e.g., product, quantity) as well as the employee responsible for the sale are all entered. A copy of this order sheet is sent to the warehouse and the order is considered 'Open.' When the order has been shipped, the warehouse sends a message to the salesperson and the order should be 'Closed.' However, now that WBS has grown, the information that an order should be 'Closed' does not always get to the right salesperson or the salesperson is too busy with other orders to mark it 'Closed.' Since billing ultimately is tied to whether an order is 'Open' or 'Closed,' it is imperative that orders are correctly marked. Aaron would like the entire order processing steps tracked through an information system. Clerks will now enter new orders for salespeople into an order file that can be read by those in the warehouse to schedule jobs to create finished products, and ultimately, to mark the order as closed.

2.3.2 Manufacturing. Production is driven by three catalysts: the order file, product inventory levels, and employee work schedules. WBS employs just-in-time recordkeeping. In other words, while they keep a supply of raw materials on hand to manufacture new products, they only build new products as an order comes in.

Customers order products offered by WBS. Currently, a salesperson creates a new order sheet in Excel as noted above and this is sent to the Warehouse. However, sometimes customers have cancelled the order, and no mechanism is in place to let the Warehouse know – or the cancellation has come in after the product was already made. In this instance, the finished product is placed in inventory. Because of this, Aaron would like a new system that will, after an order has been placed, check inventory to see if the product is already made and in inventory. He sees this inventory information being placed in a file called product.

If a new order is for a product already existing in inventory, the product should be shipped by the warehouse to the customer and the product file updated showing the product is no longer in inventory. If the ordered item is not already made, a production schedule will be created daily to indicate all items that need to be made. In the past, Aaron could figure out what was needed. But, with the increase in hired salespeople, and the increase in products ordered, a more orderly way of scheduling products to be built is needed. Aaron would like to see a production schedule automatically generated every evening based on items in the order file, items already made and in the product file, and knowing how many employees will be scheduled to work that day by reading the *emp_sched* file. On a daily basis, this production schedule should be made available to the Manufacturing Line to create new products. When production begins, raw materials are used. In the past, there was no way to track what was used, and it was hoped that someone would notice if a raw material was running low. With the new system, the manager of the Manufacturing area should be able to input into the system what raw material has been used so that the raw material file can be decreased accordingly. The FIS system will be responsible for ordering more raw materials when the inventory gets low. When an order of new raw material is delivered to the warehouse, an employee should be able to update the new POPS to indicate the increase in raw material. Finally, when production is completed, the product file should be increased. Again, Aaron would like this to be

automated. Once the product file is updated, the warehouse should be able to check the product file along with the order file to find open orders needing to be created. Those products that fulfill an open order are shipped to the customer and the Accounts Receivable file is updated for the Financial Management department. Once the products have shipped, the warehouse marks the order as 'shipped' and the product file should be updated to indicate the product is gone.

2.3.3 Reports. Aaron is excited about the prospect of automating reports from the system. He would like to track the raw materials used and the products being manufactured and sold. Also, he would like to monitor how quickly customer orders are fulfilled when there isn't enough stock in inventory and the items must be manufactured. He is excited to hear any ideas your team has for additional reports that may aid him in more efficiently running the Production side of the company.

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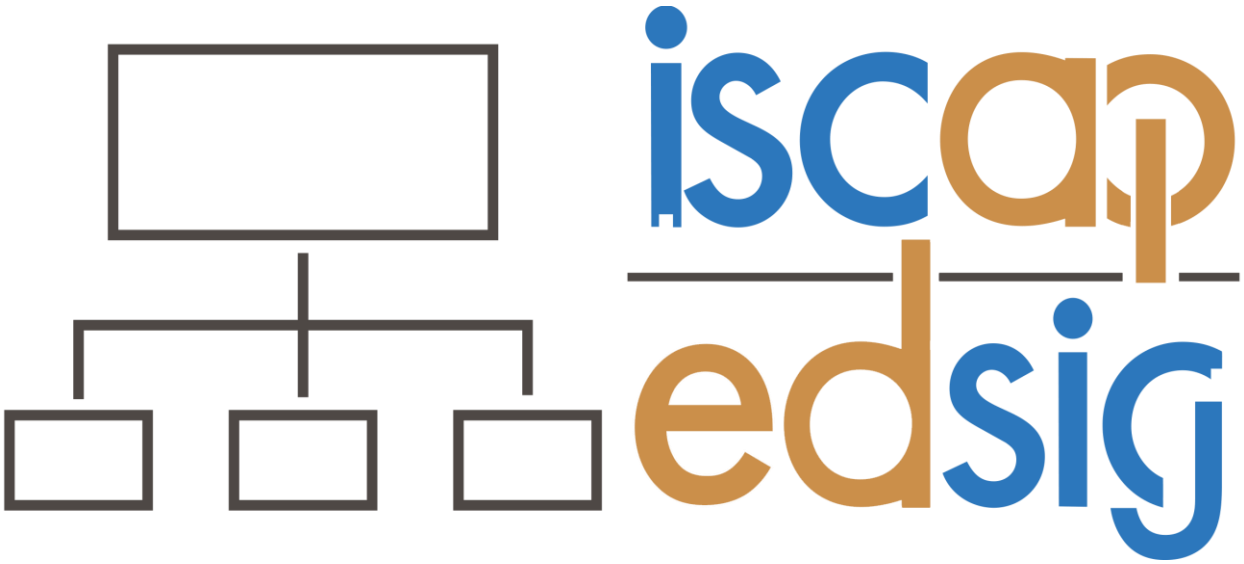

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