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Workflow Improvements and Workplace Redesign for an Office Space

Alexander Makarewich and Mason Pitts
Industrial Engineering Technology Graduates
Department of Engineering Technology
Northwestern State University, Natchitoches, LA 71497, USA

Md. Shahriar J. Hossain
Interim Department Head and Assistant Professor
Department of Engineering Technology
Northwestern State University, Natchitoches, LA 71497, USA
hossains@nsula.edu

Abstract

The purpose of this study is to determine whether using screencasts and snapshots in an instructional workflow for new learners will lower the time required for them to create a data report. Our team examined the current workflow that a regional organization uses to teach new employees and redesigned it to include screencasts and snapshots, which allow the user to see what exactly needs to be done on a screen just like theirs. After the team created a version of the workflow, they assembled a control group and an experimental group, each of seven people. The control group used the original workflow to complete a data report, while the experimental group used the new workflow. For each individual workflow was timed and found the mean time of each group. On average, the experimental group was able to complete their data report about 2.66 minutes (8.5%) earlier than the control group, and the difference in times was statistically significant. The study team was also offered the opportunity to design a new office layout for that office space. The goal was to provide the organization with a design that allowed for synchronous work. The team researched various types of facility layouts and decided to base the design on a process layout. Ergonomics and other various standards were considered while redesigning the office layout. Through the proposed design, the study team was able to create a more collaborative space, which would allow employees to communicate more easily and efficiently.

Keywords

Workflow improvement, 2-sample t-test, Office layout, Screencasts, Time study.

1. Introduction

This study is part of a yearlong capstone project conducted at a regional company headquartered in Natchitoches, Louisiana. The company specializes in aerial photography using metric cameras that work in tandem with high-precision GPS/INS to create imagery with ultra-high resolution and extremely accurate geographical data. Using its multitude of cameras and GPS systems, many services are offered to clients including 3D modeling, leak detection, LIDAR scanning, wildlife counts, underwater mapping, and disaster response. Their pilots are based nationwide, giving them the ability to launch immediately and be onsite as quickly as possible. To help the clients better understand the imagery and data, reports are created that include the portions of imagery or modeling that the client has requested along with any pertinent data regarding the images. This can include certain elevations, diameters, and estimated volumes.

The company had created a written protocol for its employees to take the imagery, dissect the data from it using certain software, and create reports for the clients. However, these workflows could be confusing and riddled with industry language, which made them tough to understand and follow for someone unfamiliar with the pertinent software. Therefore, the number of people who could create these reports was limited to the employees that were well-versed in the software and industry lingo, forcing them to take time to churn out these reports and ignore other duties. By forcing these employees to do so, the company was losing money and misusing time that could be put towards the next client or objective. Workflow systems are designed to automate the implementation of processes within a

business. They are responsible for the logistics of a project, while the workflow participant is responsible for completing the individual steps (Eder, 2009, p. 3545).

The purpose of this paper is to explore these workflows and use them to improve efficiency. To develop workflows that are better understood by a less technologically savvy group, it was needed to portray the information in steps that can be readily comprehended and carried out by any employee, regardless of their software knowledge. Screenpresso is a screen capture and video recording software for Windows and macOS that allows users to capture screenshots and record videos of their computer screen. It offers a variety of features such as full-screen capture, partial-screen capture, scrolling window capture, and annotation tools that enable users to add text, arrows, and shapes to their captures. It also includes a built-in image editor, a workspace manager, and the ability to export captures to various file formats and share them via email, social media, or cloud storage. By using Screenpresso, screen capture videos are created that walks the user through each step, even showing them where to click when necessary. By doing so, the workflows become easier for the user to comprehend, making the reports easier to create. This method gives the company the ability to have a more hands-on approach to the education of new users without the senior employees having to sacrifice as much time and effort. An example of a workflow video created in Screenpresso is shown in Figure 1.

