AC 2012-3752: USE OF A COMPREHENSIVE SIMULATION IN TECHNICAL MANAGEMENT COURSES

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Use of a Comprehensive Simulation in Technical Management Courses

Abstract

An old adage says that you have not really learned something until you can "do it." In many fields this finds its expression in internships, on-the-job experience, and apprenticeships. For many adult learners these sorts of supplemental learning experiences are not available when they take graduate programs to advance their professional development. Immersing the students in a simulated management environment for the duration of a class can approximate this on-the-job learning experience. This simulation paradigm has been employed in the Technical Management introductory courses at The Johns Hopkins University – Engineering for Professionals for more than a decade. Recently, this concept has been introduced into a higher-level Communications in Technical Organizations course in the program. This paper will describe the specific components of the simulation, including some details about the fictitious company used in the simulation and the way that the student experiences something very close to the "real" world in the online course experience by completing writing, presentation, and other communication assignments at several levels of responsibility within the company.

Introduction

The challenge for a graduate program in technical management is how to most effectively help students learn to be successful managers. This task includes both helping the students learn a body of knowledge that will be helpful to them for many years but also helping them acquire skills to actually do management. In many such degree programs the learning of the body of knowledge is facilitated by having the students engage in activities like reading books , listening to lectures, watching videos, reading and discussing case studies, and even writing reflective essays in order to integrate all that knowledge with their personal experiences.

But we have all heard the old adage that a person doesn't really learn something until they can do it, in this case "do management". There is another old saying that is attributed to Archimedes and goes like this "I hear and I forget; I see and I remember; I do and I understand." [1]That practicing aspect of learning is very important in all of the professional programs like medicine or nursing. It is also practiced in engineering when new bachelor grads go to work and find themselves in intern programs with one or more mentors to acquire important knowledge and skills in the companies for which they are working. In a graduate program in technical management, an important way that we as educators can give our students a jump start in this "do it" area is to immerse them in a simulation that extends for the duration of the course in which they are the learner or apprentice and the instructors are the mentors.

In our Master of Science in Technical Management program, we use a small fictitious engineering company called Autonomous Vehicles, Inc. (AVI), which has about 300 employees involved in both development and manufacturing. The engineering development part of the company is arranged in a matrix for management. Simplistically put, in a matrix system, the functional managers are in charge of the people who do the work and the program managers are responsible for the deliverable work and funding.

In our classes, we use scenarios to depict the types of management situations that the students will encounter in the real world and ask them to describe what they would do to move forward in those situations and what their rationale is for their actions. This simulation now spans three courses in the program: two introductory courses and one higher-level course. When this simulation spans multiple courses, the students are better able to focus on the management problems that are posed to them because they are familiar with the structure of the simulation.

We encourage the students to immerse themselves as deeply as they can in the simulation so the experiences become as real as possible. We provide names for all of the people with whom they interact in the simulation. In the case of their direct reports, we allow them to select the first names to make it even more personal. We choose last names to provide an indication of diversity in the work place. We try our best to encourage them to think the way they would in a role-playing game or like their avatar might interact with others in Second Life.

In this simulation the student is a manager, in some cases a new manager, and the instructors are the mentors. This requires a great deal of interaction between the students and the instructors in the grading of the scenarios and during the office hours we have with the online classes or discussions in the classroom, in the face-to-face classes.

These scenario situations in the simulation allow the students to make mistakes in a safe environment and learn important lessons before they enter the real management world in which making mistakes that could have been avoided have greater consequences. It is expected that when real-world situations arise, former students will recognize them, understand the mechanisms, and know how to act.

The top-level organization chart for the simulated company is provided in Figure 1. The engineering functional groups are shown on the left. In the third column is the program office that forms the other axis of the matrix. The administrative and financial support functions are in the second column and on the right are the operations groups in which manufacturing activities take place and fabrication and testing support are provided for the engineering development effort. The detailed description of the company, including more structural and personnel detail as well as more detail about the work being done, is included in additional documentation.

