BNL-220983-2021-INRE

Learning Management System User Requirements for the National Nuclear Security Administration's International Nuclear Safeguards Engagement Program

C. Carroll

February 2021

Nonproliferation and National Security Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE National Nuclear Security Administration (NNSA), Office of Nonproliferation and Verification Research and Development (NA-22)

DISCLAIMER

Learning Management System User Requirements for the National Nuclear Security Administration's International Nuclear Safeguards Engagement Program

Colin Carroll, Brookhaven National Laboratory
Ruth Smith, NNSA (NA-241)
Oksana Elkhamri, Pacific Northwest National Laboratory
Linda Hansen, Spectratech, Inc.
James McCarthy, Sonalysts, Inc.

January 2021

BROOKHAVEN NATIONAL LABORATORY
a passion for discovery
U.S. DEPARTMENT OF ENERGY | Office of Science

Learning Management System User Requirements for the National Nuclear Security Administration's International Nuclear Safeguards Engagement Program

Colin Carroll
Brookhaven National Laboratory

Oksana Elkhamri
Pacific Northwest National Laboratory

Linda Hansen
Spectratech, Inc.

James McCarthy
Sonalysts, Inc.

Ruth Smith
NNSA (NA-241)

January 2021

Nonproliferation and National Security Department
Division
Office

Brookhaven National Laboratory

U.S. Department of Energy
National Nuclear Security Administration
Office of Nonproliferation and Arms Control

DISCLAIMER

Table of Contents

List of Figures

List of Tables

Executive Summary

The National Nuclear Security Administration's (NNSA) International Nuclear Safeguards Engagement Program (INSEP) is considering investing in new tools that would allow the program to support its partner states from a distance. At the same time, the program is considering approaches that would allow several organizations, including NNSA, IAEA, national laboratories and contractor staff, to collaborate in the development and maintenance of instructional content. Software systems known as Learning Management Systems (LMSs) might represent a mechanism through which INSEP could accomplish these goals (collaborative development and remote support). To assess the usefulness of an LMS, INSEP has specified its needs for delivering online training and compared those needs to the capability of a range of LMSs. This comparison will allow INSEP to determine whether an LMS would be a useful tool and may set the stage for a "make-buy" decision in the future.

The study team concluded that INSEP's content development and delivery needs align well with the capabilities of the leading LMSs on the market today and that that INSEP performance requirements allow for a customized approach using existing training portals that are already available to NNSA. Additional work would be required to specify the desired processes for developing online training and outreach materials, structuring the databases, specifying the data that should be collected, and detailing the desired system reports and documentation.

Introduction

The National Nuclear Security Administration's (NNSA) International Nuclear Safeguards Engagement Program (INSEP) is considering investing in new tools that would allow the program to support its partner states from a distance. At the same time, the program is considering approaches that would allow several organizations, including NNSA, IAEA, national laboratories and contractor staff, to collaborate in the development and maintenance of instructional content. There are a number of theoretical and practical reasons why this type of "virtual support" might be beneficial. For example, including online support might reduce costs, make it easier to support partners when travel is not possible, and provide "on demand" resources to increase mission effectiveness.

Software systems known as Learning Management Systems (LMSs) might represent a mechanism through which INSEP could accomplish these goals (collaborative development and remote support). To assess the usefulness of an LMS, INSEP wanted to specify more completely its needs and compare those needs to the capability of a range of LMSs. This comparison will allow INSEP to determine whether an LMS would be a useful tool and may set the stage for a "make-buy" decision in the future.

Purpose of the Study

INSEP developed this user requirement to identify the program's needs for delivering on-line training and for developing and maintaining training and outreach materials across the range of parties that support INSEP. The user requirements focus on the program's needs over both the short- and long-term that could be addressed by a learning management system or a broader training support environment. INSEP managers can use these requirements to communicate the program's needs to others who also might be assessing approaches for online training delivery or for implementing more effective collaboration tools for training material development and management. Managers can also use these requirements to evaluate training delivery and data management products, learning management systems available on the commercial market or from the national laboratory complex, or specifying new customized solutions that will be developed under future tasks.

These requirements represent the first step in a process for implementing an LMS or a more capable information management environment. They describe the end state of a process, but not necessarily the process itself. This is done intentionally to allow training and process specialists and software engineers flexibility when designing a new system or modifying an existing one. If INSEP decides to move forward with an LMS, the on-line training implementation and development processes will need to be defined in more detail. This work is left to future efforts.

Method

INSEP used converging methods to conduct its analysis. INSEP used "bottom-up" methods to define the program's requirements and "top-down" methods to define system capabilities.

The study team conducted the bottom-up analysis in two-parts. First, the team defined a number of use-cases to ground the analysis of program requirements in the day-to-day activities of the team. We began by identifying the range of stakeholders involved in creating and delivering instructional support. We then specified the high-level tasks that they performed. These use cases (appendices 4-12) allowed the team to specify a range of relatively high-level user requirements that specified what a hypothetical system had to do. We were not concerned with how the system accomplished the requirements or even if the requirements were satisfied by a single tool or a constellation of tools.

The study team also used a multi-step procedure to complete the top-down analysis. The first step in the process was to identify the prominent LMSs. To complete this step, the study team conducted an internet search and identified ten lists of prominent/successful LMSs. Understanding that there is often a profit motive associated with lists of this sort, we wanted to cast a broad net and identify products that appeared frequently. A similar approach was used to identify "buying guides," "system comparisons," and so forth, that provided a basis for describing and comparing LMSs. This analysis produced a list of attributes that INSEP could use to describe, compare, and contrast LMSs. The third step in the process was to reach out to the vendors of some of the prominent products to ask them to review the list of attributes. The study team wanted to give these vendors an opportunity to expand the list to identify discriminating features of their project. By doing so, we created a more comprehensive list.

The last step in the process was to compare the bottom-up user requirements with the top-down system attributes and identify any significant gaps. These might be user requirements that were not addressed in the attribute list, which might suggest than an LMS is an appropriate tool. Alternatively, these might be attributes that are not mentioned within the user requirements. This type of "mismatch" might indicate that either the user requirements failed to account for some important aspect of the problem or, perhaps more likely, there are features of LMSs that are not important to the INSEP community and its mission.

Results

The LMS User Requirements and supporting documentation are included in the Appendix section of this report. The bulk of the report is detailed in these appendixes.

Collectively, the results of the bottom-up and top-down analyses indicated that:

- INSEP's content development and delivery needs align well with the capabilities of the leading LMSs on the market today
- The requirements allow for a customized approach using existing training portals that are already available to NNSA

Additional details are required to:

- specify the desired processes for developing online training and outreach materials
- structure the databases
- specify the data that should be collected
- detail the desired system reports and documentation

Figure 1 (page 4) provides a schematic representation of our study methods and a map to the results associated with each task.

Next Steps

The interim results of this project indicate that continued investigation of LMS technology is warranted. The among questions that need to be answered or answered in more detail are:

- What are the training material development tools that the program will use in both the short and long term
- What are the delivery methods that the program will use
- Does the program require a learning management system or does it simply need a portal that acts as an interface between INSEP and its partners
- If an LMS is desired, should the program implement a COTS solution or should it use the Safeguard Portal (or some other existing portal) and develop applications itself to support its future needs
- Should the program use an Agile approach for implementing the LMS or a Waterfall approach
- What are the life-cycle costs
- What type of license is needed to use the software and how is it structured
- What are the processes that INSEP will use to develop and manage program materials, and how can the LMS be used to implement a rules-based system

The study team recommends the following next steps:

1. Continue to refine use cases and user requirements
2. Conduct pilot studies to assess the viability of delivering synchronous and asynchronous instruction via an LMS
3. Use the lessons learned from the pilot studies to guide the refinement of system requirements
4. Move forward with an LMS procurement or upgrade an existing information portal

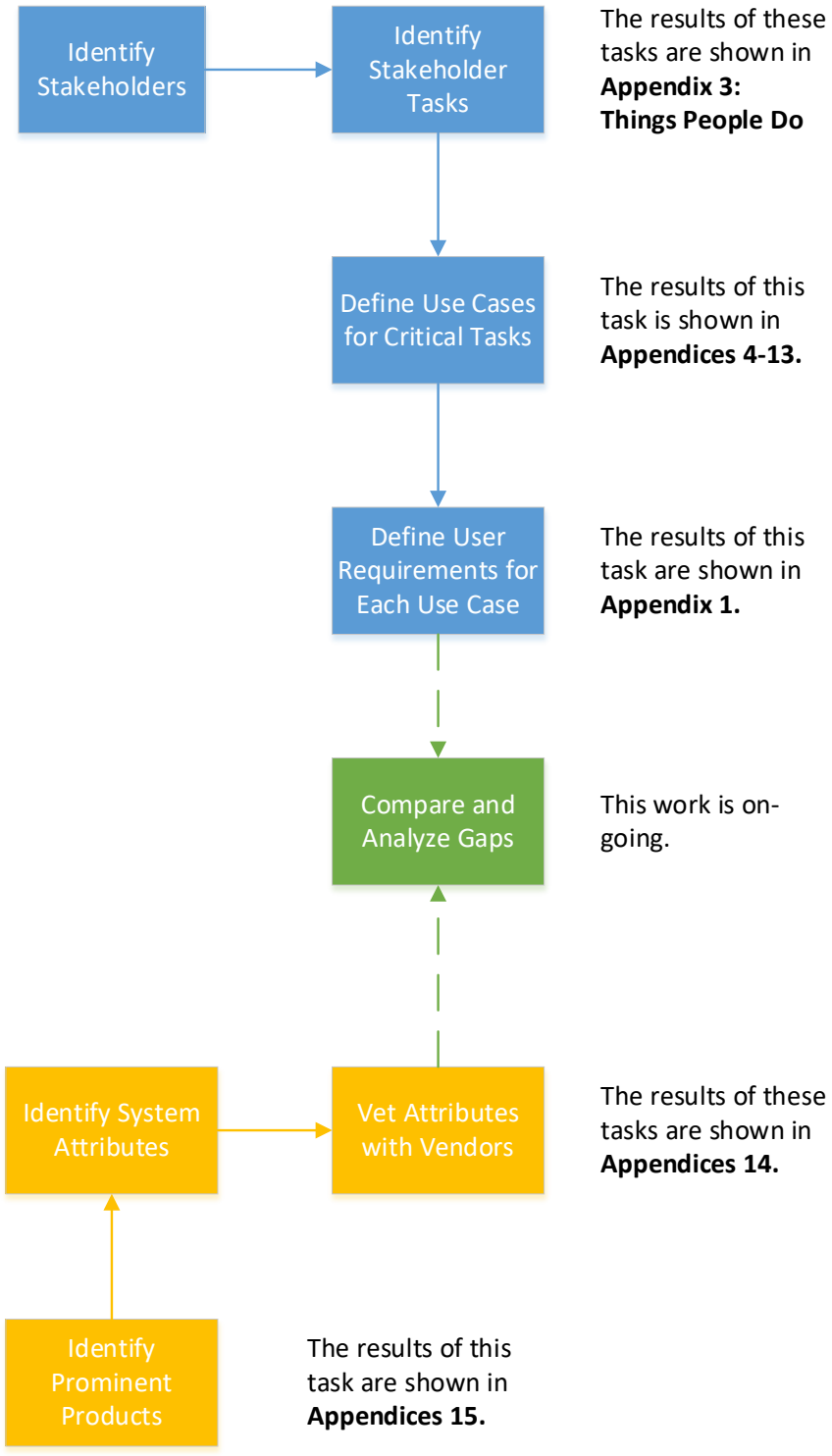

Figure 1: **Summary of Methods and Results**

LMS User Requirements and Supporting Data

The LMS User Requirement is included as Appendix 1. Selected supporting documents that the study team used to develop the User Requirement are summarized in Table 1: LMS Report Appendixes. Additional data on the user requirements can be found in the LMS User Requirement Excel spreadsheet which is located in the INSEP eRoom at:

https://rivendell.ne.anl.gov/eRoom/242/INSEP-Training/0_4fdd6

Table 1: **LMS Report Appendices**

Section	Title	Content Summary
Appendix 1	INSEP Learning Management System User Requirement	A table summarizing INSEP's LMS user requirements. It lists INSEP's needs in the form of capabilities, conditions for operation, or constraints on possible future solution.
Appendix 2	Technical Approach	Summary of the process used by the INSEP study team to develop the user requirements
Appendix 3	List of Online Training User Tasks	List of tasks performed by user groups when interacting with on-line training and training material management
Appendix 4-12	Use Cases	Uses cases develop to support the development of user requirements
Appendix 13	LMS Requirement Categories and Requirement Types	Details on the two-tiered hierarchy used to group similar user requirements. Used to support data analysis and final report readability
Appendix 14	LMS Dimensions for Comparison	Significant features of COTS LMSs that could be used for comparison purposes
Appendix 15	Attribute to Requirements Map	Cross references attribute to system requirements
Appendix 16	List of LMS Products Available on the Commercial Market	List of prominent LMS products
Appendix 17	Glossary	Definitions of terms used in this report