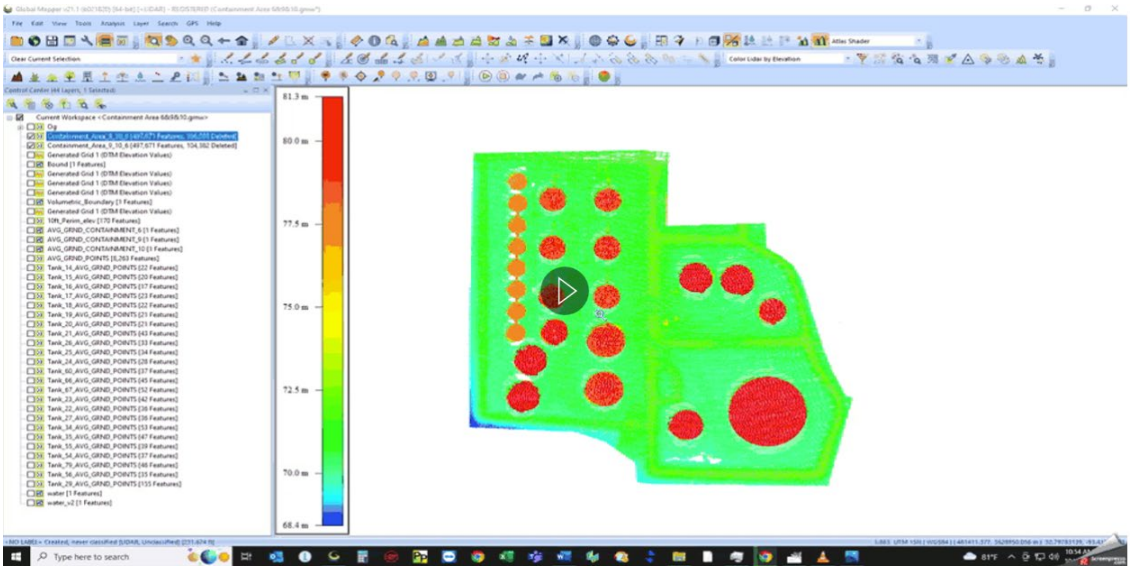

Figure 1: An example of a workflow video created in Screenpresso

As the project team worked on the workflow study, the company management requested the team to also redesign the layout of their office. They believed that the current layout made it tough for employees to work together on projects and that it cost them time and money by having to wait. Facility layout is an integration of the physical arrangement of departments, workstations, machines, equipment, materials, common areas, etc., within an existing or proposed industry (Naik & Kallurkar, 2016). Often, layouts are designed properly for the initial needs, but as a company grows, so do its requirements. It is often necessary for redesign as a company continues to grow and its workload steadily increases. In the case of this company, they now have enough employees to have multiple working on tasks simultaneously. The problem is that their office layout is currently set up for about 3-5 employees can work at once. However, the company has 12 available computers, and therefore, is not maximizing productivity because they are limiting the amount of work that they can get done at once. Hence, the study team planned to present the company with a redesign of the office that would allow their employees to work concurrently, and without waiting time.

1.1 Objectives

Regarding the workflow study, the current workflow document that the company has in place to instruct employees on how to create client reports can be confusing and tough to follow for employees that are not well-versed in software jargon. Hence, the goal of this project is to update the workflow to a more user-friendly model which will save the company both time and money, while successfully teaching new employees and users the proper way to create a data

report. Concerning the facility redesign, the current design of the office is too crammed and does not allow multiple employees to work on the same project at the same time. Hence, the goal is to provide Air Data Solutions with a design that allows for synchronous work.

To achieve these two goals mentioned above, the objectives of this project are,

i. Create a modified workflow document template that can be used to instruct any employee on the creation of client reports in a shorter timeframe. This includes using the application Screenpresso to add instructional videos to the document, allowing the user to visually follow along, step-by-step.
ii. Do a time study and statistical analysis to verify if the redesigned workflow decreases the amount of time necessary for data report creation.
iii. Research possible facility layouts and determine what type would work best for the office under the given circumstances, and then create a redesign of the office layout that utilizes the office space more efficiently.

2. Literature Review

In this section, a literature survey on *screencasting* is summarized where researchers analyze screencasts made by themselves and professionals to create a framework and checklist for instructors. The study team also looked at workflows in AiiDa, or the *Automated Interactive Infrastructure and Database for Computational Science*. This is a workflow management system that simplifies the creation and analysis of data but presents challenges with storing massive amounts of data. The second subsection summarizes some relevant literature on facility layout which refers to the arrangement of different components, such as equipment, machines, workstations, storage areas, and offices, within a manufacturing, service, or office facility. The goal of facility layout design is to maximize efficiency, minimize costs, and improve productivity by optimizing the flow of materials, people, and information through the facility.

