Project #3

Operation: Confidence

System Requirements and Design-Informing Models

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Requirements and Modeling Phase Overview

After the initial contextual inquiry and analysis phase, our team began formalizing system requirements and narrowing the project concept scope. We focused our attention to specific user needs and constructed 8 design-informing models. These draft models enabled us to explore and think critically about possible user interactions and functional system requirements. We anticipate these initial requirements and models will evolve as we move closer to a prototype design for *"Operation: Confidence."*

Project Concept Statement

Excerpt: "Operation: Confidence" will serve as a repository for annotated, self-created and self-selected resources. Using these resources, it will offer a collaborative space for connecting residents, experts, and instructors. This system will connect to the cloud and to INOVA's intranet and has a push function for updating resources. We envision surgical residents improving their understanding of surgical procedures, increasing their passing rate on their exams and, thus, their confidence level in the operating room.

Refining Our Focus

During this phase, our team clearly identified specific needs of our various system users (ASTEC Staff and Residents). In addition, we deepened our understanding of how our users interact with each other and with the physical ASTEC environment. Moving forward, refining our focus now requires a critical prioritization and alignment of user needs with potential instructional strategies and solutions. The next section describes our initial work to document user and system requirements.

Interaction Design System Requirements

These draft requirements statements (refer to Table 1) are based off of work activity notes (WAN) from the work activity affinity diagram (WAAD) generated during the contextual analysis phase. We aligned each system requirement to an expressed need documented in our WADD. The WAAD traceability coding is as follows: First Letter(s) of Main Bin. First Letter(s) of Category within Bin. Note Number (ex. 1.EN.2). Some of our data was gathered post-WAAD. The traceability coding for those until we can incorporate them into the WAAD are as follows: Interviewee Initials. Interviewer Initials. Question or Paragraph Number (ex. KI.CB.9).

The next section begins the description of our various design-informing models; starting with the **User Model.**

Table 1: System Requirement Statements

Statement #	Traceability (WAAD Code)	User Requirement (Expressed Need)	Interaction Requirements (UX)	Functional System Requirements (Rationale & Technical Logic)
1	I.EN.2	Instructors indicate residents are unprepared for labs.	**Student Study Aids** Users (residents) have access to multiple types of study aid tools such as a note-taker, video/audio recorder, voice-to-text dictation, E-reader, and instructor notes.	System contains a tool for mobile note taking that includes typing, video/audio recording, voice-to-text dictation, and file annotation. Note-taking files can be organized by parameters such as date, time, course, importance, and read/unread. Files can be shared electronically. System contains an "E-Reading" view integrated with the file annotation feature. System is able to receive and organize instructor notes into the student study aid tools.
2	I.EN.3	Instructors are unable to provide preparatory course materials to residents electronically prior to course attendance.	**Information Dissemination** Users (instructors) can send course files electronically to residents.	System contains a searchable database of course material files. System allows for upload, download, and modification of files in real-time. System has multiple options for information dissemination including email and assignment of specific documents to individual resident online profiles.
3	T.EN.2	ASTEC does not have a learning management system to support their education and training program.	**Learning Management System (LMS)** Users (all) have access to electronic information that is searchable and easily retrieved and reviewed.	System allows users to store, retrieve, and modify information in a categorized and intuitive fashion. System allows users to create personal profiles and customized dashboards. System includes features to assign materials, track completion, and assess student performance.
4	C.EN.2	ASTEC lacks in-depth feedback from residents.	**Instructor & Resident Communication** Users (all) are able to send text messages, emails, voicemails, and complete feedback forms.	System allows users to send text messages, emails, audio files, and complete feedback forms. System assigns/categorizes feedback based on event, instructor, administration, and student.
5	C.EN.3	Improved surgical team communications are need in the operating room.	**On-the-Job Skills** Users (all) can create virtual surgical operation rooms and invite other team members to join. Users then engage in debrief, knowledge sharing, and dialogue.	System includes a virtual collaborative space. System allows users to create private workspaces and send invitations for collaborative meetings. System enables users to have access to all LMS files, Student Study Aid files, and videos of training sessions.