Appendix 1: User Requirement Summary

Category: **Functionality**

Requirement	Requirement Type	Importance
1. The system shall send automated electronic messages via email or SMS to users, including but not limited to participants, developers, instructors, administrators, with training communications, such as user names and passwords	Communications	Required
2. The system shall send manual electronic messages via email or SMS to users, including but not limited to participants, developers, instructors, administrators, with training communications.	Communications	Required
3. The system shall have a white board feature for participants and instructors to interact with each other via diagrams, equations, and written notes.	Communications	Required
4. The system shall save the current version of the whiteboard in long term storage.	Communications	Required
5. The system shall save the history of the whiteboard in long term storage	Communications	Desired
6. The system shall have a discussion forum for participants to interact with instructors and each other.	Communications	Required
7. The system shall have a mechanism for posting questions.	Communications	Required
8. The system shall have a mechanism for posting responses to questions.	Communications	Required
9. The system shall provide a live chat feature to allow participants to communicate with each other	Communications	Required
10. The system shall provide a live chat feature to allow the instructor to communicate with the participants	Communications	Required
11. The system shall provide for simultaneous translation	Communications	Required
12. The system will create event work spaces where users can collaborate on specific events or to develop training materials.	Performance/Capabilities	Required
13. The system shall support content development and storage for online and classroom training	Performance/Capabilities	Required
14. The system will include collaboration tools that allow content developers to work together to develop or adapt training materials	Performance/Capabilities	Desired

Requirement	Requirement Type	Importance
15. The system shall provide training materials development tools such as text editors, graphics production, video editing, etc.	Performance/Capabilities	Desired
16. The system shall provide templates that can be used by course developers	Performance/Capabilities	Desired
17. The shall allow content developers or instructors to sequence modules	Performance/Capabilities	Desired
18. The system shall have a calendar feature for scheduling online and classroom-based courses	Performance/Capabilities	Required
19. The system shall have a calendar feature for tracking online and classroom-based courses	Performance/Capabilities	Desired
20. The system shall have a calendar feature for scheduling instructor availability	Performance/Capabilities	Desired
21. The system shall have a calendar feature for tracking instructor availability	Performance/Capabilities	Desired
22. The system shall provide for real time video streaming using built-in tools	Performance/Capabilities	Optional
23. They system shall have a recording feature that will allow participants to playback content at a later time.	Performance/Capabilities	Required
24. They system shall have a recording feature that will allow content developers to playback content at a later time.	Performance/Capabilities	Required
25. The system shall allow the participant to pause the training and continue from where they left off at a later time.	Performance/Capabilities	Required
26. The system shall provide for participants and instructors to maintain an online journal during training	Performance/Capabilities	Desired
27. The system provides a point of contact for any training course questions	Performance/Capabilities	Required
28. The system shall have "knowledge check" features and/or support external tools for knowledge check (e.g. Menti)	Performance/Capabilities	Required
29. The system shall have the capability of customizing the LMS user interface to accommodate different languages	User interface	Desired
30. The system shall allow for creation of customized dashboards for different types of users (e.g. content developers, instructors, project leads, trainees)	User interface	Required
31. The system shall allow a participant to review the completion status of any content being worked on for any module or course	User interface	Required
32. The system shall support programmatic branding options for all types of training	User interface	Required

Category: **Data Management**

Requirement		Requirement Type	Importance
1.	The LMS shall be able to display different media file formats, such as MS Word, Power Point, jpeg, etc.	Data formats	Required
2.	The LMS shall maintain a training profile for each participant.	Data records	Desired
3.	The system shall provide version control media used by content developers	Data records	Required
4.	The system shall tag content development according to INSEP-specified parameters (e.g. draft, Master, cleared for release, etc.)	Data records	Required
5.	The system shall maintain a list of email addresses for a participant to contact an instructor, or content developer, or course administrator	Data records	Required
6.	The system shall save, store and allow for query of evaluation data from online and classroom trainings	Data records	Required
7.	The system shall save and store chats, discussion boards, and Q&A information for each training course	Data records	Required
8.	Databases can be maintained on cloud-based servers maintained by Amazon or Microsoft (among others), the vendor, or an NNSA or national laboratory server contingent of meeting security requirements.	Data storage	Desired
9.	The LMS shall reside on a cloud server	Data storage	Optional
10.	The system will allow rules-based file downloads	Data Transfer	Required
11.	The LMS shall allow for uploads and downloads of multiple documents, images and other media	Data Transfer	Required
12.	The system shall have data sorting features based on a range of INSEP-specified variables (e.g. region, country, topic, etc.).	Database manipulation	Required
13.	The system shall allow authorized users to create data tables	Database structure	Required
14.	The system shall allow authorized users to create data fields	Database structure	Required
15.	The system shall allow authorized users to customize data tables	Database structure	Required
16.	The system shall allow authorized users to customize data fields	Database structure	Required

Category: Records and Reports

Requirement	Requirement Type	Importance
1. The system will generate or print any report on demand	Reports	Required
2. The system shall produce customized reports	Reports	Required
3. The system shall display a summary of the statistics for asynchronous course (training material, who has completed, who is still working	Reports	Required

Category: System Operations

Requirement	Requirement Type	Importance
1. The system shall provide asynchronous training 24/7k with the exception of maintenance periods	Availability	Required
2. The system shall have an availability level of 99 percent	Availability	Required
3. The system shall display when it is not available due to backup/maintenance schedules	Availability	Required
4. The system shall store PII in accordance with DOE regulations	General Security	Required
5. The system shall provide for roles-based access	General Security	Required
6. The system can be accessed only by authorized users	General Security	Required
7. LMS shall enforce access, viewing/exploring restrictions on foreign national content developers	General Security	Required
8. The system shall operate world-wide without restriction	Regulatory constraints	Required
9. The LMS shall have no more than 100 bugs in the software at any time	Reliability	Desired
10. LMS shall flag and collect any system issues raised by participants and/or other users	Reliability	Required
11. The system shall provide drop and drag capability for both Windows and OSX operating systems when working with the training databases	Software	Required
12. The LMS shall be compatible with the following operating systems: Windows, OSX, LINUX, Android, and iOS.	Software	Required

13. System software updates shall be made only on the server, or shall be pushed to users when they log in to the LMS	Software	Desired
14. The system shall provide 24/7 technical support	Support	
15. The system shall assist users who are having difficulty with the LMS interface.	Support	Desired
16. The system provides a point of contact for any system question	Support	Required
17. The vendor shall work with NNSA to ensure that NNSA's objectives are met.	Support	Desired
18. The LMS shall offer plans for either active users or unlimited/enterprise users	Support	Desired
19. The LMS vendor shall provide product support	Support	Desired
20. The system will support 3rd party software	System integration/interface	Required
21. The LMS shall be able to display content for 3rd party vendors such as MS Teams, Zoom, Bluejeans, Skype	System integration/interface	Required
22. The LMS shall support the surveys from 3rd party vendors	System integration/interface	Required
23. The LMS shall work with the existing INSEP databases	System integration/interface	Required
24. The LMS shall access multiple databases.	System integration/interface	Required
25. The system shall be compatible with Sharable Content Object Reference Model	System integration/interface	Required
26. The system shall be compatible with Learning Tools Interoperability	System integration/interface	Required
27. The system shall be compatible with TinCan/xAPI	System integration/interface	Required
28. The system shall have a tutorial for system familiarization training	Training	Desired

Appendix 2: Technical Approach Used to Develop the LMS User Requirements

INSEP convened a five-person study team comprising INSEP safeguards experts, training specialists, and headquarters staff to develop these user requirements. The goal was to develop a set of user requirements by the end of July 2020 to assess options for implementing on-line training and managing the INSEP training materials database. The study team focused on the high-level capabilities, operating conditions and constraints associated with short- and long-term on-line training implementation. Defining detailed training development and implementation processes, which is a labor-intensive effort, would be addressed at some point in the future.

The study team organized its work into seven phases.

- Draft a list tasks performed by users to develop, implement, and manage online training delivery
- Develop use cases for selected tasks
- Draft raw user requirements based on use cases
- Analyze selected COTS LMS to identity dimensions for comparison
- Update and refine use cases
- Consolidate and refine user requirements
- Finalize requirements

As a first step in the user requirement development, the study team grouped all INSEP training users into five general categories:

- Participants *(people who would be receiving training)*
- Instructors
- Context Developers *(both developing and adapting training materials)*
- Administrators
- Information Technology Professionals

With these five categories in mind, the study group identified tasks that each user group would perform when developing, implementing, or managing an online training event. Although the tasks are organized by user group, but it is important to note that many tasks are interdependent so when developing the cases studies, multiple user groups would be involved in the performance of any given use case. The list of tasks that each user group would perform is included as Appendix 3.

The study team next selected tasks from the list for which to develop use cases. The study team selected the use cases based on their importance, frequency of performance, and significance to the online training experience. The study team developed use cases for the following activities:

- Instructor Led Training
- Record Synchronous Training for Asynchronous Playback
- Review Instructor Led Asynchronous Training
- Complete Assignments
- Provide Feedback on Assignments
- Conduct Asynchronous Training
- Develop Synchronous Training
- Course Administration

The use cases are included as Appendixes 4-13.

With the use cases as a starting point, the study team drafted raw user requirements. The requirements define a capability, a condition for operation, or a constraint on the final solution. The study team defined system capabilities at a high level in order to avoid the complexity introduced by excessive detail at this point in the analysis process. In some cases, however, such as data security, detailed requirements are incorporated into DOE regulations and are implied.

The study team grouped the user requirements into four major categories and 21 requirement types. The categories and requirement types are included in Appendix 14.

Four members of the study team developed the raw user requirements independently based on the use case assigned to them. The study team then combined the results of each individual, grouped like requirements, consolidated requirements when necessary and rewrote them as needed to improve clarity and specificity. Each requirement was assigned a tracking number and was tagged according to various criteria to facilitate sorting and vetting. Each requirement was assessed for:

- Completeness
- Clarity
- Duplication with other requirements
- Category
- Requirement type
- Importance (required, desired, optional)
- Whether the requirement had to be met by an LMS, or if it could be met by a broader training environment tool
- If it should be included in the list of final user requirements
- Basis for the requirement (use case or some other source)
- Comments

Comparing Learning Management Systems

The study team conducted a review on online resources to identify attributes that the team could use to describe LMSs. A preliminary list of attributes was then shared with prominent vendors who had an opportunity to add attributes that they thought would allow a more nuanced discrimination among products. The current list of attributes is shown in Appendix 14.

Commercial LMS Products

The study team identified a number of prominent LMSs to provide a foundation for our "top down" analysis. To create this list, the research team conducted an internet search and identified ten lists of prominent/successful LMSs. Understanding that there is often a profit motive associated with lists of this sort, we wanted to cast a broad net and identify products that appeared frequently. Appendix 15 lists the LMSs that were identified in order of the percentage of time they appeared in the ten lists (e.g., Canvas and Moodle each appeared in nine of the ten lists).