2.1 Literature Survey on *Screencasting* and *AiiDa*

According to Sugar *et al.* (2010) screencasting is a way to present digitally recorded playback of computer screen output, and to visually demonstrate procedural information. Essentially, a screencast consists of the instructor recording their movements and mouse clicks during a procedure. It can also include accompanying audio to create a multimedia presentation that clearly explains the actions, thoughts, and supporting details of the instructor. This type of instruction is especially advantageous because it can be done anywhere if the user has access to a computer, and because the user can observe what the actual screen looks like in completing the specific operation. Through this inquiry, Sugar *et al*. (2010) hoped to find the common instructional strategies used in these screencasts, as well as how they can be best understood. The researchers dissected screencasts made by themselves, as well as ones that were professionally produced, searching for similarities and commonalities. During the analysis, the researchers came across several common components and educational strategies and were able to use them to create a framework for considering the role of screencasts as online instructional tools. Sugar *et al*. (2010) used this framework to create a checklist so that instructors have a more practical application to compare and assess their screencasts.

Although Sugar *et al.* (2010) were able to analyze screencasts from various producers, the sample size was still relatively small. Therefore, it cannot fully represent the total number of screencasts created and distributed for both the public and specific courses. Another limitation of this study was the exclusion of face-to-face screencast instruction, making it possible that certain instructional elements or strategies were missed. According to Soepriyanto *et al*. (2021), regarding screencasts, there is little empirical evidence that shows that screencasts are effective for learning programming and command interfaces. Therefore, Soepriyanto *et al*., (2021) were looking to produce empirical evidence that conveys the effectiveness of screencasts in comprehending these command interfaces. They compared the "average learning outcomes" of a group of students that used screencasts to learn and a group that learned through a conventional classroom demonstration, looking for a significant difference between the two. The researchers first created a lecture and teaching materials for the instructional phase of the study. Next, they produced a testing system with multiple-choice questions and gave them to students who had formerly taken the operating systems courses. This was to test the "validity and reliability" of the questions that the experimental groups would answer later. Then, the researchers implemented the lectures using the screencasting method in the experimental class and the conventional method in the control class. After the lecture, they gave out a post-test to both classes. The researchers took the data and processed it to find the "normality of the data distribution" and conducted a homogeneity test to determine the variance.

Workflows in AiiDa explains the use of workflows given in a combination of scientific computational methods and data analysis, showing that a workflow management system (WMS) has improved the functionality to define and develop the sequence of data. In recent years, many WMSs have been developed which have greatly simplified and streamlined the creation and analysis of data. (Uhrin *et al.*, 2021). The challenge with these, as explained in the article is storing the massive amounts of data that will be produced. Thus, needing a system such as AiiDa to store the data created by the workflows. An additional benefit of an API-based workflow language and the engine is that it allows for the definition of dynamic workflows, whose exact path is not pre-determined but evolves during execution based on the results of completed steps. With a system like AiiDa, one can use the workflow system to create a language of data, meaning that the WMSs can show and keep track of the data used in the system. Allowing the sequence of data to be easier to follow and allowing the user to understand the results of the data provided.

2.2 Literature Survey on Facility Redesign

Facility layout design is an important aspect of facility management that can have a significant impact on productivity, efficiency, and costs (Kumar, 2010). Effective facility layout design requires careful planning and consideration of the different types of layouts, as well as the factors that influence layout design. By optimizing the flow of materials, people, and information through the facility, facility layout design can result in improved quality, reduced lead times, and increased profitability. Kumar (2010) mentions that effective facility layout design can result in reduced inventory, shorter lead times, and improved quality, among other benefits. There are several types of facility layouts, including process, product, cellular, and fixed-position layouts (Muther, 2006). Process layout is used when a variety of products are produced using the same equipment and resources. In this type of layout, equipment, and workstations are grouped based on the production process they perform. Product layout, on the other hand, is used when a single product is produced in large quantities. In this type of layout, equipment, and workstations are arranged in a linear sequence to optimize the production process. Cellular layout, also known as group technology layout, is used when a family of similar products is produced. In this type of layout, equipment, and workstations are arranged in cells to facilitate the production of similar products. Fixed-position layout is used when large, bulky products, such as airplanes or ships, are produced (Muther, 2006). In this type of layout, the product remains stationary while equipment and resources are moved around it. Each type of facility layout has its advantages and disadvantages. Factors that influence facility layout design include product design, volume and variety of production, equipment and machinery, material handling, safety and environmental considerations, and worker comfort and convenience.