Statement #	Traceability (WAAD Code)	User Requirement (Expressed Need)	Interaction Requirements (UX)	Functional System Requirements (Rationale & Technical Logic)
6	I.S.6	To be board certified residents must pass several exams including a technical exam based on Fundamentals of Laparoscopic Surgery (FLS) curriculum.	**Board Certification** Using their virtual player profiles, users (residents) can play educational games and take quizzes.	System allows users to create virtual player profiles. These profiles contain data on game play such as games played, scores, and hours of play. System includes dashboard that shows all games, top scores, and game feedback forum.
7	A.EN.4	ASTEC does not have a standardized assessment of resident education, training, and performance in either residency programs.	**On-the-Job Skills** Users (residents) can access multiple mobile-specific assessment forms.	System contains multiple mobile-friendly forms where users can enter feedback. System contains links to more comprehensive ASTEC assessment tools design for non-mobile applications.
8	O.EN.5	Ensure ASTEC meets performance goals for resident training, patient safety, productivity, and time efficiency.	**ASTEC Performance** Users can navigate through clearly distinct paths of the mobile application	System provides clearly distinct paths for the user to navigate. Each path is designed to show a clear connection to user actions and overall ASTEC Performance. For example, the *Resident Training Path* allows users to navigate through ASTEC performance goals, resident expectations, LMS courses, and Board Certification games/quizzes.
9	E.EN.1	Residents are unfamiliar with the physical location of needed resources in the training simulation room.	**On-the-Job Skills** Users are able to view virtual operation room layouts and interact with in-room resources.	System contains virtual rooms based on ASTEC physical layout. System allows admin users to organize and customize the rooms by changing physical layout of resources and equipment. Users (residents) are able to select resources and read more about them.

User Model

User models define users, including any salient information related to the work roles identified though the contextual analysis. A work role would be considered a work activity or a work "hat" that an individual wears in their daily work lives. One person may don several hats in their daily work life. For example, the director of education can teach, but is also responsible for maintaining administrative duties such as scheduling sessions and ordering supplies. When we initially began the design process, we identified individuals to observe and interview in their normal work habits in ASTEC to gather data on work activities and necessary experiences. This data will inform the kind of roles and characteristics we will consider when designing for a typical user.

The main work roles identified are teaching, learning, and evaluating (refer to Table 2). Within each of these work roles, we identified user classes. A user class is a description of the typical characteristics of the user population who take on a particular work role. A user class is not necessarily a specific person in the current system but rather characteristics of a user population. Within the teaching work role are the user classes of ***Education Director, Chief, Attending Surgeon, Operations Manager, and Simulation Technologist.*** Within the learning work role are the user classes of ***Chief and Post-Graduate Year (PGY) 1 Resident through (PGY) 4 Resident***. Within the assessment work role are the user classes of ***Education Director, Resident, and Attending Surgeon.*** We identified that another possible role could be administration, doing the behind-the-scenes work to keep ASTEC running smoothly. We chose not to include this possible work role within the table because we found that there was redundancy with the other work roles, identifying these tasks within the broader work roles. As we continue to develop our design and work on our Work Activity Affinity Diagram (WAAD), we are open to the fact that other work roles may become clearer and we can add to the models.

We also discussed individuals and entities beyond ASTEC that would influence the work roles but do not directly interact with the users. One of these entities would be the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), the organization that developed the Fundamentals of Laparoscopic Surgery (FLS) exam. What is on the exam guides ASTEC decisions, but SAGES does not make these decisions for ASTEC.

Through developing this model, we identified that the requirements for some of these roles could be identified as a barrier. For instance, chiefs are responsible for their own learning and preparation for their board exams. They also perform another role as an instructor and go-between with ASTEC faculty and residents. This could be a barrier because they will not have as much time to learn when they also have to teach. However, this can be leveraged in their favor and help them with evaluation and learning by using teaching as a form of articulating their knowledge.

Table 2: Work Roles and User Classes

Work Role	User Classes and Characteristics
Teaching	**Education Director** • *Background*: is responsible for developing and maintaining learning opportunities for residents and INOVA staff teams (I.EN.3) • *Experience*: extensive medical training (ex. board certified surgeon) and extensive experience in training and residency programs • *Skills*: curriculum development, assessment, Microsoft Office, research (I.EN.3), board certified **Chief** (O.P/R.2) • *Background*: is responsible for delivering and developing laboratory and lecture training for residents as directed by the attending; coordinates resident participation; distributes materials to residents (I.C.2)