Appendix 3: Things People Do

Things Participants Do

1. Log in (No use case needed now)
2. Change Passwords (No use case needed now)
3. Navigate to Content (No use case needed now)
4. Check their Status (no use case needed now)
5. Participate in Instructor Led Synchronous Lessons (Use Case)
6. Review Instructor Led Asynchronous Lessons (Use Case)
7. Work through Self-Paced IMI (Use Case)
8. Complete Self-directed Explorations (Assume same as asynchronous lesson)
9. Synchronous Lessons for Asynchronous Playback
10. Complete Assignments (Use Case)
11. Participate in Discussion Groups (Use Case)
12. Complete Surveys (Use Case)
13. Record Video Presentations (Use Case)

Things Instructors Do

1. Lead Synchronous Lessons (Use Case)
2. Record Synchronous Lessons for Asynchronous Playback (Use Case)
3. Provide assignments (Use Case)
4. Provide feedback on assignments (Use Case)
5. Check on the status of their students (No use case needed now)
6. Provide Forum Boards for Discussions (No use case needed now)

Things Course Developers Do

1. Develop Presentations for Instructor-led Lessons (Use Case)
2. Develop Self-paced IMI activities (Use case)
3. Develop Self-directed explorations (No use case needed now)
4. Develop simulations/scenarios (No use case needed now)

Things Administrators Do

1. Create Accounts (No use case needed now)
2. Reset Passwords (No use case needed now)
3. Delete user accounts (No use case needed now)
4. Delete user records (No use case needed now)
5. Assign students to lessons (No use case needed now)
6. Generate reports on usage, completion, etc. (Use Case)
7. Develop Surveys (Use Case)
8. Deploy Surveys (Use Case)
9. Generate reports on survey results (Use Case)

Things IT Professionals Do

1. Install software (No use case needed now)
2. Authorize operation of software (No use case needed now)
3. Update software functionality (No use case needed now)
4. Apply security patches (No use case needed now)
5. Monitor access/usage (No use case needed now)
6. Manage records. (No use case needed now)

Appendix 4: Instructor Led Training Use Case

User: **Participant**

- The participant receives notification from the State Authority that they have been nominated to participate in an INSEP training course.
- The State Authority provides INSEP a list of participants with the information needed to create a user account (if not already done) and to register them for the training.
- The LMS notifies the participant that they are registered for the training and provides the information needed to log into the training.
- The LMS provides a tutorial to assist a new user with interacting with the LMS
- The participant logs onto the LMS at the appointed time for the training. If they have difficulty logging on, the LMS (or a help line) provides the participant assistance with connecting.
- The LMS presents the user an interface that is in English or their native language. The user interface allows the participant to interact with the instructor or other participants via text messages (chat like feature) or voice.
- The LMS will manage participants audio and video, allowing the instructor to override local controls.
- The participant views all instructor presentation media (slides, video, audio, surveys, quizzes) via the LMS on their computers.
- The participants ask questions of the instructor, or other participants on a peer-to-peer basis. The participant also engages in discussions with other participants.
- The LMS records all participant questions.
- The participants take notes via an LMS feature. The participants notes can be downloaded at the completion of the training in a standard text file format.
- The LMS alerts the instructor if a participant drops off.
- The LMS provides a participant who had been disconnected an option to rejoin the training in progress (synch) or pick it up from where they left off (async).
- At the completion of a presentation or at the end of the training, the LMS presents the participants a survey to complete.
- The participant downloads the course materials to their computers or to other storage media of they desire via the LMS.
- The LMS notes who has downloaded all media downloaded by the participants (Maybe).
- The LMS allows participants to review portions of the presentation for some period after the training is completed in order to clarify certain points or to simply refresh their memories.

User: **Instructor**

- The LMS notifies the instructor that they are registered for the training and provides the information needed to log into the training session2.
- The LMS provides a tutorial to assist a new user with interacting with the LMS.
- The instructor logs onto the LMS.
- The instructor reviews the training presentation on the LMS and conducts a dry run of the presentation or the discussion, as needed.
- At the appointed time of the training, the instructor reviews the list of participants logged in provided by the LMS and determines if everyone who is expected to attend the training has logged in. The LMS assists the instructor with determining if anyone is missing.
- The instructor presents a multi-media presentation via the LMS, which includes power point slides, video clips, a text-based document (such as INFCIRC 153), and short surveys (or quizzes) to gauge participants understanding of certain points and to stimulate interest and discussion. The LMS allows the instructor to move between media types seamlessly, so that the participant learning experience is not disrupted by delays as different programs are called by the LMS.
- The instructor responds to participant question as they are posed via an LMS interface, such as a chat feature or a hand-raising feature.
- The LMS maintains a record of questions asked and instructors' responses, if they are texted based.
- The LMS facilitates group discussions by displaying multiple participants (or instructors) on the screen at once as they perform a round-table style discussion.
- The instructor solicits feedback on the training via the LMS.
- The LMS tabulates the participant feedback and provides a report.

User: **Course Administrator**

- The CA receives the list of participants from NNSA HQ.
- The CA creates a user profile in the LMS for the participants if one does not already exist.
- The CA registers the participants for the training in the LMS.
- The CA, via the LMS, notifies the participants that they are registered and provides them their log in information.
- The CA creates a user profile for instructors based on NNSA HQ authorization.
- The LMS notifies the instructors that they are registered and provides them their log in information

Appendix 5: Asynchronous Training

User: **Participant**

- The participant receives notification from the State Authority that they will be participate in an INSEP asynchronous training course.
- The State Authority provides INSEP with a list of participants and their information to create a user account (if not already done).
- The LMS provides an instructive tutorial on how to use the LMS.
- The participant logs into the LMS to navigate through course content.
- The participant begins to complete the training course.
- The LMS automatically creates a "marker" to save a location where the participant can pick-up the training should the participant decide to stop working through the course content.
- The participant can review content that has been completed or not completed.
- The participant takes notes on an online journal.
- The participant asks questions of the instructor via email, SMS, or a course discussion room.
- The LMS informs the participant as well as keeps track when content has been completed.
- The LMS informs the participant as well as keeps track if content has not completed.
- The LMS provides assistance to the participant should the participant experience problems (e.g., navigating the LMS, or navigating through the course).

User: **Content Developer**

- The Content Developer prepares the location within the LMS where the asynchronous training will occur.
- The Content Developer prepares the training curriculum.
- The Content Developer identifies the content to meet the objectives of the training curriculum.
- The Content Developer identifies training material to be developed.
- The Content Developer monitors the progress of the content development process.
- The Content Developer monitors the progress of the participants completing the training (possibly a different Use Case???).

User: **Instructor**

- The instructor customizes the material to meet the participants' needs.
- The instructor creates content knowledge or content learning checks for the training material to ensure concepts of the training material are understood.
- The instructor creates recordings of any training material (PPT, MSWORD, Excel).
- The instructor modifies or deletes any training material.
- The instructor responds to participant questions posed via the LMS.
- The instructor monitors the asynchronous training course
  - LMS identifies the participant who has received access
  - LMS identifies the participant who has logged into the asynchronous training course
  - LMS identifies the status of modules completed by the participant

    - LMS identifies the modules not completed
    - LMS sends a reminder to the participant to complete the asynchronous training
- The instructor solicits feedback on the training via the LMS.
- The LMS tabulates the participant feedback.

User: **Course Administrator**

- The course administrator receives the list of participants from INSEP.
- The course administrator registers the participants for the asynchronous training.
- The course administrator notifies the participant that they are registered for the asynchronous training and provides the participant with their login information to access the LMS.

Appendix 6: Record Synchronous Training for Asynchronous Playback

User: **Instructor**

- logs onto the LMS
- reviews the training presentation on the LMS
- conducts a dry run of the presentation
- records a multi-media presentation via the LMS, which includes power point slides, video clips, or a text-based document
- pauses the recording
- playbacks any material previously recorded
- edits the presentation using tools provided either by the LMS or third-party software
- LMS automatically saves the presentation at predetermined intervals
- saves the presentation to the LMS

Appendix 7: Participate in Group Discussions

User: **Participant**

- logs onto the LMS
- participates synchronously via live stream video
- participates synchronously with another individual via text
- participates synchronously with groups of participants via text
- participates synchronously via a group white board
- participates synchronously with another individual via a white board
- participates synchronously in a discussion forum
- shares online journal synchronously with individuals and others
- shares online journal a synchronously with individuals and others
- participates asynchronously in a discussion forum
- participates asynchronously with another individual via text
- participates asynchronously with groups of participants via text
- participates asynchronously via a group white board
- participates asynchronously with another individual via a white board
- searches a discussion forum for a topic
- responds to questions in writing on a discussion forum
- records video for posting to discussion forum

Appendix 8: Training Material Development

Content Development Lead: HQ, TMMG, or SME
Content Developer: SME, TMMG member, Regional Lead, private contractor, foreign expert (e.g. IAEA, partner country expert)
Grey: Outside of LMS
Black: Inside the LMS
Purple: Content related to asynchronous training

CONTENT MANAGEMENT

- Based on JTA and other factors, HQ and Content Development Lead) identify and prioritize the training topic/modules that need to be developed.
- Based on various types of feedback, HQ and CDL identify existing content that needs to be edited.
- HQ can set up and use share folders/'collaboration spaces' in LMS for internal HQ taskers related to content development (e.g. strategic plans for training, budgets, etc.). LMS allows real-time collaboration among various federal users at DOE/NNSA.
- CDL creates and manages content development folders and processes through LMS.
- LMS creates 'collaboration spaces" for CDs to work together in real time on content.
- CDL can tag topics and modules that are meant for web-based (instructor-led or asynchronous) or classroom training.
- CDL assigns users who can have "create, read, update, or delete' responsibilities in the LMS and imposes the content approval process.
- CDL or CD can set up restricted/protected files containing Official Use Only documentation.
- LMS allows CDL to impose viewing/exploring restrictions on foreign CDs. The project team involving foreign CDs can set up a restricted content development folder in LMS.
- LMS sends content development request to CD or multiple CDs
- LMS allows CD or CDL to identify individual content items and aggregate them into a given training module or group of modules becoming a course.
- CD, RL uploads or downloads multiple documents from LMS for assembly into a full package to be sent for translation and duplication for classroom delivery.
- CD can see a percentage of training material completed, incomplete, in progress to tract their progress.
- HQ or CDL has access to a LMS dashboard which illustrates the status of curriculum being developed in the LMS, which can be viewed at different levels of granularity (such as tasks and modules rolled up to a course) to have insight if the milestones are being met.

CONTENT AUTHORING (DEVELOPMENT)

- CD receives notification new content needs to be development or existing content modified
- CD accesses LMS from different geographical locations (US and globally).
- CD accesses, develops and uploads content to LMS using a variety of devices (PC, Mac, desktops, mobile phones)
- CD develops materials using a range of applications (Word, PP, Video, Excel, VR platforms, Menti, etc.) on their computer or development tools that are provided via the LMS.
- CD follows the ADDIE model to develop content via pre-approved templates and processes in LMS.
- LMS contains repository of existing training/outreach materials and references for CD to draw from during content development process.
- LMS can identify whether a content item (e.g. text, image, video) already exists to allow for efficient reuse of content items.
- CD uses Program-branded template (DOE/NNSA INSEP) to create content. Program-branded templates are automatically available through LMS.
- CD or CDL can recommend/tag sequencing of modules to facilitate course agenda development and instruction
- CD can modify existing content in LMS based on feedback from Regional Leads or HQ, trip reports, surveys, dry runs, etc.
- LMS allows CD to record a training session
- CD can also edit a recorded session to correct, delete and add material if needed
- LMS makes it possible for the CD to write on a 'virtual' white board while recording a session (e.g. to explain a concept)
- CD develops quizzes or other check-knowledge methods at the end of each training module or set of modules in LMS.
- For asynchronous training, LMS allows CD to set up sequential navigation for given modules.
- CD develops course evaluation surveys in LMS. Survey will be automatically added upon completion of a module or a course in an asynchronous setting.
- LMS aggregates and sends participant feedback related to a module/course to CD.

CONTENT APPROVAL AND GOVERNMENT RELEASE

- CD goes through government release process at his/her organization prior to posting any drafts in LMS
- CD submits a draft in LMS for peer review and approval.
- LMS notifies other users when draft is submitted and automatically sends an action to the next user (e.g. peer reviewers, QC, CDL).
- LMS imposes version control features and archives old versions.
- LMS notifies users when changes are made to content, what those changes are, by whom and when.
- CD marks final government release status in the LMS.
- LMS tags approved modules as Master.

Appendix 9: Conducting Surveys

User: **Content Developer or Instructor**

- The LMS facilitates the creation of survey instruments, either through an LMS provided tool or through third party software such as Survey Monkey or Menti-Meter.
- The LMS provides options for soliciting feedback, such as radio buttons, short-answer text, long-answer text, and selecting from pre-populated lists among others.
- The LMS provides the capability to distribute surveys pre-training, post-training, or during the training.
- The LMS collects and tabulates survey responses.
- The LMS provides options for displaying data, such as bar graphs, pie charts, groups of common answers, or simple lists (for example, Menti-meter).
- The LMS displays surveys in multiple languages.
- The survey developer can specify types of reports desired.

User: **Participant**

- The LMS displays a survey to the participant via the user interface.
- The LMS provides the ability for the participant to print a survey in certain circumstances.
- The participant responds to a survey through the LMS using radio buttons, short-answer text, long-answer text, and selecting from pre-populated lists among others.
- The participants review and modify their response before submitting to INSEP via the LMS.
- The participants have the ability to complete the survey over a period of time, such as a pre-training survey may require one or two weeks to complete, whereas a training survey may be completed at the end of the training, or during the training.
- The LMS can support multiple languages.
- The LMS allows for participants to submit surveys anonymously.

User: **Course Administrator**

- The course administrator reviews surveys on the LMS
- The course administrator includes survey results in training reports
- The course administrator annotates survey results with comments.

Appendix 10: Course Administration

(CA's role is assumed to be cross-cutting and spans support in aspects of web-based and classroom style training as could be supported by LMS).