3. Methods

To determine whether the screencast walkthrough was a better option than the currently written walkthrough that the company had in place, the research team created a virtual walkthrough to be used in comparison with the written version. Next, a control group was created using the written walkthrough, and an experimental group was created using the visual walkthrough and timed all of them. The data was collected from each group, processed, analyzed, and interpreted. From there, the research team was able to assess whether the hypothesis, that the screencast would minimize the time it takes for new users to learn report creation, was correct.

The two-sample *t*-test is a method used to test whether the unknown population means of two groups are equal or not. The two-sample *t*-test is used when the data of two samples are statistically independent. To use the two-sample *t*-test, it is assumed that the data from both samples are normally distributed and have the same variances. The hypothesis for this study assumes that the mean time to complete a report would be equal for both groups. The alternate hypothesis assumes that the mean time taken by the control group ($\boldsymbol{\mu_1}$) would be longer than that of the experimental group ($\boldsymbol{\mu_2}$).

Null Hypothesis, $\boldsymbol{H_0: \mu_1 = \mu_2}$

Alternate Hypothesis, $\boldsymbol{H_1: \mu_1 > \mu_2}$

Test Statistics, $$\boldsymbol{t = \frac{(\bar{x}_1 - \bar{x}_2)}{s\left[\sqrt{\left(\frac{1}{n_1} - \frac{1}{n_2}\right)}\right]}} \quad \text{..... Eq. (1)}$$

where $\boldsymbol{\overline{x_1}}$ and $\boldsymbol{\overline{x_2}}$ are the sample mean time taken by the control group and experimental group, respectively. The standard deviation is calculated as, $\boldsymbol{s = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_1^2}{(n_1 + n_2 - 2)}}}$, where $\boldsymbol{n_1}$ ***and*** $\boldsymbol{n_2}$: the sample sizes of the control group and the experimental group, respectively. The *t*-statistic calculated using Eq. (1) is compared to a critical value from the t-distribution (significance level, α = 0.05). If the calculated *t*-value exceeds the critical value, then the null hypothesis of equal means is rejected, indicating that the two groups have significantly different means (Gosset, 1908).

To further understand what the company was looking for in the redesign of its office, the research team had several meetings with the managers and employees, to survey the need for space between each computer, which would allow employees to use them simultaneously. The gathered information from this survey reveals that the need for computers with similar software should be placed beside each other to better organize the space. From this survey, and the characteristics of various types of facility layouts the study team decided to base the design on a process layout. The office ergonomics and the various standards are also considered while redesigning the office layout. AutoCAD 2023 software was used to put together a design of the office along with proper placements of the computer workstations.

4. Data Collection

Because the current workflow used by the company is solely textual, it can be tough to follow and understand for someone unfamiliar with the software being used. Therefore, after creating a visual walkthrough aimed at simplifying the process, the two must be compared to determine whether the new version of the workflow is an improvement. The first step was to use the current workflow that the company has in place as a guide for the necessary information to be included in the visual walkthrough. With that, the team created a more interactive workflow that includes snapshots and screencasts of the tasks that the employee must complete for the report. Next, the team collected data similarly to how it was done in the study documented by Soepriyanto*, et al.* (2021). The current study used a control group and an experimental group, teaching the control group through a conventional lecture, and the experimental group through a screencast; each with seven people. None of the individuals included in the study have recent experience in using the software. The time taken by everyone to complete a data report was recorded using their respective workflow.

Table 1: Mean time in minutes and seconds that each group took to complete a data report.