	• *Experience*: completed medical school and in final year of residency, little experience in teaching • *Skills*: Microsoft office (I.D.1), research (I-EN-3), organization, communication (A.F.3; I.LE.1 through 3) **Attending** • *Background*: is responsible for overseeing resident learning during patient care as well as developing and delivering training opportunities for residents on their team (I.D.3) • *Experience*: board certified and practicing physician; range of experience in training and education • *Skills*: board certified, curriculum development, assessment (A.F.1; A.F.2), research (I.EN.3) **Operations Manager** • *Background*: is responsible for technology within simulated learning experiences (O.P/R.6) • *Experience*: expert technology user with some experience in healthcare and training • *Skills*: video editing, hardware maintenance, information systems, medical training software programming (T.PoA) **Simulation Technologist** • *Background*: is responsible for realistic healthcare experience within simulated learning experiences (E.G.2; E.TS.6) • *Experience*: expert technology user with extensive experience in healthcare • *Skills*: Medical training software and hardware, information systems, medical training (T.PoA)
Learning	**Chief** • *Background*: completing their final year of residency while studying for their boards • *Experience*: completed most postgraduate work; technologically savvy and uses mobile applications frequently (T.MR.1 through 4) • *Skills*: research, clinical, problem-solving, communication, organization, reflection **Resident (PGY1 Through 4)** • *Background*: beginning or halfway through their residency, learning clinical skills through practical application (I.S.1; I.S.2) • *Experience*: just starting or halfway through postgraduate work; technologically savvy and uses mobile applications frequently (T.MR-1 through 4) • *Skills*: research, clinical, problem-solving, communication, organization, reflection