- CA tracks and updates instructor availability in LMS. LMS displays a dashboard for any given month/quarter showing instructor availability.
- CA tracks and updates a calendar of all training courses (web-base and face-to-face) in LMS. LMS displays a dashboard showing all training in a given month/quarter/fiscal year. CA can sort training and instructor availability by geographical region (e.g. Asia, FSU, etc.)
- CA sets up participant user accounts and arranges for participant site access.
- CA re-sets password in LMS.
- CA edits and/or deletes participant accounts from LMS, if needed.
- CA registers participants in LMS for asynchronous training course.
- CA provides the participant with their login information to access the LMS for asynchronous training.
- CA manages the participants roster and notes any cultural or professional sensitivities and protocols in LMS (next to the user account).
- CA establishes and manages participant learning profiles in LMS and ensures that appropriate learning is delivered to the target audience.
- LMS sets up personalized learning dashboard (indicate completed training, other available training for specific topic, announcements from the Program, links to specific IAEA guidance).
- CA uploads online courses in the system and validates course functionality for participants.
- CA helps troubleshooting any issues in LMS for participants in asynchronous training.
- CA identifies and secures PII information of participant users. LMS stores PII in a secure manner.
- CA checks participant profiles against any US government restrictions and sanctions and makes notes in LMS.
- CA works together with Content Developers and TMMG to manage training materials release authorizations such as DC, export control prior to use.
- CA chooses appropriate platform for delivery and ensures interoperability with LMS. LMS is interoperable with main platforms such as Zoom, BlueJeans, Webex.
- CA monitors and saves Q&A, chat information in LMS.
- CA trouble-shoots log-in, interface issues.
- CA addresses participant and instructor questions and issues, concerns prior, during and post-training related to LMS.
- Makes a record of questions and/or issues and resolutions.
- CA connects a participant question with an instructor for answers and explanations in LMS.
- CA manages a range of reports and records generated during and post-training:
    - Quiz and test results (per specific question/topic; data can be rolled up into aggregate)
    - Evaluation surveys,

    - Participant feedback (other than in evaluations) during asynchronous training and other web-based training
    - Instructor feedback (e.g. Survey Monkey results), etc.
- CA creates and manages certificates for participants, incorporates them into course completion as appropriate.
- CA administers other reporting as required by the INSEP Program (e.g. aggregate participant learning profile data, training data by country/region, etc.).
- CA audits and monitors data integrity within LMS.
- CA downloads courses (in multiple files) from LMS for assembly and printing.

Appendix 11: Complete Assignments

User: **Participant**

- Logs onto the LMS
- Navigates to a work space for conducting exercises and assignments
- Accesses the assignment from the LMS
- Reads assignment provided by the instructor
- Documents exercise progress on the LMS
- Uses white board to share ideas and approaches with other participants
- Uses SMS li
- Interacts with other participants to complete exercise steps, or;
- Completes exercise by alone
- Interacts with the instructor to ask questions
- Interacts with the instructor when prompted by the instructor
- Documents exercise results
- Submit results to LMS
- Participants in exercise review with other participants or the instructor

Use: **Instructor**

- Logs onto the LMS
- Distributes the assignment
- Orients participants as required
- Tracks participant progress
- Interacts with participants to ask questions or to answer questions *(See Provide Feedback on Assignment User Case)*
- Notifies the participants that the exercise time is complete

Appendix 12: Provide Feedback on Assignments

User: **Participant**

- Logs onto the system
- Receives synchronous feedback over live video
- Receives synchronous feedback using chat feature
- Receives synchronous feedback using a whiteboard feature
- Receives asynchronous feedback over video
- Receives asynchronous feedback using a text-based response
- Receives asynchronous feedback via a class discussion room

Use: **Instructor**

- Logs onto the LMS
- Provide synchronous feedback over live video
- Provide synchronous feedback using chat feature
- Provide synchronous feedback using a whiteboard feature
- Provide asynchronous feedback over video
- Provide asynchronous feedback using a text-based response
- Provide asynchronous feedback via a class discussion room

Appendix 13: LMS Requirement Categories and Requirement Types

Functionality: The features of the system that we need to support our training events. It is the front-end of the system – user interfaces, types of media presented, how the various users interact with the LMS and the training environment. Subcategories are:

- Communications
- Data Input (all users except IT professionals)
- General Security
- Growth capacity
- Human factors
- Performance/Capabilities
- User interface

Data Management: The back end of the data system. The structure of data bases, information security, and managing and manipulating the training data. For the various reports we would want, the data sorting and queries would be documented here, and the types of reports and the information they contain would be addressed in the *Reports and Documents* section. Subcategories are:

- Database structure
- Database manipulation
- Data formats
- Data records
- Data security
- Data storage
- Data transfer

System: Addresses broad system requirements, including but not exclusive to software, that are necessary for system operation. Subcategories are:

- Availability
- Maintenance
- Regulatory constraints
- Software
- Support
- System integration/interface
- Training

Reports and Documents: Data that is organized and presented to allow decision makers to assess the status and effectiveness of INSEP's engagements. This section will also include necessary documents, other than training documentation. Subcategories are:

- Reports
- Documentation

Appendix 14: LMS Dimension for Comparison

.

The research team conducted a review on online resources to identify attributes that the team could use to describe LMSs. A preliminary list of attributes was then shared with prominent vendors who had an opportunity to add attributes that they thought would allow a more nuanced discrimination among products. The current list of attributes is shown below.

1) Communication Tools
- a) White Board
  - i) Distribution
    - (1) 1 whiteboard for all students
    - (2) Multiple whiteboards for subsets of students
    - (3) Each student has his/her own
  - ii) Ability to save
    - (1) None
    - (2) Current Version
    - (3) History
- b) Stream Video
  - i) Live/synchronous
  - ii) Recorded
- c) Discussion Forums
  - i) Organized Structure
  - ii) Ability to Search for Topics
  - iii) Ability to respond to prompt
  - iv) Ability to respond to other user's comments
  - v) Presence of Moderator function
- d) Social / Experiential Learning - Communities
  - i) Closed Communities based on role, geography, or discipline
    - (1) Ability for end users to contribute assets such as videos, commentary recorded in the platform, documents, links to outside resources or webpages
    - (2) Ability for a moderator to approve or reject content based on community standards
  - ii) Content is accessible anywhere
    - (1) Available through the browser interface as well as on a mobile device
    - (2) Content should live and be viewable within the platform, not take the learner to a new page outside the platform
    - (3) Data, Reporting & Analytics

e) File Exchange
    i) Ability to control scope of share
    ii) Ability to add security to exchange locations (e.g., a secure drop box)
    iii) Ability to proctor/moderate file exchange
    iv) Integration with Google Docs or other file sharing tools
    v) Allow for drag & drop functionality
    vi) Allow for multiple upload/download
    vii) Variety of File types
        (1) JPEG
        (2) PNG
        (3) GIF
        (4) MP4
        (5) SVG
        (6) PDF
        (7) DOC
        (8) XLS
        (9) RTF
        (10) TXT
        (11) PPT
f) Communication Support
    i) Email
        (1) By individual
        (2) By group
        (3) By course
        (4) All users
    ii) Live Chat
        (1) Instant messaging
        (2) Video chat
    iii) Online Journal
        (1) Ability to secure journal
        (2) Ability to share the journal with an instructor (e.g., for assessment)
        (3) Ability to share the journal with other users
        (4) Ability to search journal entries

2) Administration Tools
a) Authentication
    i) Two-factor Authentication
    ii) No Authentication
    iii) Single Sign On

iv) Location of Credential Database
    (1) External database
    (2) Specified Server
        (a) IMAP Server
        (b) LDAP Server
        (c) NNTP Server
        (d) POP3 Server
        (e) RADIUS Server
        (f) Shibboleth Server
v) Ability to reset credentials
vi) Allow signups through social media
vii) Allow administrator accounts to log on remotely (i.e., restricted to console access only)?
viii) Remove all disabled accounts within a specified timeframe?
ix) Allow for central management of authentication to the firewalls, IPS sensors, routers and switches for individually identifiable accounts?

b) Course Authorization
    i) Single enrollment
    ii) Batch enrollment
    iii) Self-enrollment
c) Registration Integration
    i) Support self-registration
    ii) Support manual registration
    iii) Support match registration
        (1) from Excel
        (2) from Database
d) Student Profiles
    i) Extensibility (i.e., the ability to add custom fields to the student profile)
e) Report Generation
    i) Pre-built and custom reporting
    ii) Ability to export reports in csv/excel
    iii) Ability to schedule reports

3) Curriculum Design
a) Course Templates
b) Course categories and subcategories (ability to categorize courses based on their content)
c) Ability to allow students to pick courses from a course catalog
d) Ability to allow students to rate courses (stars)

e) Curriculum Management
    i) LMS has ability to create modules or units
    ii) LMS provides the ability to sequence students through content
f) Customization of Look-and-Feel
    i) Allows for Customization and Personalization
    ii) Allows for Branding
    iii) Use a template to lock specific settings or content items
g) Instructional Design/Content Development Tools
    i) Support for Synchronous instructor led training via streaming video
    ii) Support for streaming recorded video
    iii) Support for interactive multimedia instruction
    iv) Support for blended instruction
    v) Support for gamification
    vi) Support for virtual classrooms
    vii) Support for mobile learning
h) Automated Testing and Scoring
    i) Simple assessment tool to add different types of questions
        (1) Multiple choice
        (2) Short answer
        (3) Essay questions
        (4) Equation
        (5) Word cloud
        (6) Matching
        (7) Provides tools for creating assessments with
        (8) Multimedia
        (9) Learning games
        (10) Interactive tools (e.g., polls and surveys)
    ii) Provides tools to share the results of polls and surveys with the class
    iii) Adaptive testing (e.g., Multipart questions and branching)
    iv) Tests can provide immediate feedback with tips for remediation
    v) Calculation capabilities beyond +-*/ (e.g., engineering equations)
    vi) Ability to include pictures or diagrams with questions
    vii) Robust rubric integration
    viii) Ease of use and user friendliness of the system to provide contextual comments on written papers (e.g., pdf annotator)
i) Content Sharing and Reuse
    i) LMS provides a repository for content and basic tools for content organization
    ii) Supports Multi-file upload/download

iii) Supports drag & drop upload/download
iv) LMS capable of using content from public, private and shared workspaces including subscription-based content (e.g., podcasts and feeds) to archival content

4) Course Delivery Tools

a) Course Management
   i) Communication capabilities when assignments are posted and when discussion questions responses have been completed
   ii) Tracking tools available for all user activity, including instructional users (audit log, student participation log, time on task etc.)
   iii) Hierarchical and flexible system for anonymous evaluations at course, department and institutional level for either summative or formative purposes

b) Instructor Support
   i) Helpdesk
   ii) Printed Materials
   iii) Webinars, online and classroom training sessions

c) Online Grading Tools
   i) Grade book
   ii) Grades can be exported to a spreadsheet or student information system
   iii) LMS provides a record of learning that could be used across multiple disciplines/functions
   iv) Support for peer and 360 evaluation

d) Student Tracking
   i) Students are automatically emailed when their participation is substandard (or other triggers met)

e) Archives
   i) Provide instructor access to completed and archived courses
   ii) Allows retrieval of student learning history
   iii) Ability of students to re-take completed units

5) Student Involvement

a) Group Work
   i) The definition of groups
   ii) The definition of collaboration areas

b) Student Community Building

c) Self-assessment

d) Student Portfolios
   i) Tools to allow students and instructors to create ad-hoc presentations
   ii) Tools to allow students and instructors to create structured presentations
   iii) Tools to allow students and instructors to gather and present student work products

e) Ability to share ePortfolio outside of the LMS

6) Productivity Tools
   a) Bookmarks
   b) Searching Within a Course
   c) Calendar/Progress Review
   d) Ability to Work Offline and then Synchronize
   e) Orientation/Help
      i) Online user manual
      ii) Context Sensitive help
      iii) Pop-up and rollovers for just-in-time prompts
      iv) 24/7 Helpdesk

7) Pricing/Licensing
   a) License Structure
      i) Open Source
         (1) Significant Usage requirements
         (2) Significant modification restrictions
      ii) Proprietary
         (1) One-time Charge
         (2) Yearly Flat Fee
         (3) Active users per month Fee
         (4) Registered users per month
         (5) Free
         (6) Free + Premium Upgrades
   b) Payment Methods
      i) Credit card
      ii) Wire transfer
      iii) Check
      iv) PayPal
   c) Free Trial Available

8) System
   a) Hosting Location
      i) Locally Hosted
      ii) Software As a Service
      iii) Hybrid (e.g., locally hosting via AWS)
   b) Server OS
      i) Windows
      ii) Linux
      iii) Other

c) Client Hosting
    i) Instructor
        (1) Client Desktop Software
            (a) Windows
            (b) macOS
            (c) Linux
        (2) Browser-based
            (a) Edge
            (b) Internet Explorer
            (c) Chrome
            (d) Firefox
            (e) Safari
        (3) Mobile Application
            (a) Android
            (b) iOS
            (c) Other
        (4) Mobile Form Factor
            (a) Phone
            (b) Tablet
    ii) Students
        (1) Client Desktop Software
            (a) Windows
            (b) macOS
            (c) Linux
        (2) Browser-based
            (a) Edge
            (b) Internet Explorer
            (c) Chrome
            (d) Firefox
            (e) Safari
        (3) Mobile Application
            (a) Android
            (b) iOS
            (c) Other
        (4) Mobile Form Factor
            (a) Phone
            (b) Tablet
    iii) Administrators