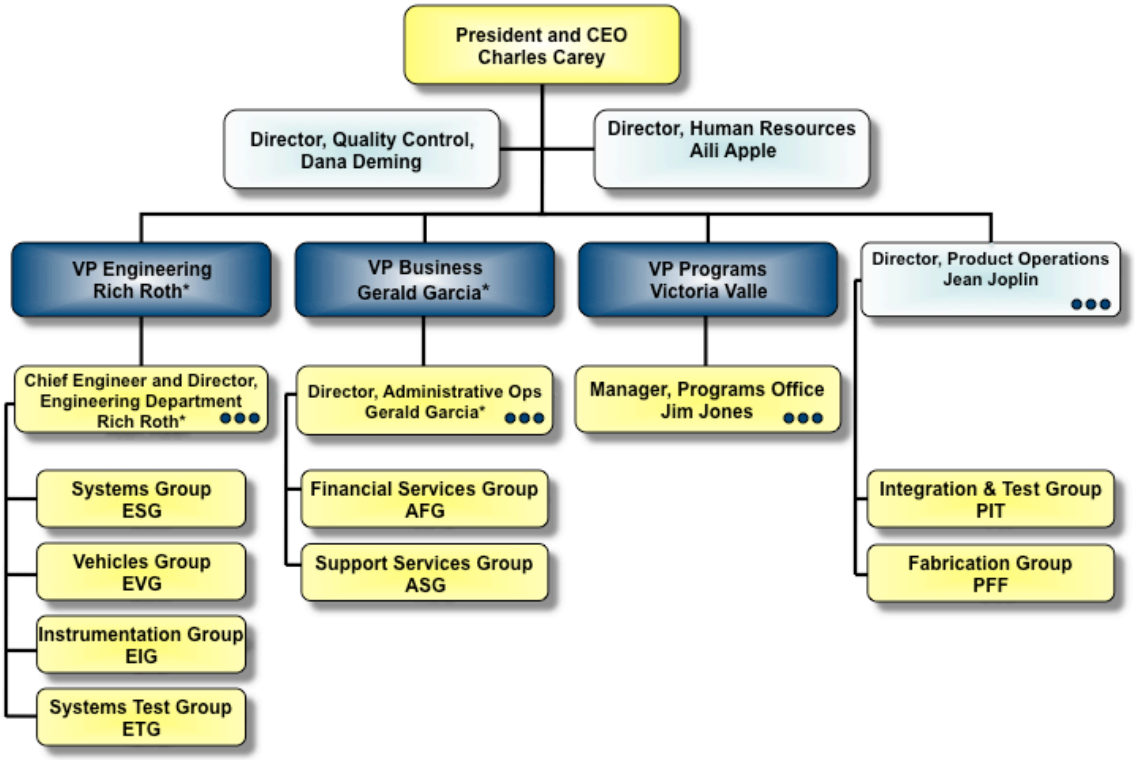

Figure 1. Top-level Autonomous Vehicles, Inc. Organization Chart

Application of Simulation Approach

Within the Master of Science in Technical Management, there are five concentrations that require one or more of the courses that use the simulation approach: Organizational Management, Project Management, Project/Organization Management, Technical Innovation Management, and Quality Management. The simulation approach courses are also electives for the Master of Science in Systems Engineering.

Project Management

The first course in which the student encounters this simulation is entitled Introduction to Project Management. In this course, the students learn about planning, organizing, and monitoring a project. The scenarios involve the sequences of activities involved in bringing a new project into AVI. Each student takes on the role of the manager of this new project and learns about all the activities and interactions with others in the company at each stage of the project from beginning to end. Not only does the student interact with the engineering groups to staff the project, but they also interact with the financial, administrative, and operations groups needed to execute a successful project.

The project is very specific and involves significant documentation of the background, requirements, and technical specifications that emerge during the proposal stage and then the finalization of the contract prior to the beginning of the work.

A sample simulation assignment for project management is provided in Figure 2.

Learning Objectives

- Identify the objective of the presentation.
- Analyze the audience and determine its information needs.
- Plan a presentation that contains all the necessary information for the audience to make a favorable decision.

Group Assignment #1

Each team will prepare a 45 - 50 minute presentation to communicate the Pinpointer Unmanned Aerial Vehicle (UAV) project plan, the project operating processes, and understanding of the customer's need and objectives for this procurement, and how the project will satisfy the customer's needs. Each team should select two of its members to deliver the briefing. All team members shall contribute to the development of the presentation and participate in answering questions from the audience. Each team shall provide copy of their presentation to the faculty prior to the presentation.

A presentation is most effective when it is targeted to a specific audience. Each team will tailor their presentation to a specific audience from the following array:

Group #1:	Top Management
Group #2:	Customer
Group #3:	Project Team
Group #4	Functional Management

Remember that you must first introduce the project and the project objectives to the audience. Be creative, but appropriate for the given audience.

Figure 2. Sample Project Management Simulation

Technical Group Supervision

The second course the students typically take is entitled Technical Group Management. This course views the issues in technical management from the perspective of a first-time functional group supervisor. The simulation begins with the students transitioning from a role as technical contributor to that of the new supervisor of an existing technical group. The scenarios involve that transition while they learn about the responsibilities of being a group supervisor and learn about all the interactions a supervisor has with his or her group and the rest of the company. Then the scenarios turn to the support of a new project by the group. This project is the same one they learned about from the project management side of the matrix. Then there are two scenarios that involve common special circumstances, one involves a conflict between staff members and the other the emergence of an unexpected technical problem that morphs into a management problem.