Time to Complete Data Report			
Participant Number (Control)	Existing Workflow (minutes)	Participant Number (Experimental)	Visual Walkthrough (minutes)
C1	28.2	E1	26.8
C2	33.3	E2	28.9
C3	30.1	E3	28.0
C4	31.6	E4	29.3
C5	32.7	E5	27.6
C6	30.0	E6	30.1
C7	31.4	E7	28.2
Mean Time	**31.06**		**28.4**

The results of this study can be seen in Table 1. The mean time taken to complete the data report in the control group was 31.06 minutes, while the mean time for the experimental group was about 28.4 minutes. The visual walkthrough led to more than a half-minute reduction in the time required to complete a data report.

5. Results and Discussion

After collecting the data, a two-sample *t*-test was conducted to determine whether the difference between the mean times was statistically significant. While sample mean time for the control group and experimental group are $\overline{x_1}$ = 31.06 min and $\overline{x_2}$ = 28.4 min, respectively, the pooled standard deviation is calculated as, $s = \sqrt{\frac{[(7-1)\times 3.056]+[(7-1)\times 1.224]}{(7+7-2)}} = 1.463$. Thus the calculated t-statistics becomes, $t - \text{stat} = \frac{(31.055-28.4)}{1.463\times\sqrt{\frac{1}{7}+\frac{1}{7}}} = 3.36$.

The *t*-critical value found in the *t*-table is 1.782, with significance level, α = 0.05, and degree of freedom *df* = 7+7-3 = 12. The test statistic is higher than the *t*-critical value. Hence, the hypothesis of equal means is rejected, and in turn, concludes that the visual walkthrough has shortened the time necessary to create a data report by a significant amount.

Office ergonomic standards are a set of guidelines and regulations that aim to promote safe and healthy working conditions for employees. These standards ensure that workstations are designed and set up in a way that reduces the risk of injury or strain and promotes good posture and comfort. One of the widely recognized ergonomic standards is the ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations guideline. This standard outlines the ergonomic design requirements for computer workstations, such as the positioning of the keyboard, mouse, and

monitor, as well as the adjustability and lumbar support of the chair (ANSI/HFES 100-2007, 2007). Adhering to this standard can help prevent musculoskeletal disorders and other health problems associated with prolonged sitting and computer use. The Americans with Disabilities Act (ADA) also requires employers to make reasonable accommodations for employees with disabilities, which may include providing ergonomic equipment or adjusting workstations to meet the employees' needs (U.S. Equal Employment Opportunity Commission, 2022). By doing so, employers can ensure that employees with disabilities can perform their job duties safely and comfortably, reducing the risk of injury or strain. Adhering to ergonomic standards is critical in promoting the health and safety of employees in the workplace. By implementing ergonomic guidelines and regulations, employers can create a work environment that promotes good posture and comfort while reducing the risk of injury or strain. This, in turn, can lead to improved productivity, job satisfaction, and overall employee well-being.

The research group also proposed the office layout redesign shown in Figure 2. This layout creates a functional and efficient workspace for 12 employees who will be doing computer work in a single 100 ft. x 50 ft. room. The open workspace promotes collaboration, while the space between workstations provides privacy when needed. Mobile whiteboards or screens can be used to create temporary partitions for additional privacy or to divide the space for different projects or teams. A separate office for more privacy is also included, as well as a conference room so that employees can meet. The layout was based on a process layout because it's a layout type that arranges workstations and equipment based on the process flow. This layout groups together similar tasks and equipment, which can help increase productivity and efficiency. Additionally, it's flexible, making it an ideal choice for businesses that require frequent adjustments. Workers can move easily from one station to another, which can help reduce wasted time and unnecessary movement. The process layout can also facilitate communication and collaboration among workers, leading to better teamwork and improved job satisfaction. Finally, this process layout is cost-effective as it does not require extensive construction or remodeling of the office space. It can help optimize workflow and reduce operational costs. Overall, the process layout can be an excellent option for businesses looking for a flexible, productive, communicative, and cost-effective office layout type.