Evaluating	**Education Director** • *Background*: uses assessment to track learning; in charge of site accreditation (O.EN.1) • *Experience*: familiar with relevant exams for resident certification; collects and organizes informal assessment from resident training

	• *Skills*: assessment (A.W.2), organization (A.W.1) **Resident** • *Background*: completes assessment (A.C.1 through 9) • *Experience*: varying familiarity with relevant exams for certification • *Skills*: clinical, diagnostic **Attending** • *Background*: uses assessment to track learning (A.F.2) • *Experience*: familiar with relevant exams for certification and recertification • *Skills*: clinical, diagnostic, communication, certification, assessment

Social Model

The social model illustrates the social interactions between surgical residents, ASTEC teachers and administrators, and outside entities as they relate to the educational progression of residents as they move toward board certification (refer to Figure 1).

At a primary level, this model identifies four key user classes: PGY 1-4 residents, chief residents, teaching staff, and ASTEC administration. These user classes were chosen because of their direct contact with the ASTEC learning environment, which is the focus of our study. Each user class contains a thought bubble containing a personified thought derived from interviews with residents, Dr. Bachman, and Dr. Graling.

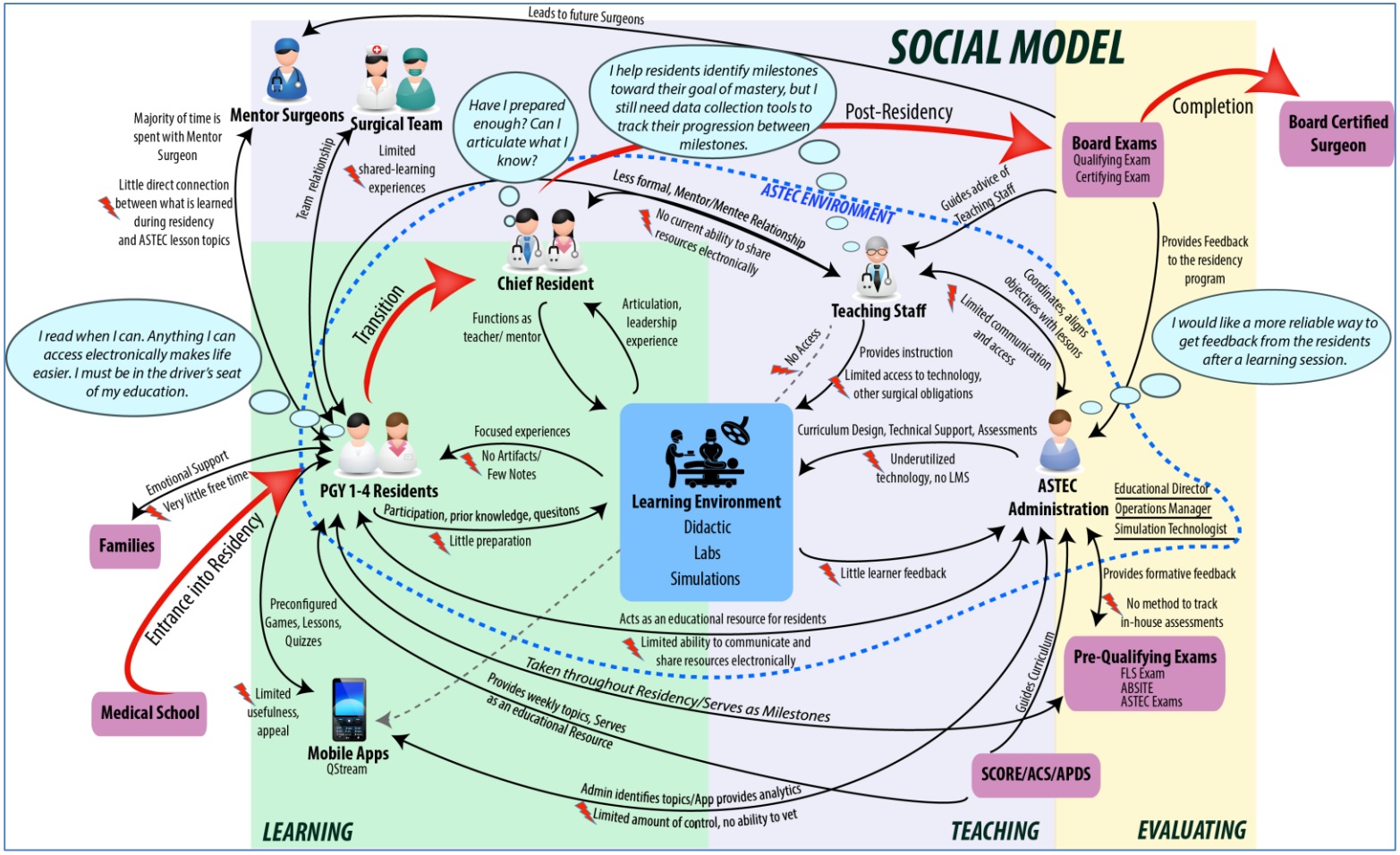
At a secondary level, we can see how each key user class interacts with the ASTEC learning environment as well as with each other. The interactions and barriers recorded within the secondary and tertiary level related directly to our WAAD and WANs (in expanded version, traceability notation is evident but not included in this version to save space). Within this level, you may notice gaps in our analysis. Although we understand how each user class interacts with the ASTEC environment, we are not yet clear in how chief residents relate to the ASTEC Teachers and Administrators as opposed to PGY 1-4 residents. Because chief residents serve in an instructional capacity within ASTEC, we will want to learn more about their relationship with ASTEC faculty as we move forward.