With the combination of these two classes the students learn about life on both sides of the matrix. They gain a deeper appreciation of the issues faced by both sides as revealed in the

simulation, which proves very valuable later in the workplace. Students often comment on the benefits of the simulation. For many of our less-experienced students, this simulation experience has proven very valuable, not just for its problem-solving experience but also for its insight into areas of business they might not yet have encountered.

A sample simulation assignment for technical group management is provided in Figure 3.

Learning Objective

- Prepare a plan for your activities during the first six months as the supervisor of EIG.

Scenario

You are now in your new position. You've spent the last two weeks getting out of your old job, and have been successful at that. You've talked to Bob Sparks, Rich Roth, your group management team, and your office administrators. You are now showing up in Bob Sparks' old office. This scenario actually started at the beginning of this module and you have hopefully done some writing on it.

Assignment

1. After taking charge of EIG [AVI Instrumentation Group], what would be your immediate (first month) goals and actions and the rationale behind them? What problems do you expect to encounter? What meetings do you plan to have, with whom do you plan to meet, and for what purposes? Which of these meetings do you intend to be recurring meetings and what will be the frequency of each?

2. What do you think your principal objectives should be during the next six months as supervisor of the Instrumentation Group?

3. Irrespective of this scenario, in what areas would you personally expect to have the most difficulty or problems in making the transition from your present job to that of a supervisor or manager, and how would you deal with them? (Note: If you are already a supervisor, discuss your personal experience in making the transition.)

Figure 3. Sample Technical Group Management Simulation

Communications in Technical Organizational

The third course in which this same simulation setting is used is entitled Communications in Technical Organizations. In this course, the students take on several roles during the course of the semester. They are sometimes program or project managers, sometimes engineering group supervisors, sometimes managers of support groups, sometimes department heads and sometimes the president of the company. The common thread is the communication problems inherent at all levels of an organization.

In each role, they are asked to produce actual communications like they would in the real world. They do some team projects like preparing requests for proposals (RFPs) and proposals. They write memos, white papers, and emails in various roles and in various scenarios. They also make individual presentations in their roles. Special emphasis is placed on the importance of graphics as a communication medium.

Especially in a communications course, the writing and presentation assignments can take on a surreal aspect and often seem like academic exercises that are less than realistic. This simulation environment is a perfect setting to provide the reality aspect for the assignments.

A sample simulation assignment for technical organizational communications is provided in Figure 4.

Learning Objectives

- Analyze a communication context, including the audience characteristics, the message, and the desired outcome, to determine what additional information is needed by the audience.
- Develop an optimal communications methodology based on the previous analysis.
- Design and present the communication.

Assignment

As an AVI group supervisor (you pick the group) prepare a five-minute presentation to pitch a new project to upper-level management and record an Adobe Connect video to post. You will be given your own private Adobe Connect room for this assignment. Videos demonstrating how to use Adobe Connect are provided.

Figure 4. Sample Technical Organizational Communications Simulation

Lessons Learned

Over the course of teaching these courses, we have learned some lessons that we think are worth sharing.

The use of the same simulation setting in multiple courses has definitely improved the continuity of the students' learning experience. It allows effective building on the experience in the previous course and reduces the time it takes to learn the environment while taking the second and third course.

We learned that it is important to provide enough background about the company and the circumstances that precede each scenario to ensure that the problem is sufficiently bounded so the students actually can achieve the learning objectives associated with the scenario. This is achieved while also having enough creative latitude so the students have the opportunity to explore various options for resolving the scenario problem.

This simulation adventure does require much more interaction between the student and the instructor than simple lectures and canned assignment questions. Be prepared to spend a fair bit of time helping and mentoring the students. But these simulations also provide an excellent way to present the students with technical, organizational and management challenges that allow for the application of the theory they learn in the readings, videos, and lectures.

Results

The results we have observed have been very gratifying. Often students comments in the class opinion survey (conducted by our institution after each class at the end of the semester) that they really appreciate the simulation aspect if the class. We are convinced that this is a very effective

way to relate the "book learning" to application in the workplace. Many students tell us that they are able to integrate their past experiences with what they are learning in the class as they respond to the scenarios we pose for them. The mistakes they make in the simulation provide valuable lessons learned that they can take to the work place. Many students have said that they have applied what they learn in the scenarios to their work that very week. And long after they have finished their course of study, we hear from students who have actively used the lessons from the simulations in their careers.

Conclusion

We both think that using this simulation environment, coupled with the more traditional aspects of our courses, is the most effective thing we do to provide the students with a great learning environment. We recommended that you consider using it in your courses if you don't already do so.

[1] http://www.bbc.co.uk/history/ancient/romans/tech_01.shtml