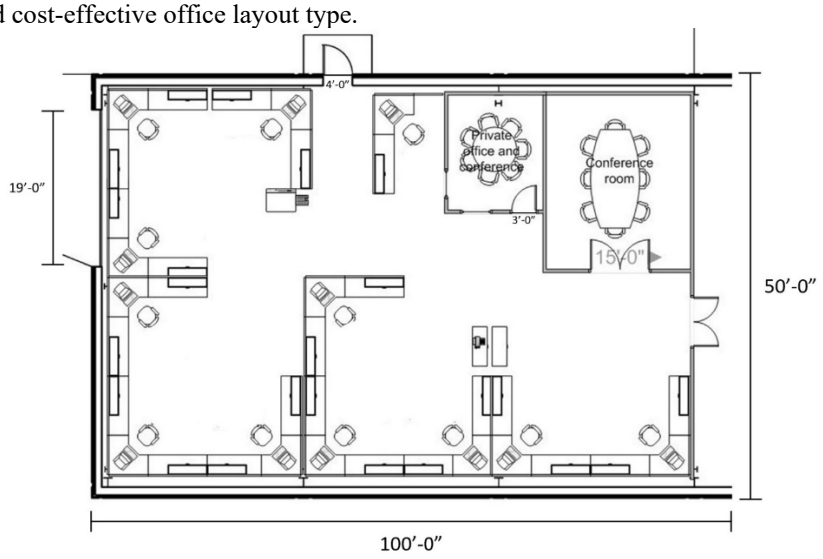

Figure 2: Proposed redesign for the workplace layout

6. Conclusion

Based on the results of the workflow study, it can be concluded that using *Screenpresso* for creating workflow will significantly shorten (8.5%) the time required to complete a data report for new learners. Thus, if this time saving is scaled on a yearly basis for the whole company the trend of time savings will translate to hundreds of thousands of dollars. The idea of an improved visual walkthrough enhances both the quality of the client reports as well as productivity within the company. Using *Screenpresso* to create visual walkthroughs for the workflow document shows the employee exactly how the image should look and where the data should be placed. This creates and displays a standardized example of how each snapshot should look, leaving nothing to interpretation. Doing so also gives employees the ability to hand off reports to each other, when necessary, which can be crucial when one person may not be able to complete their work. Another employee could simply pick up where they left off, and the client would never notice the difference because of the standardized look of each snapshot. On the other hand, the redesign of the current office layout into a process layout gives the company the ability to have their employees work congruently on

a task, eliminating the need for them to wait on each other when needing a certain computer or area. The proposed layout redesign would group computers with similar software but will also give each computer enough space so that each one can be used by an employee at the same time. The proposed design solves the company's issue of multiple computers being taken up by a single employee. We were also able to create a more collaborative space, which would allow employees to communicate more easily and more efficiently.

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Biographies

Alexander Makarewich is a student-athlete who earned his Bachelor of Science degree in Industrial Engineering Technology from Northwestern State University (NSU) in Spring 2023. For his outstanding performance in academic results, he is honored with SUMMA CUM LAUDE during the commencement. He is a proud member of the Demon Baseball team at NSU.

Mason Pitts is a recent honor graduate of Northwestern State University, earning his Bachelor of Science degree in Industrial Engineering Technology. He is an alumnus of the Kappa Sigma Fraternity, Theta Mu Chapter. As an active member, he was selected amongst his peers to serve his chapter as the Grand Scribe. Throughout his collegiate career, he has been employed with Pleasure Pools Inc. assisting with project designs. His future careers plans include pursuing a career in a manufacturing facility in design or management.

Dr. Md. Shahriar J. Hossain is currently serving as the Interim Department Head and Assistant Professor in the Department of Engineering Technology at the Northwestern State University of Louisiana. He completed my Ph.D., and M.S. in Industrial Engineering from Louisiana State University. He has more than 14 years of academic research/teaching experience including 10 years of active teaching in industrial, and manufacturing engineering. He is a FANUC certified CERT (Level I & II) instructor. He served as a camp director for NSU/LA GEARUP Programs from 2019 to 2021. His research and teaching interests are mostly in the industrial engineering area including manufacturing systems, and supply chain optimization. He published more than 30 journal and conference articles. His research works were recognized by many national and international organizations through awards including IISE, AAER and IEOM.