At a tertiary level, we begin to see how key user classes interact with outside entities. In order to limit our scope, we chose only those entities that serve in an educational capacity toward the goal of board certification. Because of this, we chose to focus on mentor surgeons, surgical teams, board exams, pre-qualifying exams, Surgical Council on Resident Education (SCORE)/Academic Surgical Congress (ASC)/Association of Program Directors in Surgery (APDS) Standards, mobile apps, patients, and families. Although we identified key attributes with each relationship, each attribute represents only a fragment of the complex relationships between these outside entities and the four key user classes.

At a quaternary level, we are able to see the overall progression of residents starting from their matriculation from Medical School, through their residency program, leading toward becoming board certified surgeons. Because so many education decisions ride on this progression, we felt it very important to identify this component in our model.

At the final, or quinary level, we notice the three work roles identified in our analysis: learning, teaching, and evaluating. One of the important components at this level is how residents transition to a teaching role as they become chief residents. Another important component is how ASTEC administrators balance between teaching and evaluating work roles. This component reflects how the administration relies on assessments and standards for evaluation to drive their teaching decisions. Finally, we would like to point out how entities like SCORE, ASC, and APDS serve as both a body of standards for evaluation as well as an educational resource for residents to draw from.

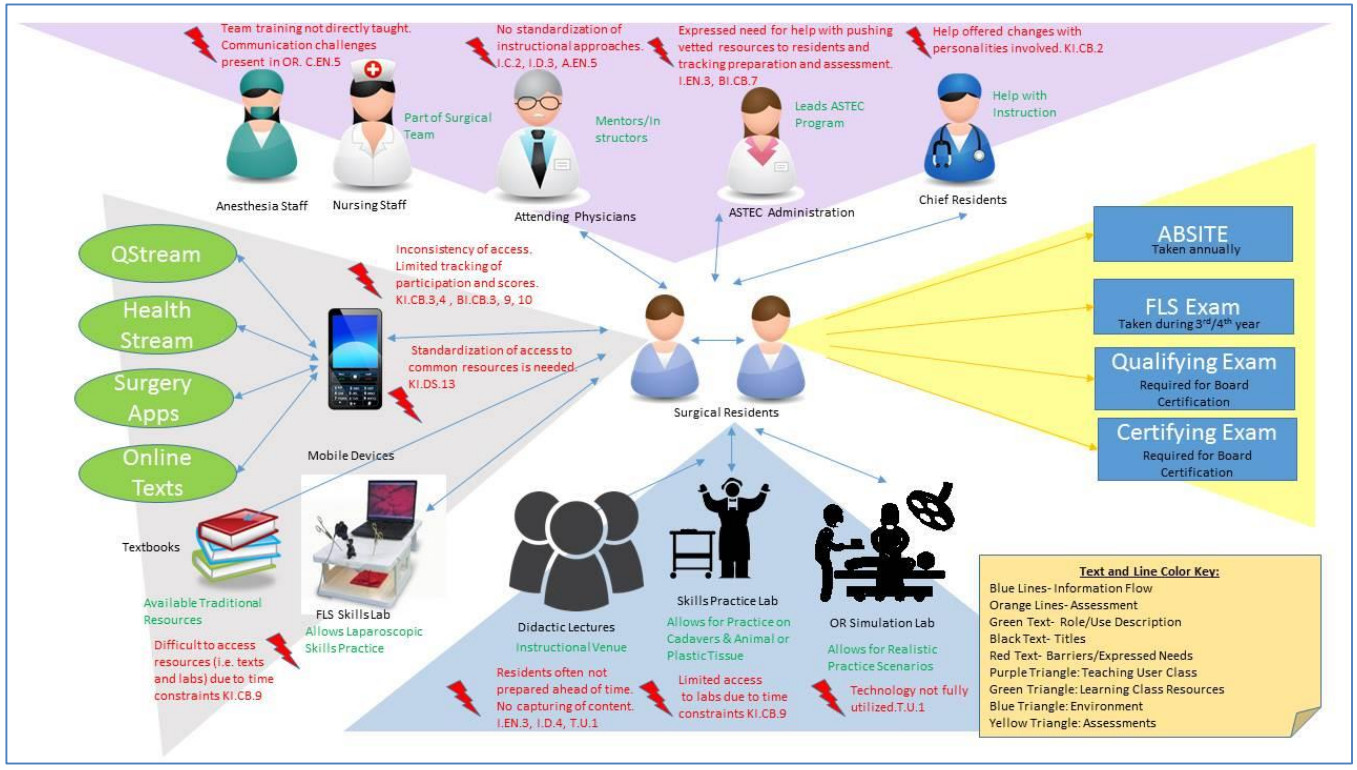
Figure 1: Social Model



Usage Model

The Usage Model depicts the many and varied ways ASTEC educates and trains surgical residents. In the center of the model are the residents, with the resources available to them grouped by type including instructional staff, informational or learning class resources, environment, and assessment. Information flow between residents and resources, shown in blue, takes many forms. ASTEC's goal is to prepare residents for successful completion of all assessments; however, there are barriers present that complicate the process (indicated in red).

