How Industrial Engineering Students can Learn to Write Project Reports

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Abstract:

This study explores the current issues with the way industrial engineering students are taught how to write, paying specific attention to project reports. Using online and university articles in tandem with a survey of current professionals in the field, the study develops a series of definitive steps to help better prepare students to write for a career in industry. After outlining the importance of writing as an industrial engineer, the study explains that the purpose of a project report is to convey the current state of ongoing or completed projects and analyze the findings of said projects. Then, the study describes how data was collected through two different channels: article analyses and a research survey. The study goes on to reveal that there are three specific ideas that need to be focused on which could help students learn how to write project reports: reviewing examples, planning reports, and learning how to analyze data. Providing concrete examples of how those three areas could be implemented and improved, the study finally concludes with an overarching view of how industry needs to be implemented into the classroom and further studies need to be increased in scale if there is ever going to be a resolution to the problem.

Keywords: industrial engineering, student writing, project reports, data analysis, industry

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1. Introduction

The field of industrial engineering is concerned with the optimization of complex processes, systems, or organizations by developing, improving, and implementing integrated systems of people, knowledge, and equipment (Salvendy, 2001). This definition emphasizes just how vast and wide-reaching the field of industrial engineering is, and according to the latest data, it isn't getting any smaller. The Bureau of Labor Statistics has forecasted an 8% growth rate in the labor force of industrial engineers over the next 10 years (*Industrial Engineers*, 2019). Furthermore, a 2015 study found that "the number of monthly job postings for industrial engineers is more than 7 times the amount of monthly hires," showcasing the current need for industrial engineers (Burrow, 2015). As the field continues to grow, it also continues to change. Despite these changes, the one thing that has stayed fairly consistent across the field is the way industrial engineers write.

Writing is a critical part of any engineers job. The ability to "convey ideas to clients, managers, and other engineers" is a major key in becoming a successful engineer (*How to Write an*

Industrial Engineering Report, n.d.). Often times, these ideas are communicated through project reports. Project reports address the state of ongoing or completed projects in industry and provide an analysis of what said projects have discovered. While these reports hold large amounts of significance, there is very little being done to teach students in the field how to write them. For example, to get a Bachelor of Science in Industrial Engineering and Operations Research at UC Berkeley, students only have to complete two semesters of Reading and Composition courses, neither of which have to be related to industrial engineering at all (*Industrial Engineering and Operations Research: Major Requirements*, 2019). Furthermore, project reports are not widely published for students to learn from because they contain analyses of ongoing projects that businesses and shareholders have massive stakes in. As such, companies would never release this valuable information to larger audiences, because then their competitors could gain access to said information.

These issues are leaving students woefully underprepared to do the writing that jobs in the field require them to do, and they beg the question "How can industrial engineering students learn to write project reports for a career in industry?"

2. Methodology

This study attempted to answer the question above using two approaches, and each approach aimed to evaluate a different aspect of how to write project reports.

1. Gather information from online resources provided by universities and writing services about how to write project reports.
2. Collect data from current professionals in the field detailing how they go about writing project reports.

In the first part of the study, we looked for university affiliated or professional writing help websites. Then, we searched those sites for help writing project reports specifically. Lastly, we looked for key themes and similarities across the different sites in order to locate the most prominent sections of a project report that we could analyze.

To more fully develop the ideas generated in the first portion, the study then surveyed current professional industrial engineers working in the industry sector. The purpose of the survey was to learn firsthand about how current professionals had learned to write project reports and what they found most helpful or would recommend to current students. Participants for the survey were collected using connections through the Cal Alumni Network, UC Berkeley faculty, and other professionals in the field of industrial engineering. All of these current industrial engineers were directed to a google forms survey which in and of itself had three separate parts.

- The first part asked short answer questions which gathered basic demographic information about the participant, like "What is your email, name, and current job title?"
- The next part asked multiple choice questions which investigated how familiar the participant was with writing project reports, like "How long have you been employed in the field of industrial engineering, and, on average, how often do you write project reports for your job?"
- The last section was the most important part as it asked 4 extended response questions about what project reports consist of and how they learned how to write them. This final section was where we pinpointed similarities and differences between them and where we looked for general consensus on what should be done to help teach students.

Finally, we then synthesized all of the information gathered from each of the two approaches into a few concrete ideas that could help best teach students how to write project reports.