(1) Client Desktop Software
(a) Windows
(b) macOS
(c) Linux
(2) Browser-based
(a) Edge
(b) Internet Explorer
(c) Chrome
(d) Firefox
(e) Safari
(3) Mobile Application
(a) Android
(b) iOS
(c) Other
(4) Mobile Form Factor
(a) Phone
(b) Tablet

d) Software Support
i) Type of Support Provided
(1) Manual
(2) 24/7 Help Desk
(3) Remote Support/Remote Desktop Functionality
(4) Dedicated Customer Success Manager
(5) Onboarding Training
(6) Support for Multiple Languages
(7) Chat Support
ii) Cost of Support
(1) Free/Included in Subscription
(2) Additional Fee
iii) Updates
(1) How often is the Software Updated?
(2) Is there a fee for updates?
iv) Uptime Guarantee

9) Integration
a) Content Standards
i) Interoperability Standards
(1) AICC
(2) Sharable Content Object Reference Model (SCORM)

(3) PENS
(4) Learning Tools Interoperability (LTI)
(5) IMS Common Cartridge
(6) CMI5
(7) LETSI RTWS
(8) TinCan / xAPI

ii) Accessibility
(1) Section 508

b) Embedded Support for Third Party Tools
i) Adobe Connect
ii) ADP
iii) API
iv) BambooHR
v) BigBlueButton
vi) Dropbox
vii) Drupal
viii) G Suite
ix) Google Calendar
x) GoToMeeting
xi) GoToTraining
xii) GoToWebinar
xiii) HubSpot
xiv) Joomla
xv) Magneto
xvi) Mailchimp
xvii) Microsoft Dynamics CRM
xviii) Namely
xix) Office 365
xx) Okta
xxi) OneDrive
xxii) OneLogin
xxiii) Oracle Sales Cloud CRM
xxiv) Outlook Calendar
xxv) PayPal
xxvi) Salesforce CRM
xxvii) SAP CRM
xxviii) Service Now
xxix) SharePoint

xxx) Shopify
xxxi) Slack
xxxii) Stripe
xxxiii) Sugar CRM
xxxiv) WebEx
xxxv) WooCommerce
xxxvi) WordPress
xxxvii) Zapier
xxxviii) Zendesk
xxxix) Zoom

10) Portal Organization and customization

a) Ability to create independent sub-portals (branches)
b) Ability to create groups of students, in order to assign common courses (groups)
c) Ability to customize and brand your portal and sub-portal(s)
d) Ability to add your own login domain
e) Ability to create automated events based on triggers (e.g., course assignments, user deactivation, point assignment, etc.)
f) Ability to customize automated notifications based on triggers (e.g., on course assignment, on user signup, X hours before expiration)
g) Ability to configure user permissions

11) Security

a) Allow IP control and filtering?
b) Support double username access lockability?
c) Support secure password management?
d) Support encryption and user password per authentication?
e) Encrypt data during transmission?
f) Include an advanced antivirus check on all uploaded content?
g) Is the system compliant with ISO 27001 Certification?
h) Is there a protocol for conducting penetration test assessments?

12) Logging and Security Response

a) Log security events on networking, security device, or on server equipment?
b) Does the system's logging practices enable the identification of the IP Address of the remote system in the event of an attack?
c) Maintain all security logs? If yes, indicate retention period.
d) Have documented and implemented security incident response procedures?
e) Have incident response processes in place to investigate potential security incidents in real-time? If no, specify timeframe.

f) Have processes in place to report security incidents to the customer? If yes, indicate timeframe.
g) Send logs to a centralized log collection server?
h) Monitor logs for security events and intrusion attempts in real time?
i) Perform an automated correlation of security logs between the various device types (system, network, firewall, and/or IPS)?
j) Enable the identification of internal personnel (specific user) in the event of an internal attack?

13) Network/Service Architecture

a) Deploy firewalls?
b) Deploy network Intrusion Prevention System (IPS) sensors? If yes, are all IPS sensors updated within 24 hours of new signatures released?
c) Support the firewalls, IPS sensors, routers and switches on software and hardware levels?
d) Patch all critical security issues on firewalls, IPS sensors, routers and switches within 1 month of release?
e) Encrypt data in transit on public or shared networks?

14) Secure Server

a) Have antivirus software installed and running optimally in the server?
b) Have measures in place to protect data from exposure when the service is executed on shared servers?
c) Have measures in place to protect from performance degradation when the service is executed on shared servers?
d) Have policies in place to ensure the integrity of any software prior to installation?
e) Have its servers built off a general network or on an isolated network?
f) Have security patches installed prior to the server being put onto the general network?

15) Backups

a) Are the servers backed up to external media (e.g. tape) on a daily basis or all data replicated in near real-time to a secondary site?
b) Are backups tested regularly? If yes, please specify the frequency.
c) If data is backed up to external media, how often are full backups performed?
d) If data is backed up to external media, are the backups encrypted?
e) If data is backed up to external media, are the backups stored offsite?

Appendix 15: Attribute to Requirements Map

The research team, working with prominent vendors defined a set of attributes that the team could use to describe and discriminate among various products. Using these attributes as a starting point, the team then defined a set of user requirements that were related to each class of attribute. This mapping is provided below.

Attribute	Derived Requirements for INSEP
16) Communication Tools	
a) White Board	• The system shall allow for individuals and groups to create whiteboards for sharing ideas in real-time. • The system shall allow users to save, recall, and edit individual whiteboards. • The system shall NOT save the history of each whiteboard. • The system shall allow users to resume work on a previously saved whiteboard.
i) Distribution	
(1) 1 whiteboard for all students	
(2) Multiple whiteboards for subsets of students	
(3) Each student has his/her own	
ii) Ability to save	
(1) None	
(2) Current Version	
(3) History	

Attribute	Derived Requirements for INSEP
b) Stream Video i) Live/synchronous ii) Recorded	• The system shall support the streaming of live videos. • The system shall support multiple resolutions to accommodate various bandwidth limitations. • The system shall have the ability to encode video files in various formats • The system shall maintain adequate non-volatile storage for recorded videos • The system shall allow the user to move back in the video timeline when streaming a stored video. • The system shall allow the user to move forward in the video timeline when streaming a stored video. • The system shall prevent the user from moving past an unviewed portion of the timeline when streaming a stored video. • The system shall allow the user to pause playback when streaming a stored video. • The system shall prevent the user from pausing playback when streaming a live video. • The system shall prevent the user from moving back in the timeline of a live video. • The system shall support the streaming of recorded videos stored in the following formats ○ TBD

Attribute	Derived Requirements for INSEP
c) Discussion Forums	• The system shall allow instructor and administrators to create discussion boards. • The system shall allow discussion boards to have an internal structure (i.e., sub-boards). • The system shall allow discussion boards to be linked to instructional courses/activities. • The system shall allow instructors/administrators to post prompts. • The system shall allow students to respond to posted prompts. • The system shall allow students to respond to other students. • The system shall provide an optional moderator function. • The system shall allow moderators to hide posts. • The system shall allow moderators to prevent specific users from creating posts. • The system shall allow moderators to review posts before they appear to all users. • The system shall notify students when instructors have posted prompts. • The system shall notify users when other users have responded to them. • The system shall notify users when other users have mentioned them by name. • The system shall allow for keyword searches of prompts and responses and discussion board titles. • The system shall implement automated ways/measures to prevent cross site scripting and cross site request forgery in discussion board posts (cybersecurity)
i) Organized Structure	
ii) Flexible discussion options; discussions do not need to be tied to a course or activity (course vs community-based for example)	
iii) Ability to Search for Topics	
iv) Ability to respond to prompt	
v) Ability to respond to other user's comments	
vi) Presence of Moderator function	

Attribute	Derived Requirements for INSEP

d) Social / Experiential Learning - Communities	• The system shall provide community spaces within which students can collaborate on "group projects."
	• The system shall allow students to upload the following types of content to the group space.
	  ○ TBD
	• The system shall provide for an optional moderator function for approving uploads.
	• The system shall provide an interface for viewing every type of upload it allows.
	• The system will provide access to the group space based on the following student profile attributes.
	  ○ User name
	  ○ Course enrollment
	  ○ Country of origin
	  ○ Region of origin
	• The system shall warn students if clicking on a link will take them to an external site.
	• The system shall allow for an administrator to limit the size of a community uploaded asset.
	• The system shall provide data analytics and reporting:
	  ○ User name
	  ○ Content list of assets uploaded
	  ○ Platform (mobile/computer/tablet) used to access community.
	  ○ Time spent in community space.

i) Closed Communities based on role, geography, or discipline	
(1) Ability for end users to contribute assets such as videos, commentary recorded in the platform, documents, links to outside resources or webpages	
(2) Ability for a moderator to approve or reject content based on community standards	
ii) Content is accessible anywhere	
(1) Available through the browser interface as well as on a mobile device	
(2) Content should live and be viewable within the platform, not take the learner to a new page outside the platform	
(3) Data, Reporting & Analytics	

Attribute	Derived Requirements for INSEP

e) File Exchange	• The system shall support file exchange among users.
	• The system shall provide a secure exchange location/drop box.
	• The system shall allow the user to limit the scope of access based on the following user attributes.
	  ○ User name
	  ○ Course enrollment
	  ○ Country of origin
	  ○ Region of origin
	• The system shall provide for an optional moderator function for approving file exchange.
	• The system shall support "drag and drop" upload and download from/to a user's local system.
	• The system shall allow a user to upload/download multiple files within a single operation.
	• The system shall support upload/download of any approved file type.
	• The system shall indicate file upload/download progress.
	• The system shall warn user if attempting to upload a non-supported file type.
	• The system shall automatically virus/malware scan uploaded files(cybersecurity)
	• On Mobile platforms, the system shall launch native file sharing apps when users select links for those services.
	• The system shall allow an interrupted file upload to be resumed.
	• The system shall allow file shares to have an expiration date.
	• The system shall enforce a configurable storage capacity per user.

i) Ability to control scope of share	
ii) Ability to add security to exchange locations (e.g., a secure drop box)	
iii) Ability to proctor/moderate file exchange	
iv) Integration with Google Docs or other file sharing tools	
v) Allow for drag & drop functionality	
vi) Allow for multiple upload/download	
vii) Variety of File types	
(1) JPEG	
(2) PNG	
(3) GIF	
(4) MP4	
(5) SVG	
(6) PDF	
(7) DOC	
(8) XLS	
(9) RTF	
(10) TXT	
(11) PPT	

Attribute	Derived Requirements for INSEP
f) Communication Support	
i) Email	• The system shall allow instructors/administrator to send custom email messages to each of the following groups. ○ Individual users ○ All individuals enrolled in a course. ○ All members of a specific learning community. • The system shall provide the ability to generate automatic emails to users under the following conditions. ○ The user has been enrolled in a course. ○ The user has been removed from a course. ○ The user has completed a course. ○ The user has not accessed course material by a specified date. ○ The user has an assignment that is past due. • The system shall allow for instructors/administrator to save email templates.
(1) By individual	
(2) By group	
(3) By course	
(4) All users	
ii) Automatic email generation based on a number of trigger conditions. For example:	
(1) Inactivity (no log ins)	
(2) Missing assignments	
(3) Performance levels	
(4) Completion	

Attribute	Derived Requirements for INSEP
iii) Live Chat	• The system shall support user-to-user text chat. • The system shall support group text chat. • The system shall allow users to define text chat groups. • The system shall include an optional moderator function for the chat system. • The system shall allow moderators to prevent specific users from posting to specific chat groups. • The system shall allow moderators to prevent specific users from posting to all chat groups. • The system shall allow moderators to close down specific chat groups. • The system shall support user to user video chat. • The system shall support single user video stream to many users text chat. • The system shall prevent users from moving the timeline during video chat. • The system shall prevent users from pausing playback during video chat. • The system shall allow users to set an available-for-chat status visible to other users. • The system shall allow users to set an unavailable-for-chat status visible to other users. • The system shall allow users to hide their online status from all other users. • The system shall allow users to block specific other users from seeing their online status. • The system shall allow users to block specific other users from communicating with them via chat. • The system shall allow for video chat functionality. • The system shall accommodate for low bandwidth connections when using chat features
(1) Instant messaging	
(2) Video chat	