Figure 2: Usage Model

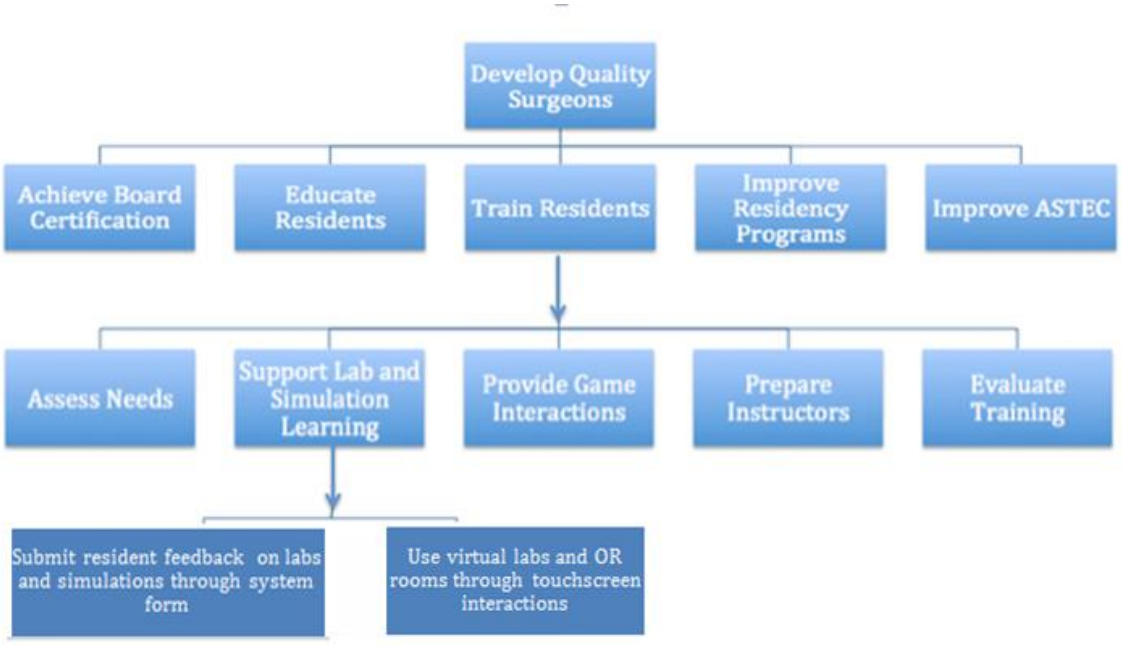


Task Structure Model

Task structure modeling, such as hierarchical task inventory modeling, is the process of cataloguing the task and subtasks that must be supported in the system design (Hartson & Pyla, 2012, pp216). The purpose of this model is to show what user tasks and actions are possible, to guide overall design, as a checklist for keeping track of task coverage in your design, and for matching that coverage to you inventory of scenarios and other task representations.

Figure 3 is an example of a Task Structure Model for our "Project: Confidence" system. It shows the hierarchy of *Developing Quality Surgeons* through the specific path of these two user system actions: participating in virtual rooms and providing feedback. As an example, in our second level we make a distinction between "educate residents" and "train residents" recognizing the instructional differences as it relates to acquiring knowledge versus demonstrating skill.

Figure 3: Task Structure Model Showing Train Residents



Task Interaction Model

The Task Interaction Model consists of the usage scenario model, step-by-step interaction model, and the essential use case task interaction model. The purpose of the usage scenario model is to provide user roles, the key usage situations happening over time, to focus on their needs, goals, and concerns. The purpose of the step-by-step model is to provide descriptions of task performance observed in the user as well as steps of the task performance. We captured the purpose, reason, and rationale for doing the task. By providing triggers, we can see what activation leads a user to initiate a given task. We identify barriers that limit the current system (noted with a red lightning bolt). The purpose of the essential use case task

interaction model is to describe single user intention or goal and define task description. The system responsibility captures what users intend to do and not how. These models combined create the task interaction model in order to visualize tasks, roles, and user classes.

Usage Scenarios

ASTEC Residency Program

The users are the residents, varying from PGY-1 to PGY-5. A goal of ASTEC is to optimize the care of patients and minimize conflicting outcomes through simulation-based education and training of these residents. The facility attempts to better prepare residents for their didactic lectures, robotic simulations, operating room (OR), FLS examinations, and other board examinations. A expressed by Dr. Kaminsky and stakeholders in ASTEC's residency program, the residents need to have a place that houses the information, such as a learning management system (LMS) that contains PowerPoint (PPT) presentations from lectures, videos, and pertinent resources for the residents to be able to access in an easy electronic format. ASTEC's main concern is getting this information to the residents in a fast, efficient, at-their-fingertips way to prepare them for the procedures they are learning and pass the examinations they take (i.e. FLS, American Board of Surgery In-Training Examination (ABSITE), and board exams).

Communication

There needs to be more effective communication among the residents, between residents and surgeons, between residents and other surgical team members, and between the residents and ASTEC (ex. receiving feedback from residents about ASTEC programs) (C.EN.3). The concern is to get the residents to communicate with one another in the program to allow them to articulate their understanding and to enhance their own knowledge of the procedures. Improving resident communication and feedback will help ASTEC to improve understanding of procedures, and improve the overall program over time (C.EN.2).

Step-by-Step Task Interaction Model

Residency Program Didactic Lectures

Task Name: Preparing students for didactic lectures
Task Goal: Provide students with up to date materials to read prior to lectures
Task Trigger: Residents realize that their needs to be more readily available and up to date information for them to better prepare for the days procedures.

1. Residents attend didactic lectures in a classroom set up (E.G.7).
   
   Barrier: Instructors are unable to provide course materials to residents electronically prior to course attendance. (I.EN.3)

2. Presentations are done using PPT presentations (I.D.5)
   
   Barrier: Students do not take notes during lecture (I.D.4)

Barrier: Students do not have a place to go back to view the PPT presentation (T.EN.2)

3. Some students may use their phones to record the lecture

4. Attending physician uses hand written objectives to brief residents of procedure for that day then have residents practice on mannequin
   - Barrier: There needs to be more communication from residents during the simulation. (C.EN.2)
   - Barrier: Residents are unable to take notes quick and efficiently during this time. (Post WAAD Notes)
5. Residents discuss risks, the patient, procedure and consequences prior to a procedure (C.LE.3)
   - Barrier: Younger residents are not as confident or secure in procedures to speak up and ask questions.
   - Barrier: Culture has become a barrier in this context (Post WAAD Notes)

6. Residents have access to outside resources for medical information regarding procedures and techniques
   - Barrier: Residents do not take advantage or fully understand QStream or the purpose, which enables them to rest themselves and use that resource for learning (A.EN.1)