3. Results

Throughout the first part of our study, we found four articles that contained valuable information about how to write a project report. Each of these articles contained a list of the specific sections of a project report; however, each list was different in the number of sections it listed. Nonetheless, when we looked closer, we saw that there were four main sections all four of the articles agreed upon: the executive summary, the introduction, the main body/analysis, and the conclusion. All of the other sections they listed were simply optional additions or sometimes even subsections of one of the main four.

Each article analyzed stated that the first part of a project report is the executive summary section. The main purpose of this section is to "convey the important information quickly without burdening readers with the small details" (Roseke, 2019). Essentially, it's nearly identical to an abstract of a research project, but it differs in that it is mainly for shareholders and organizations funding the project because they often don't have the time to read the whole report.

The second section, the introduction, is where the real development of the report begins. Just like any other introduction, this section needs to "provide a context for the report and outline the structure of the contents," and it also needs to communicate "the scope of the report and any particular methodologies used" (Windsor, 2016). In essence, this section is similar to any other introduction as it sets the stage for what comes next: the main body.

The main body is where an engineer needs to explain "how [they] applied techniques of Industrial Engineering and Management Science to the problem" (Hazen, 2004). The main body

is the largest portion of the report as it explains how the engineer attempted to solve the problem, what they found, and what other considerations need to be taken into account. Furthermore, the main body should include a heavy analysis of the data that was collected, an explanation of what said data means, and why it's important. All of the analysis provided in this section should set up what is going to be said in the conclusion.

The conclusion, like the introduction, is closely related to conclusions seen in other kinds of writing reports. It's the section that "communicates the report's main purpose and final recommendation" (Roseke, 2019). In addition, it can include a proposed plan of action, but doing so depends on the problem analysed in the project report.

After identifying these four sections, the survey was then used to find out more about how these sections are written and what overall strategies could be used to help tackle them. This process relied heavily on the advice from current professionals as they are the ones that have to do this type of writing on a consistent basis and, hence, they are the ones who know how to do it.

Our survey of current professionals included six participants, all of whom worked in the field of industrial engineering. What was more interesting about their jobs though were the spectrum of companies they worked for. For instance, we had industrial engineers from construction companies, to food distributors, to hospitals, indicating just how broad the field of industrial engineering is. More than that, though, all of them said they wrote project reports, and every single one of them said they had learned to write a project report on the job. Such comments reinforce the problems we stated earlier: there is an extreme lack in writing instruction being given to industrial engineering students, and they aren't being properly prepared for their jobs because of it.

The information the participants gave about the sections of a project report supported what we had seen in the articles. Practically everyone surveyed listed some form of, if not the exact sections that were outlined in the articles. As in the articles, there were minor variations in how many subsections they listed, but the main four were largely agreed upon.

What the survey really helped us learn though was what actual industrial engineers thought about writing project reports and what they would recommend current students do to learn how to write them better. Because they had all learned to write project reports on the job, one of the most common recommendations was for students to review examples of previous project reports. For instance the Manager of Quality Improvement at Nationwide Children's Hospital, Jahnavi Valleru, said the two main ways she learned to write project reports were by "practicing [writing them] and reviewing examples." This just goes to show that other than by literally sitting down

and writing practice project reports, one of the best ways to learn how to write them is by reviewing examples.

Another key area the participants elaborated upon was the need to plan the writing beforehand. Project reports can be dozens of pages long, and thus, they need to be properly planned out before they are written. For this reason, more than two-thirds of the engineers surveyed stressed outlining papers and getting feedback as they go. By doing this, students can get a sense of the overall goal of the paper and make sure their writing makes sense along the way. Also, they should get advice from others on where they need to do more explaining and where they need to shift focus.

The last area of development focused on the ability to properly analyze data. The majority of any project report is the main body section, which is also literally referred to as the analysis section. It is for this reason explaining data is so important. If students can't clearly explain what their data means or support their conclusion with sufficient evidence, the rest of the project report won't make sense. Four out of the six engineers recommended getting practice talking about and learning how to effectively explain an analysis of collected data to others. The Senior Director of Engineered Standard at Tyson Poultry, Dan Gish, said that "knowing the data is key" because "if you know your data well, then communicating what it means and how to improve becomes easier and less subjective," and that's ultimately what writing project reports are all about.

The remainder of our discussion will now focus on these three suggestions and how they could be implemented by universities and put into practice by students.