Attribute	Derived Requirements for INSEP
iv) Online Journal	• The system shall allow students to maintain journals. • The system shall allow instructors to review and comment on student journals. • The system shall include keyword searching within journals. • The system shall allow journals to be shared with other users. • The system shall allow students to revoke access to their journals from other students • The system shall allow users to archive journal entries after a specified time period, preventing all users including instructors from accessing them
(1) Ability to secure journal	
(2) Ability to share the journal with an instructor (e.g., for assessment)	
(3) Ability to share the journal with other users	
(4) Ability to search journal entries	

Attribute	Derived Requirements for INSEP
17) Administration Tools	
a) Authentication	• The system shall require each user to maintain a unique identity. • The system shall associate a role with each identity. • The system shall allow for two-factor authentication to enable access. • The system shall allow users to reset forgotten passwords by sending an automated secured link to the user's email address on record. • The system shall require confirmation of a user's email address at registration by sending an automated secured link to the address. • The system shall prompt the user to re-confirm their email address periodically. • The system shall disable accounts that have been inactive for a specified period. • The system shallow allows for administrator remote access.
i) Two-factor Authentication	
ii) No Authentication	
iii) Single Sign On	
iv) Location of Credential Database	
(1) External database	
(2) Specified Server	
(a) IMAP Server	
(b) LDAP Server	
(c) NNTP Server	
(d) POP3 Server	
(e) RADIUS Server	
(f) Shibboleth Server	
v) Ability to reset credentials	
vi) Allow signups through social media	
vii) Allow administrator accounts to log on remotely (i.e., restricted to console access only)?	
viii) Remove all disabled accounts within a specified timeframe?	
ix) Allow for central management of authentication to the firewalls, IPS sensors, routers and switches for individually identifiable accounts?	
b) Course Authorization	• The system shall allow administrators to add individual users. • The system shall allow administrators to add a group of users. using an Excel file or another similar delimited source. • The system shall allow administrators to enroll individual users in a course. • The system shall allow administrators to enroll a group of users to a course using an Excel file or another similar delimited source.
i) Single enrollment	
ii) Batch enrollment	
iii) Self-enrollment	
c) Registration Integration	
i) Support self-registration	
ii) Support manual registration	
iii) Support match registration	
(1) from Excel	
(2) from Database	

Attribute	Derived Requirements for INSEP
d) Student Profiles	• The system shall maintain a user profile for each user. • The system shall enable administrators to add fields to the standard user profile.
i) Extensibility (i.e., the ability to add custom fields to the student profile)	
e) Report Generation	• The system shall include a collection of standard reports pertaining to the following data types. • TBD • The system shall allow administrators to define custom reports summarizing stored data. • The system shall export report data to Microsoft Excel. • The system shall export report data to comma-separated text files. • The system shall allow administrators to set schedule for automatic report generation and distribution.
i) Pre-built and custom reporting	
ii) Ability to export reports in csv/excel	
iii) Ability to schedule reports	
18) Curriculum Design	
a) Course Templates	• The system shall provide one or more course templates to provide common structures among similar courses. • The system shall allow for course templates to be customized. • The system shallow for new course templates to be created. • The system shall allow for keyword tags to be embedded within a template.
b) Course categories and subcategories (ability to categorize courses based on their content)	N/A
c) Ability to allow students to pick courses from a course catalog	N/A

Attribute	Derived Requirements for INSEP
d) Ability to allow students to rate courses (stars)	• The system shall support the development of course-rating surveys (i.e., Kirkpatrick Level 1 surveys). • The system shall support discrete and short answer questions within course-rating surveys. • The system shall generate/export reports-based course rating data. • The system shall allow students to modify and delete survey responses.
e) Curriculum Management	• The system shall allow curriculum developers to decompose a course into constituent modules/units. • The system shall allow curriculum developers to establish the sequence in which students should access/complete modules/units. • The system shall allow curriculum managers to define prerequisites for a given module/unit.
i) LMS has ability to create modules or units	
ii) LMS provides the ability to sequence students through content	
f) Customization of Look-and-Feel	• The system shall allow the administrator to set the color scheme to be used within the system. • The system shall allow the administrator to define screen layout for learning activities within the system. • The system shall allow an organizational logo to be displayed in the interface. • The system shallow allows for default color scheme to be overridden by user to support 508 compliance.
i) Allows for Customization and Personalization	
ii) Allows for Branding	
iii) Use a template to lock specific settings or content items	
g) Instructional Design/Content Development Tools	
i) Support for Synchronous instructor led training via streaming video	Addressed elsewhere
ii) Support for streaming recorded video	Addressed elsewhere

Attribute	Derived Requirements for INSEP

iii) Support for interactive multimedia instruction	• The system shall support the authoring of asynchronous self-paced interactive multimedia instruction.
	• The system shall support the delivery of asynchronous self-paced interactive multimedia instruction.
	• The system shall allow content developers to include the following content presentation media:
	  ○ Text
	  ○ Still Graphics (TBD – Add file types)
	  ○ Animated Graphics (TBD – Add File Types)
	  ○ Video (TBD – Add File Types)
	• The system shall allow content developers to include the following question types for learning checks:
	  ○ Two-state
	  ○ Multiple Choice
	  ○ Hot Spot
	  ○ Matching
	• The system shall provide IMI templates to promote commonality among similar IMI units.

iv) Support for blended instruction	TBD
v) Support for gamification	TBD
vi) Support for virtual classrooms	TBD
vii) Support for mobile learning	• The system shall allow students to access content via iOS devices. • The system shall be compatible with at least the two most recent major version releases of iOS. • The system shall allow students to access content via Android devices. • The system shall be compatible with at least the two most recent major releases of Android.
h) Automated Testing and Scoring	Addressed elsewhere
i) Simple assessment tool to add different types of questions	Addressed elsewhere
(1) Multiple choice	Addressed elsewhere
(2) Short answer	N/A

Attribute	Derived Requirements for INSEP
(3) Essay questions	N/A
(4) Equation	N/A
(5) Word cloud	N/A
(6) Matching	Addressed elsewhere
ii) Provides tools for creating assessments with	N/A
(1) Multimedia	
(2) Learning games	
(3) Interactive tools (e.g., polls and surveys)	
iii) Provides tools to share the results of polls and surveys with the class	• During synchronous activities, the system shall allow instructors to pose poll questions to attendees. • During synchronous activities the system shall give students the ability to respond to poll questions. • During synchronous instruction, the system shall provide the instructor with a control for displaying the results of the poll. • Within discussion boards, the system shall allow instructors to pose poll questions. • Within discussion boards, the system shall give students the ability to respond to poll questions. • Within discussion boards, the system shall provide the instructor with a control for displaying the results of the poll.
iv) Adaptive testing (e.g., Multipart questions and branching)	N/A
v) Tests can provide immediate feedback with tips for remediation	• The system shall allow an option for immediate remediation. • The system shall allow tests to be configured with automatic correct and/or incorrect remediation to be displayed when a user enters an answer for test questions.
vi) Calculation capabilities beyond +-*/ (e.g., engineering equations)	N/A

Attribute	Derived Requirements for INSEP
vii) Robust rubric integration	N/A
viii) Ease of use and user friendliness of the system to provide contextual comments on written papers (e.g., pdf annotator)	• The system shall provide instructors with the ability to annotate students' written input.
i) Support for peer-to-peer feedback	• The system shall provide students with the ability to annotate other students' projects.
j) Support for self-assessment	N/A
k) Content Sharing and Reuse	• The system shall provide a content repository for content developers. • Content developers shall be allowed to create organizational structures (e.g., folders) within the content repository. • The system shall limit access to the content repository to individual with appropriate role designations. • The system shall support "drag and drop" upload and download from/to a user's local system. • The system shall allow a user to upload/download multiple files within a single operation. • The system shall support upload/download of any supported file type. • The system shall provide version history of file uploads for content developers. • The system shall allow import of content published through xml feed specifications such as rss.
i) LMS provides a repository for content and basic tools for content organization	
ii) Supports Multi-file upload/download	
iii) Supports drag & drop upload/download	
iv) LMS capable of using content from public, private and shared workspaces including subscription-based content (e.g., podcasts and feeds) to archival content	
19) Course Delivery Tools	
a) Course Management	
i) Communication capabilities when assignments are posted and when discussion questions responses have been completed	• The system shall alert the relevant instructor when a student has completed an assignment. • The system shall alert the relevant instructor when a student has completed assigned discussion questions.

Attribute	Derived Requirements for INSEP
ii) Tracking tools available for all user activity, including instructional users (audit log, student participation log, time on task etc.)	• The system shall provide a dashboard that will allow instructors to monitor each student's level of participation. • The system shall monitor and display a record of the time that a student has accessed a course. • The system shall provide and display a record of the time that a student has been active within a course. • The system shall provide and display the status of each course assignment for each student.
iii) Hierarchical and flexible system for anonymous evaluations at course, department and institutional level for either summative or formative purposes	Addressed under course rating
iv) Ability to release content as a function of a variety of trigger conditions including dates, specific content consumption, grades received/assignment completion	• The system shall allow the instructor to program the automated release of content, assessment activities, and assignments. • The system shall allow the instructor to base release triggers on date/time information, content completion status, assignment completion status, and performance levels. • The system shall provide a manual control for an instructor to release content to everyone in a course. • The system shall provide a manual control for an instructor to release content to specific students.
b) Instructor Support	

Attribute	Derived Requirements for INSEP
i) Helpdesk	• The system shall provide a staffed Help Desk for instructor and administrator support. • The system's Help Desk shall be available on a 24/7/365 basis. • The system shall provide a knowledge database of frequently asked helpdesk questions. • The system's Help Desk shall notify users when updates are available to issues.
ii) Printed Materials	• The system shall provide printer-friendly User Guides that provide detailed step-by-step directions for completing common functions.
iii) Webinars, online and classroom training sessions	• The system shall provide structured training activities to instruct instructors and administrators on the optimal use of the system.
c) Online Grading Tools	
i) Grade book	• The system shall include an electronic gradebook that allows each instructor to record/monitor the standing of each student in each course he/she supervises. • The system shall ensure that an instructor will only be able to access grade records for courses to which he/she is assigned. • The system shall allow for an administrator or supervisor to access all electronic gradebooks. • The system should allow for administrator to change instructors for re-assigned classes. • The system shall provide alerts to the instructor for students whose grades fall below a certain threshold.
ii) Grades can be exported to a spreadsheet or student information system	• The system shall be able to export gradebook records to Microsoft Excel. • The system shall be able to export gradebook records to a delimited file.

Attribute	Derived Requirements for INSEP
iii) LMS provides a record of learning that could be used across multiple disciplines/functions	N/A
iv) Support for peer and 360 evaluation	• The system shall allow students who have worked together on a group assignment to provide feedback to their teammates. • The system shall allow students to provide feedback on courses they have enrolled in and completed. • The system shall make student feedback anonymous.
d) Student Tracking	
i) Students are automatically emailed when their participation is substandard (or other triggers met)	• The system shall allow the instructor to program the automated messages to students. • The system shall allow the instructor to base triggers on date/time information, content completion status, assignment completion status, performance levels, or access records.
e) Archives	
i) Provide instructor access to completed and archived courses	• The system shall allow instructor to review previously delivered synchronous training sessions.
ii) Allows retrieval of student learning history	• The system shall maintain a complete record of a student's learning experience. • The system shall maintain those records after a student's account has been removed.
iii) Ability of students to re-take completed units	• The system shall allow students to reselect and complete instructional units that that have previously completed.
20) Student Involvement	
a) Group Work	
i) The definition of groups	• The system shall allow instructors to define groups of students.