Residency Program Simulation/Lab/OR

Task Name: Preparing residents for lab, simulation, and OR

Task Goal: Give residents proper up to date materials and videos to review

Task Trigger: Residents preview reading materials and medical videos on the procedures they will be going over for that given day

1. Residents attend lab, simulation, and OR training.
   - Barrier: Residents do not pre-prep before lab (I.EN.1; I.EN.2)

2. Attending physician goes over objectives and brief about procedure (I.L.4; I.C.4)

3. The attending affirms the simulation participants decisions and actions (C.SE.4)

4. Residents work on mannequin to practice any given procedure (I.L.5)

5. Residents work in teams in simulation lab and OR to practice emergencies, the procedure, and ask questions as they arise. (I.C.3; O.P/R.4)
   - Barrier: Younger residents are not always confident or comfortable enough to ask questions. (Post WAAD Notes)

6. After the lab and simulations, residents do a briefing to discuss the overall experience, what could have changed, what went well, and what they liked. (A.F.4)

Barrier: Surgical team mentioned that communication in OR situations could be better. (C.EN.3)

Barrier: ASTEC needs more input from learner. (C.EN.2)

Essential Use Case

Table 3 displays an example of an essential use case for "*Operation: Confidence.*"

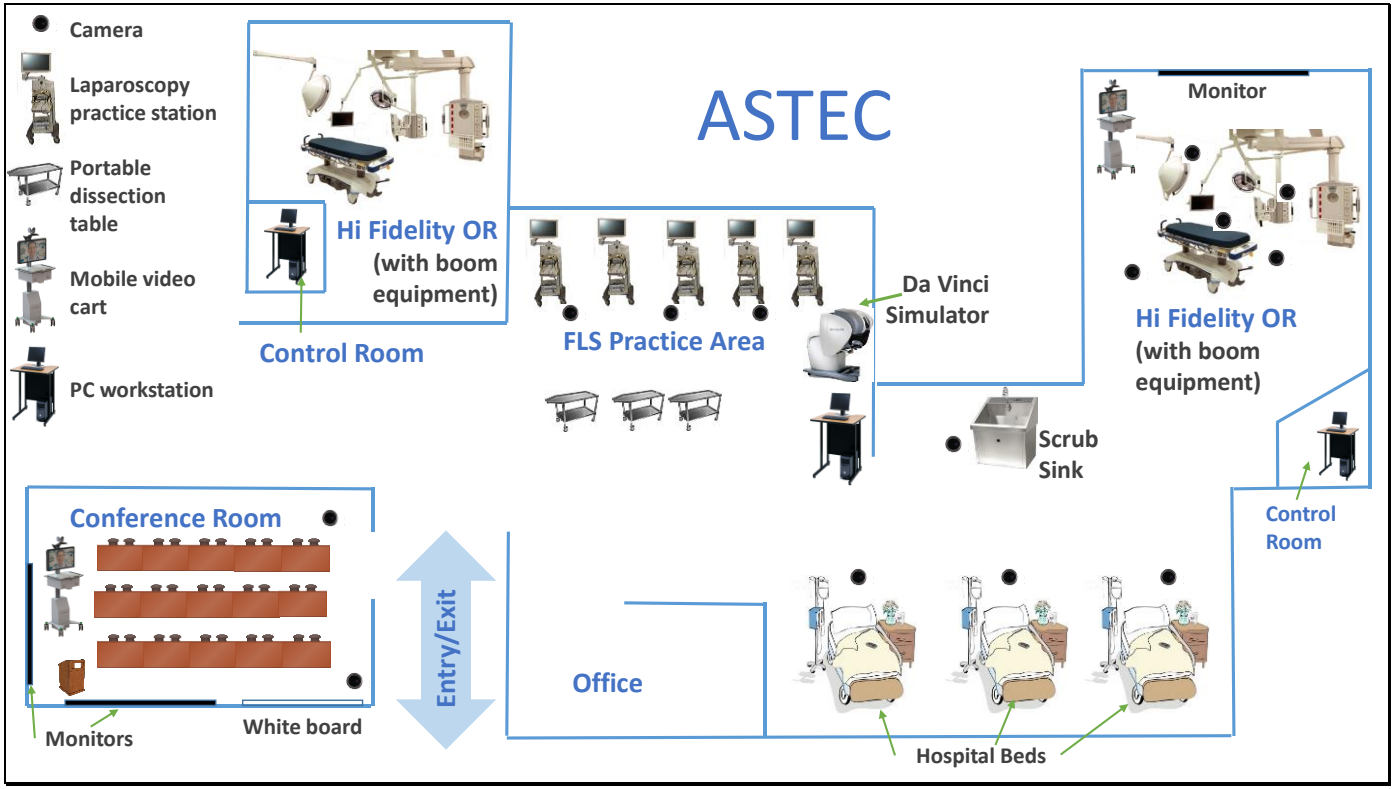
Table 3: Essential Use Case Task Interaction Model