4. Discussion

The first piece of advice our study revealed was the idea of exposing students to example project reports. The benefits of reviewing examples are quite obvious: students get to see what a report looks like, it gives them a model of what to do, and they can notice patterns that can help them craft their own project reports. Nonetheless, we've already discussed the idea that project reports aren't widely published. Even when distributing our study, some participants had to get the study approved by an intelligence officer at their company just to make sure they wouldn't be compromising any critical information. So, how exactly are students expected to find these examples when they don't have a job that gives them access to such reports?

One way we found is that professionals in industry could come in to classes and discuss the breakdown of some example reports that are now common knowledge and no longer need to be kept secret. These professionals could then point out key places where the report follows the

standard conventions, places where the report differs from the standard conventions, and why it does so.

Another way students could gain access to examples is by having professionals write about simulated projects. These fictional project reports would still have the same format and content guidelines as the real thing, but they could be published online or in textbooks, and, despite being fake, would still help students see what details are crucial enough to be included in an executive summary, how much data analysis constitutes sufficient explanation, or how broad/specific to make their conclusion.

The second idea we saw was that the planning of a report can sometimes be more instrumental than the actual writing of the report itself. Virtually every engineer surveyed recommended outlining the report beforehand, and what's better is that outlines can be readily built into the writing process. For example, professors can simply require students to submit outlines along with their final papers, forcing students to write an outline while giving instructors critical insight into a student's thought process. Also, professors could assign only an outline rather than a shorter essay; doing so might discourage students from rushing through the writing process after procrastinating on their paper and allow them to focus on the outline itself. Consequently, by being able to see a student's outline, professors and coworkers could provide more valuable feedback on where the thought process is lacking, rather than just commenting on gaps in grammar or cohesion.

Our last focus is on the analysis of data. As arguably the most important tool in an industrial engineers writing kit, being able to analyze data is a benchmark ability that all students need to have. Developing this ability takes quite a bit of time and effort, but it is already focused on in some other classes. For instance, students already write lab reports and analysis sections in many of their pure science classes, but they need to do more. This type of writing needs to be implemented into statistics and data science classes as well. Students may be able to see and understand what their data means, but this doesn't mean they can effectively communicate it to others. Simply by adding these kinds of writing assignments to math and statistics classes, professors can help students practice explaining their data before they're put in the high stakes situation of explaining it to their shareholders and company executives.

5. Conclusions

Having outlined three straight-forward ideas that can be implemented to help students in industrial engineering learn how to write project reports, we now elaborate on the two larger processes that must happen if we are really going to transform the way industrial engineering students are taught how to write project reports.

1. Implement industry writing into the classroom
2. Increase the scale of future studies

For the first process, we know that bringing industry-style writing into the classroom will help prepare students for the challenges they will have to face on a day-to-day basis. We've already discussed some of the ways students could be exposed to exemplar project reports and could get legitimate practice writing the individual parts of a project report, but there needs to be a bigger shift in how industrial engineering departments teach their students how to write as well. Colleges already teach students the most up-to-date, industry-related techniques and the newest technological advancements in the field, so why aren't they teaching them about the newest writing techniques in the field as well? Until these universities and departments realize the importance of learning field specific writing as an undergraduate, none of the suggestions we mentioned earlier will be able to make a significant impact.

Next, we believe that bigger research organizations can and should study more than just project reports. By increasing the size of surveys to hundreds of professionals and by analyzing dozens of articles, these studies could generate much more comprehensive overviews of writing in the field as a whole. They could also study some of the suggestions that have been made and see how much of an impact they truly have. With proper amounts of time and funding, these studies could create resources that fundamentally change the way writing is taught in industrial engineering.

Now even though a fundamental change in how writing is taught seems idealistic, in his article about the current student writing crisis, Robert Zaretsky exclaims that funding "a bold plan, whose one goal would be to teach America's youth how to write -- and, thus, how to think -- seems more critical than ever" (Zaretsky, 2019). Yes, it would take a large investment to help fund these future studies, and yes, it would take a large investment to actually develop these resources and programs; however, these new studies and changes are needed, and there's only so much a non-funded, one month, single-student study such as this can do. Despite its limitations, we are confident that this project can make a real impact in helping students in the field of industrial engineering learn how to write project reports. So just imagine, if the necessary resources were applied to this problem, where we could go.

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