Attribute	Derived Requirements for INSEP
ii) The definition of collaboration areas	• The system shall allow instructors to define collaboration areas to support group work. • The system shall allow instructors to assign groups and/or individual users to defined collaboration areas.
b) Student Community Building	N/A
c) Self-assessment	N/A
d) Student Portfolios	
i) Tools to allow students and instructors to create ad-hoc presentations	• The system shall allow all user types to develop presentations. • The system shall allow users to select predefined presentation templates. • The system shall enforce template constraints. • The system shall allow all users to deliver synchronous presentations to an assembled group of users. • The system shall prevent users from pausing playback of live synchronous presentations. • The system shall prevent users from moving backwards in the timeline of live synchronous presentations. • The system shall allow all users to record synchronous presentations for later asynchronous playback. • The system shall allow users move back in the timeline of recorded presentations. • The system all allow users to pause the playback of recorded presentations. • The system shall allow users to move forward in the timeline of recorded presentation. • The system shall prevent users from moving past unviewed portions of recorded presentations.
ii) Tools to allow students and instructors to create structured presentations	
iii) Tools to allow students and instructors to gather and present student work products	
e) Ability to share ePortfolio outside of the LMS	N/A
21) Productivity Tools	

Attribute	Derived Requirements for INSEP
a) Bookmarks	• The system shall allow students to set bookmarks. • The system shall allow students to navigate to bookmarks. • The system shall automatically bookmark the student's last location. • The system shall provide students with an option to jump to their last location.
b) Searching Within a Course	• The system shall allow users to search for free text terms within a given instructional unit. • The system shall allow users to search for free text terms across instructional units. • The system shall employ Boolean operators within its search functions.
c) Calendar/Progress Review	• The system will provide the user with a calendar of important events. • The system shall tailor the calendar events to user types. • The system calendar for students shall include assignment due dates. • The system calendar for instructors shall include assignment due dates, course convenings, and synchronous lectures. • The system calendar for administrators shall include report due dates.
d) Ability to Work Offline and then Synchronize	N/A
e) Orientation/Help	
i) Online user manual	Addressed elsewhere
ii) Context Sensitive help	• The system shall provide online context-sensitive help for system functions.
iii) Pop-up and rollovers for just-in-time prompts	• The system shall provide pop-up tool tips to guide user interaction with interface elements.
iv) 24/7 Helpdesk	Addressed elsewhere
22) Pricing/Licensing	
a) License Structure	TBD – Does INSEP require a specific license structure?
i) Open Source	
(1) Significant Usage requirements	

Attribute	Derived Requirements for INSEP
(2) Significant modification restrictions	
ii) Proprietary	
(1) One-time Charge	
(2) Yearly Flat Fee	
(3) Active users per month Fee	
(4) Registered users per month	
(5) Free	
(6) Free + Premium Upgrades	
b) Payment Methods	
i) Credit card	• The vendor can accept payment using U.S. Government processes.
ii) Wire transfer	
iii) Check	
iv) PayPal	
c) Free Trial Available	
23) System	TBD – Does INSEP desire a specific hosting structure?
a) Hosting Location	
i) Locally Hosted	
ii) Software As a Service	
iii) Hybrid (e.g., locally hosting via AWS)	
b) Server OS	
i) Windows	
ii) Linux	
iii) Other	
c) Client Hosting	
i) Instructor	
(1) Client Desktop Software	

(a) Windows	• Instructors shall be able to access the system via desktop/laptop systems using operating systems based on Windows, macOS, or Linux.
	• The system should be accessible with baseline operating systems:
	  ○ Windows 8.X and later
	  ○ MacOS (TBD)
	  ○ Linux (TBD)

(b) macOS	
(c) Linux	
(2) Browser-based	

Attribute	Derived Requirements for INSEP
(a) Edge	• Instructors shall be able to access the system using Microsoft Edge, Google Chrome, Mozilla Firefox, or Apple Safari.
(b) Internet Explorer	
(c) Chrome	
(d) Firefox	
(e) Safari	
(3) Mobile Application	N/A
(a) Android	
(b) iOS	
(c) Other	
(4) Mobile Form Factor	N/A
(a) Phone	
(b) Tablet	
ii) Students	

(1) Client Desktop Software	• Students shall be able to access the system via desktop/laptop systems using operating systems based on Windows, macOS, or Linux.
	• The system should be accessible with baseline operating systems:
	  ○ Windows 8.X and later
	  ○ MacOS (TBD)
	  ○ Linux (TBD)

(a) Windows	
(b) macOS	
(c) Linux	
(2) Browser-based	• Instructors shall be able to access the system using Microsoft Edge, Google Chrome, Mozilla Firefox, or Apple Safari.
(a) Edge	
(b) Internet Explorer	
(c) Chrome	
(d) Firefox	
(e) Safari	
(3) Mobile Application	• Students shall be able to access instructional content on mobile devices running either the iOS or Android operating system.
(a) Android	
(b) iOS	
(c) Other	

Attribute	Derived Requirements for INSEP
(4) Mobile Form Factor	• Students shall be able to access instructional content on both smartphones and tablet mobile devices.
(a) Phone	
(b) Tablet	
iii) Administrators	
(1) Client Desktop Software	
(a) Windows	• Administrators shall be able to access the system via desktop/laptop systems using operating systems based on Windows, macOS, or Linux.
(b) macOS	
(c) Linux	
(2) Browser-based	
(a) Edge	• Administrators shall be able to access the system using Microsoft Edge, Google Chrome, Mozilla Firefox, or Apple Safari.
(b) Internet Explorer	
(c) Chrome	
(d) Firefox	
(e) Safari	
(3) Mobile Application	N/A
(a) Android	
(b) iOS	
(c) Other	
(4) Mobile Form Factor	N/A
(a) Phone	
(b) Tablet	
d) Software Support	
i) Type of Support Provided	
(1) Manual	Addressed Elsewhere
(2) 24/7 Help Desk	Addressed Elsewhere
(3) Remote Support/Remote Desktop Functionality	• The customer service support staff shall be able to use remote desktop functionality to assist users with troubleshooting activities.
(4) Dedicated Customer Success Manager	N/A
(5) Onboarding Training	Addressed Elsewhere

Attribute	Derived Requirements for INSEP
(6) Support for Multiple Languages	• The customer service support staff shall be able to support users speaking the following languages: o TBD
(7) Chat Support	• The customer service support staff shall be able to support users via phone, email, or real-time text chat.
ii) Cost of Support	TBD – Does INSEP have a requirement?
(1) Free/Included in Subscription	
(2) Additional Fee	
iii) Updates	TBD – Does INSEP have a requirement?
(1) How often is the Software Updated?	
(2) Is there a fee for updates?	
iv) Uptime Guarantee	
e) Can localize interface to multiple languages	
i) Arabic	• It shall be possible to localize the system interface to use control/display labels that employ the following languages: o TBD
ii) Spanish (Latin America and Castilian)	
iii) Brazilian Portuguese	
iv) French (Canada and France)	
v) Japanese	
vi) Korean	
vii) Swedish	
viii) German	
ix) Danish	
x) Dutch	
xi) Turkish	
xii) Chinese (Simplified and Traditional)	
xiii) Welsh	
xiv) English (US, UK and Canada)	
xv) Ability to customize for a particular language	
24) Integration	
a) Content Standards	
i) Interoperability Standards	

Attribute	Derived Requirements for INSEP
(1) AICC	• The system shall be compatible with SCORM 2004 and TinCan/xAPI. • The system shall provide a Learning Record Store (LRS) for TinCan/xAPI data. • The system shall make its LRS available to external applications.
(2) Sharable Content Object Reference Model (SCORM)	
(3) PENS	
(4) Learning Tools Interoperability (LTI)	
(5) IMS Common Cartridge	
(6) CMI5	
(7) LETSI RTWS	
(8) TinCan / xAPI	
ii) Accessibility	
(1) Section 508	• The system shall adhere to "Section 508" accessibility standards. • The system shall allow instructors and content developers to add alternate text to media content. • The system shall alert instructors and content developers to media content that doesn't have associated alternate text. • The system shall allow multiple language versions of alternate text. • The system shall allow users to add subtitles to recorded video and audio content created by that user. • The system shall allow video and audio subtitles to be entered in multiple languages. • The system shall highlight recorded audio and video content that doesn't contain subtitles. • The system shall provide a 508-compatibility dashboard to administrators and content developers to allow 508 compliance to be audited.

Attribute	Derived Requirements for INSEP
b) Embedded Support for Third Party Tools	TBD – Which, if any, of these tools are important to Insep DropBox? G Suite? Google Calendar? Zoom?
i) Adobe Connect	
ii) ADP	
iii) API	
iv) BambooHR	
v) BigBlueButton	
vi) Dropbox	
vii) Drupal	
viii) G Suite	
ix) Google Calendar	
x) GoToMeeting	
xi) GoToTraining	
xii) GoToWebinar	
xiii) HubSpot	
xiv) Joomla	
xv) Magneto	
xvi) Mailchimp	
xvii) Microsoft Dynamics CRM	
xviii) Namely	
xix) Office 365	
xx) Okta	
xxi) OneDrive	
xxii) OneLogin	
xxiii) Oracle Sales Cloud CRM	
xxiv) Outlook Calendar	
xxv) PayPal	
xxvi) Salesforce CRM	
xxvii) SAP CRM	
xxviii) Service Now	
xxix) SharePoint	
xxx) Shopify	
xxxi) Slack	
xxxii) Stripe	
xxxiii) Sugar CRM	
xxxiv) WebEx	

Attribute	Derived Requirements for INSEP
xxxv) WooCommerce	
xxxvi) WordPress	
xxxvii) Zapier	
xxxviii) Zendesk	
xxxix) Zoom	
25) Portal Organization and customization	TBD
a) Ability to create independent sub-portals (branches)	
b) Ability to create groups of students, in order to assign common courses (groups)	N/A
c) Ability to customize and brand your portal and sub-portal(s)	• The system shall allow INSEP to modify fonts, colors, and badging to provide a consistent "brand image."
d) Ability to add your own login domain	N/A
e) Ability to create automated events based on triggers (e.g., course assignments, user deactivation, point assignment, etc.)	Addressed Elsewhere
f) Ability to customize automated notifications based on triggers (e.g., on course assignment, on user signup, X hours before expiration)	Addressed Elsewhere
g) Ability to configure user permissions	
26) Security	• The system shall align with OWASP and the Center for Internet Security (CIS) best practices and guidelines
a) Allow IP control and filtering?	
b) Support double username access lockability?	
c) Support secure password management?	
d) Support encryption and user password per authentication?	• The system shall employ data in transit encryption and data at rest encryption
e) Encrypt data during transmission?	

Attribute	Derived Requirements for INSEP
f) Include an advanced antivirus check on all uploaded content?	• The system shall scan all file uploads for viruses. • The system shall prevent the upload of files which are detected to contain viruses. • The system shall automatically update virus definitions at a regular interval. • The system shall provide administrators with the virus definition update status. • The system shall log all detected virus activity for auditing.
g) Is the system compliant with ISO 27001 Certification?	
h) Is there a protocol for conducting penetration test assessments?	• The system shall be tested using the Penetration Testing Execution Standard
27) Logging and Security Response	
a) Log security events on networking, security device, or on server equipment?	• The system shall employ security information and event management (SIEM) which provides automated alerts
b) Does the system's logging practices enable the identification of the IP Address of the remote system in the event of an attack?	
c) Maintain all security logs? If yes, indicate retention period.	
d) Have documented and implemented security incident response procedures?	
e) Have incident response processes in place to investigate potential security incidents in real-time? If no, specify timeframe.	
f) Have processes in place to report security incidents to the customer? If yes, indicate timeframe.	
g) Send logs to a centralized log collection server?	
h) Monitor logs for security events and intrusion attempts in real time?	

Attribute	Derived Requirements for INSEP
i) Perform an automated correlation of security logs between the various device types (system, network, firewall, and/or IPS)?	
j) Enable the identification of internal personnel (specific user) in the event of an internal attack?	
28) Network/Service Architecture	• The system shall implement CIS benchmarks for locking down networks and services
a) Deploy firewalls?	
b) Deploy network Intrusion Prevention System (IPS) sensors? If yes, are all IPS sensors updated within 24 hours of new signatures released?	
c) Support the firewalls, IPS sensors, routers and switches on software and hardware levels?	
d) Patch all critical security issues on firewalls, IPS sensors, routers and switches within 1 month of release?	
e) Encrypt data in transit on public or shared networks?	
29) Secure Server	• The system shall implement CIS benchmarks for locking down Servers
a) Have antivirus software installed and running optimally in the server?	
b) Have measures in place to protect data from exposure when the service is executed on shared servers?	
c) Have measures in place to protect from performance degradation when the service is executed on shared servers?	
d) Have policies in place to ensure the integrity of any software prior to installation?	

Attribute	Derived Requirements for INSEP
e) Have its servers built off a general network or on an isolated network?	
f) Have security patches installed prior to the server being put onto the general network?	
30) Backups	
a) Are the servers backed up to external media (e.g. tape) on a daily basis or all data replicated in near real-time to a secondary site?	• The system shall backup all data (course and student records) to external media on a daily basis or replicate the data at a secondary site in near real-time. • If backup (vs. replication) is performed, the backup process shall be tested on a monthly basis. • If backup (vs. replication) is performed, a full backup shall be performed on a weekly basis. • If backup (vs. replication) is performed, backup media shall be stored at an offsite location. • The system shall have disaster recovery plan in place. • The system shall be accessible within 72 hours of a catastrophic failure.
b) Are backups tested regularly? If yes, please specify the frequency.	
c) If data is backed up to external media, how often are full backups performed?	
d) If data is backed up to external media, are the backups encrypted?	
e) If data is backed up to external media, are the backups stored offsite?	