Resident/User Intention	System Responsibility
Learn about procedures	• Provide didactic lectures and hands on simulations
Learn how to perform surgical procedures	• Provide mannequins and robotic simulations • Provide team practice in OR • Provide practice labs on cadavers and/or animals
Articulate after procedures	• Debrief with attending physicians and surgeons on procedures performed in labs, simulations and OR
Pass the FLS	• FLS skill lab
Prep for boards	• Oral drill practice with chief surgeons

Working Environment Model

The working environment physical model represents the physical setting of the work environment and how it does or does not support the work activity. This includes artifacts, technology, and a floor plan of the facility at ASTEC. Many of the barriers identified in the physical model have to do with the underutilization of the technology and resources within the ASTEC facility.

Figure 4: Physical Model



Work Environment Model – Layout Descriptions

Conference Room

This space is used for didactic lessons including pre-lab and pre-simulation sessions. It is also used for oral examination preparation and miscellaneous meetings.

Barrier: Sessions are not regularly recorded, and there is no standard arrangement for delivery of online materials (T.U.1).

Hi Fidelity OR and Control Room

These rooms are used for pre-designed simulations for surgical teams. There are multiple cameras and microphones in the rooms and in the equipment. Monitors and microphones allow for real time monitoring and participation with students and instructors in the conference room, at remote locations, and between the OR and the control room. The control rooms contain the recording equipment and the computers that control the simulations.

Barrier: B-Line recordings created with the center's equipment are only available to the participants (T.EN.1).
Barrier: Recordings are deleted after 30 days. Also, users are having difficulty finding the tools they need in the OR (E.EN.1).

FLS Practice Area

This area includes multiple work stations and practice stations for laparoscopic skills practice and preparation for the FLS exam. This space also accommodates small mobile dissection tables for lab sessions.

Barrier: Though cameras are available in this area, sessions are not regularly recorded (T.U.1).
Barrier: There is sometimes a lack of communication between teaching staff and administration when preparing for a lab session resulting in wasted resources (I.EN.1).

Hospital Beds

These are fully equipped hospital beds with all connections and equipment available in the working hospital. These are used for labs and instruction using mannequins.

Barrier: Though cameras are available in this area, sessions are not regularly recorded (T.U.1).

Identified Barriers

Our group identified multiple barriers during the contextual inquiry and analysis phase. Table 4 shows each barrier associated with a specific model and the frequency in with group researchers noted the barrier as an issue.

Table 4: Identified Barriers by Model

Barriers	Model	Count
Limited shared learning experiences	Social	x
No artifacts/Few (if any) notes	Social	xxxx
No current ability to share resources electronically between chief residents and teaching staff	Social	x
Teaching staff has limited access to technology	Social	x
Underutilized Technology	Social	xxx
No Learning Management System	Social	x
Little learner feedback	Social	x
No method to track in-house assessments	Social	xx
Limited communication and access between teaching staff and administration	Social	x
Limited ability to communicate and share resources electronically between residents and administration	Social	xxx
Limited usefulness and appeal with respect to mobile apps	Social	x
Limited amount of control/no ability to vet resources	Social	xx
Limited free time with families	Social	x
Little direct connection between what is learned during residency and ASTEC topic lessons	Social	x
Surgical team training not directly taught	Usage	x
No standardization of instructional approaches	Usage	x
Help offered changes with personalities involved	Usage	x
Limited access to labs due to time constraints	Usage	x
Residents not prepared ahead of time for didactic lectures	Usage	xxx
Difficult to access texts due to time constraints	Usage	x
No standardized access to common resources	Usage	x
Limited tracking of participation and scores on assessments	Usage	xx
Sessions not regularly recorded	Physical	xx
No standard arrangement for delivery of online materials	Physical	xx
B-line recordings created with the center's equipment are only available to the participants. Recordings are deleted after 30 days.	Physical	x

Barriers	Model	Count
Users have difficulty finding the tools they need in the OR	Physical	x
Limited communication between residents and teaching staff	Task Interaction	x
Cultural barriers inhibit free communication between junior and senior residents and staff	Task Interaction	x
Difficulties with effective communication in OR	Task Interaction	xx
Advantages of using available electronic resources such as Q-Stream are not fully realized	Task Interaction	x