Appendix 16: Leaning Management Systems Available on Commercial Market

Tool	% of time listed	Product URL
Canvas LMS	90	https://www.instructure.com/canvas/
Moodle	90	https://moodle.org/
Docebo	80	https://www.docebo.com/learning-management-system-lms/
SAP LITMOS	80	https://www.litmos.com/
Blackboard Learn	70	https://www.blackboard.com/teaching-learning/learning-management/blackboard-learn
D2L Brightspace	70	https://www.d2l.com/corporate/products/core/
Schoology	70	https://www.schoology.com/
Talent LMS	70	https://www.talentlms.com/
Edmodo	60	https://www.edmodo.com/
iSpring Learn	60	https://www.ispringsolutions.com/ispring-learn
Adobe Captivate Prime	50	https://www.adobe.com/products/captivateprime.html
Absorb LMS	40	https://www.absorblms.com/
Cornerstone OnDemand	40	https://www.cornerstoneondemand.com/learning/
Lessonly	40	https://www.lessonly.com/learning-management-system-software/
Mindflash	40	https://mindflash.com/
WizIQ	40	https://www.wiziq.com/wiziq-nextgen/
eFront	30	https://www.efrontlearning.com/
Google Classroom	30	https://classroom.google.com/h
Inquisiq LMS	30	https://www.inquisiq.com/
Open edX	30	https://open.edx.org/
Sakai	30	https://www.sakailms.org/
SAP SuccessFactors	30	https://www.sap.com/products/corporate-lms.html
SkyPrep	30	https://skyprep.com/
SumTotal	30	https://www.sumtotalsystems.com/solutions/learn/
Trainual	30	https://trainual.com/lms/
Bridge LMS	20	https://www.instructure.com/bridge/
Chamilo	20	https://chamilo.org/en/
Coassemble	20	https://coassemble.com/
CoreAchieve	20	https://coreachieve.com/
GoSkills	20	https://www.goskills.com/Business
Grovo	20	https://www.grovo.com/
Kannu	20	https://www.kannu.com/
LearnUpon	20	https://www.learnupon.com/
Looop	20	https://www.looop.co/
OLAT	20	https://www.openolat.com/?lang=en

Appendix 17: Glossary

Term	Definition	Remarks
Accessibility Standards	Accessibility focuses on how a disabled person accesses or benefits from a site, system or application. Typically, accessibility is organized under four general principles: • Perceivable – Information and user interface components must be presentable to users in ways they can perceive. • Operable – User interface components and navigation must be operable. • Understandable – Information and the operation of user interface must be understandable. • Robust – Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. Various organizations have produced standards for promoting accessibility.	
Adaptive testing	Adaptive testing is a form of computer-based test that adapts to the examinee's ability level. In other words, it is a form of computer-administered test in which the next item or set of items selected to be administered depends on the correctness of the test taker's responses to the most recent items administered. Adaptive testing systems successively select questions for the purpose of maximizing the precision of the exam based on what is known about the examinee from previous questions. From the examinee's perspective, the difficulty of the exam seems to tailor itself to their level of ability.	
Asynchronous	Self-paced learning that is facilitated through recorded lectures or activities over a set period of time	
Blended instruction	Blended learning is an approach to education that combines online educational materials and	

Term	Definition	Remarks
	opportunities for interaction online with traditional place-based classroom methods. It requires the physical presence of both teacher and student, with some elements of student control over time, place, path, or pace.	
Blended Learning	Training approach that combines remote and in-person learning	Synonymous with hybrid learning
Browser-based Software	Browser based software refers to applications that do not reside on the user's local computer. Instead they use a conventional web browser to access content/functionality that remains on the server.	
Chat Support	Chat Support is a form of synchronous messaging (in which the customer and the agent must both be present at the same time to engage in a conversation). Often appearing on a company's website or in its app in the form of a pop-up dialogue box, Chat Support allows for the user and the support technician to communicate via short, written, synchronous messages.	
Client Desktop Software	Client desktop software is an application that is installed and run the user's local desktop/laptop computer. Often these client applications are responsible for communicating with a centralized server. They contrast with browser-based applications.	
CMS: Content Management System	Manages the creation and modification of digital content, typically focused on web-based publishing.	
Constraint	A statement that expresses measurable bounds for an element or function of the system. That is, a constraint is a factor that is imposed on the solution by force or compulsion and may limit or modify the design changes.	
Content Standards	Content standards refer to a set of specified rules that discuss how content should be "packaged" and how it will communicate with a hosting application, such as an LMS.	

Term	Definition	Remarks
DAM: Digital Asset Management System	Software which organizes media such as images, videos, and documents.	
Discussion Board/Forums	The Discussion Board tool in the LMS allows online communication with other members of a subject or community. Groups within a subject or community can also have their own private discussion board. The Discussion Board is an asynchronous communication tool, allowing messages to be posted and read at any time. Multiple forums (discussion topics) can be added to a subject or community's Discussion Board, and various settings can be applied to control how messages will be posted and managed in each forum. A discussion forum is organized into threads (conversations within a topic). Messages are posted by adding a new thread or replying to an existing posting. Postings can be controlled by locking or unlocking threads. Threads can also be hidden or made unavailable to participants.	
E-learning	Electronic learning experience that is formatted in a specialized software with practice activities.	
Element	A component of a system: may include equipment, a computer program, or a human	
Environment	The circumstances, objects, and conditions that will influence the complete system: they include political, market, cultural, organizational, and physical influences as well as standards and policies that govern what the system must do or how it must do it.	
Firewall	In computing, a firewall is a network security system that monitors and controls incoming and outgoing network traffic based on predetermined security rules. A firewall typically establishes a barrier between a trusted internal network and untrusted external network, such as the Internet.	
Gamification	Gamification is the use of game-based mechanics, aesthetics and game thinking to	

Term	Definition	Remarks
	engage people, motivate action, promote learning and solve problems	
Interactive multimedia instruction	Interactive multimedia instruction is a term applied to a group of predominantly interactive, electronically-delivered training and training support products.	
IP control and filtering	IP filtering is a mechanism that decides which types of network messages will be processed normally and which will be discarded. For example, you may want to discard message coming from or going to certain internet addresses.	
Just-in-time learning	Training that occurs as needed without a planned schedule or agenda. Typically associated with self-directed learning like asynchronous web-based training or localized on-the-job training or coaching.	
LCMS: Learning Content Management System	Integrated workflow, content authoring, and delivery platform allowing instructional designers to create and house materials, and publish materials to support instructional delivery in-person and remotely.	
LMS: Learning Management System	Used by training organizations to register, track, and monitor training activities. Often does not provide content authoring capabilities.	
LXP: Learning Experience Platform	A learning experience platform consolidates a variety of capabilities into a single portal, enabling a variety of methods to engage learners, such as personalized learning pathways and social learning	
Microlearning	Focused Training that occurs in short chunks and covers one or two topics. This works best for practicing job-related tasks and closing skill gaps.	
mLearning	Electronic learning that has been formatted for quick and easy consumption on mobile hand-held devices such as cell phones and tablets.	Mobile Learning is a subset of e-Learning, not a

Term	Definition	Remarks
		synonym for e-Learning.
Mobile Application	A mobile application is a unit of software designed to run on a mobile device like a smartphone or tablet computer.	
Mobile Form Factor	The form factor of a mobile device refers to its size, shape, and style, as well as the layout and position of its major components. Most significantly, the mobile form factor is often used to identify whether a specific application is optimized for use on tablets or smartphones.	
Mobile learning	Mobile learning is learning activities that employ personal electronic devices, such as smartphones and tablets. A form of distance education, m-learners use mobile device educational technology at times that are convenient for them.	
Moderator	In a discussion forum, you can assign a user the role of moderator. A moderator reviews posts before they appear in the discussion. When you create a moderated forum, all posts to the forum are added to a moderation queue. A moderator reviews each post and can: • Publish the post • Return the post to the sender without a message • Return the post to the sender with a message A moderator can delete, edit, and lock posts in a forum even if the forum doesn't use the moderation queue.	
Network Intrusion Prevention System	An intrusion prevention system is a form of network security that works to detect and prevent identified threats. Intrusion prevention systems continuously monitor a network, looking for possible malicious incidents and capturing information about them. The IPS reports these events to system administrators and takes preventative action, such as closing	

Term	Definition	Remarks
	access points and configuring firewalls to prevent future attacks. IPS solutions can also be used to identify issues with security policies, deterring users from violating the rules these policies contain.	
Online Journal	Journals are personal spaces for students to communicate privately with an instructor. Students can also use journals as a self-reflective tool. They can post their opinions, ideas, and concerns about the course, or discuss and analyze course-related materials. An instructor can create journal assignments that are broad and student-directed. Students can reflect on the learning process and document changes in their perceptions and attitudes. Students can describe the problems faced and how they solved them. An instructor can also create instructor-directed journal entries that are more formal in nature. You can narrow the focus with a list of topics for discussion.	
Open Source	Open source software is software with source code that anyone can inspect, modify, and enhance. Source code is the part of software that most computer users don't ever see; it's the code computer programmers can manipulate to change how a piece of software—a "program" or "application"—works. Programmers who have access to a computer program's source code can improve that program by adding features to it or fixing parts that don't always work correctly.	
Proprietary	Proprietary software, also known as closed-source software is computer software for which the software's publisher or another person retains intellectual property rights—usually copyright of the source code, but sometimes patent rights. The source code is not available for inspection or modification.	

Term	Definition	Remarks
Raw requirement	An environment or requirement that has not been analyzed and formulated as a well-formed requirement	
Remote Learning	Training that occurs online when instructor and participant are geographically separated and cannot meet in a traditional classroom setting. Can occur synchronously or asynchronously	Synonymous with online training, distance learning, virtual learning and virtual training
Remote Support/Remote Desktop Functionality	Remote support software is the technology that gives IT technicians the ability to access their clients' devices remotely to provide maintenance and support.	
Requirement	A condition or capability needed by a user to solve a problem, or achieve an objective. OR A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification or other formally imposed document	
Rubric	A rubric is a scoring guide used to evaluate the quality of students' responses. Put simply, it is a set of criteria for grading assignments.	
SCORM (Sharable Content Object Reference Model)	A collection of standards and specifications for web-based electronic educational technology (also called e-learning). It defines communications between client side content and a host system (called "the run-time environment"), which is commonly supported by a learning management system.	
Social / Experiential Learning - Communities	Social Learning means learning by observing, conversing or questioning. Experiential Learning is the process of learning by doing. Social/experiential learning communities are, essentially, discussion forums that allow subject matter experts and learners to share knowledge outside of courses.	
Stream Video	Streaming is the continuous transmission of audio or video files from a server to a client.	
Student Portfolios	A student portfolio is a compilation of academic work and other forms of educational evidence assembled for the purpose of (1) evaluating coursework quality, learning progress, and	

Term	Definition	Remarks
	academic achievement; (2) determining whether students have met learning standards or other academic requirements for courses, grade-level promotion, and graduation; (3) helping students reflect on their academic goals and progress as learners; and (4) creating a lasting archive of academic work products, accomplishments, and other documentation	
Synchronous	Real time learning that is facilitated live over a meeting platform (such as MS Teams)	
System	An interdependent group of people, objects, and procedures constituted to achieve defined objectives or some operational roles by performing specified functions.	
Two-factor Authentication	Two-factor Authentication is an extra layer of security used to make sure that people trying to gain access to an online account are who they say they are. First, a user will enter their username and a password. Then, instead of immediately gaining access, they will be required to provide another piece of information. This second factor could come from one of the following categories: • Something you have: Typically, a user would have something in their possession, like a credit card, a smartphone, or a small hardware token • Something you know: This could be a personal identification number (PIN), a password, answers to "secret questions" or a specific keystroke pattern Something you are: This category is a little more advanced, and might include biometric pattern of a fingerprint, an iris scan, or a voice print	
Uptime Guarantee	Uptime is a measure of system reliability, expressed as the percentage of time a machine, typically a computer, has been working and available. Uptime is the opposite of downtime.	
Virtual classrooms	A virtual classroom is a learning environment in which students engage with the lesson material online. Virtual classrooms allow for live	

Term	Definition	Remarks
	interaction between the instructor and one or more learners as they are participating in learning activities. In other words, the virtual classroom is a shared online space in which the learners and the tutor work together simultaneously. Usually, these interactions take place through videoconferencing.	
Web-Based Training	Online learning variant of instructor-led courses delivered via the web. Can be delivered as synchronous (instructor led) training or in asynchronous (self-paced) learning format.	
Webinar (Web+Seminar)	A small synchronous online learning event in which a presenter and audience members communicate via text chat or audio about concepts often illustrated via online slides and/or an electronic whiteboard. Webinars are often archived as well for asynchronous, on-demand access.	
Well-formed requirement	A statement of system functionality (a capability) that can be validated, and that must be met or possessed by a system to solve a customer problem or achieve a customer objective, and is qualified by measurable conditions and bounded by constraints.	
White Board	This is a virtual (usually web based) area for the students and teachers to write and draw equations, answers, diagrams etc., akin to a traditional classroom's whiteboards. One advantage (some) virtual whiteboards have is that they can be shared between multiple students in an e-learning scenario, and their ability to can keep a history of edits, so that students can refer back to what was written during a class without having to copy it down.	