Collaborative Training for Ground Control Operators

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Ground centers operators present special training and knowledge transfer requirements due to their operating environment. Typical characteristics are distributed skills with different specializations that shall interact efficiently to reach the goal. Learning environment should continuously collect any new information and any lesson learnt should be quickly reflected into operations.

The current approach is mainly based on classroom training and simulations. Classroom training is efficient to build up a basic knowledge required for all positions. Simulations provide essential skills in practical or emergency situations. What is missing or is expensive to implement is lessons specialization for individual skills and simulation lessons learnt dissemination.

Practical experience during training and simulations demonstrate that most operators are willing to share knowledge. The limited overlapping of their specializations and skills is helping the process because cooperation is more important than competition. Most training and knowledge transfer information is spread over many channels as e-mail, e-room reports, memos, presentations and so on. Cooperation is then limited in scope.

What should change the situation is a set-up of a common infrastructure where information is distributed and managed using a social approach, pushing forward the implementation of collaboration groups. Facebook-like profiles and groups are information hubs where operators discuss. Wikis are used to assemble and maintain knowledge. Tweets allow short information broadcasting. All the information is classified and continuously verified by all the operators; training responsibles are acting as facilitators and administrators of knowledge.

In conclusion, the project aims at providing an efficient knowledge node where information is socially collected, transformed and redistributed. Different processes are used trying to use them efficiently to sort out the operational needs, trying to keep all of them in a single common platform.

I. Introduction

THIS paper addresses a research work that Altec Turin is currently developing in the operator's training area. Training is one of the area where Altec operate as strictly related to their Control Operations Centre activities.

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Altec trainers operate in-house for internal training but are also involved in European Astronaut Centre (EAC) Cologne and Columbus Control Centre (COL-CC) Munich activities.

Internal activities on MPLM and external activities on Columbus highlighted a need for efficiency improvements related to operators training activities. The current approach based on extensive classroom training is too expensive when fully implemented and hardly covers the individual needs, mainly because these are different one from the other. If we keep the same approach but resources are limited we assume the risk of under-trained operators.

We need to find some improvements to complement a good training approach to increase its efficiency. In some areas the implementation effort is not fully justified due to limited audience or continuous changes of the delivered information. Formal certifications needs may be a blocking requirement for approach changes. However there are possible boundaries between skills that require formal certification and others that are supporting the performance.

The weak point of the formal training approach is the sharp distinction between producers (trainers) and consumers (Control Center operators). If we assume that operators are only training consumers we discard a huge contribution that could be provided by information sharing between operators. When we look at the real Control Center's world we see that people usually cooperate and share knowledge. This could be our aim then: to provide platforms and tools for collaborative training.

As platforms and tools are not sufficient to set up a collaboration environment, we are ready to consider any supporting activity to involve operators in the task. A first consideration is that if the operators can use the platform as a single access point to information they will probably be willing to use it. Obviously information sharing shall not duplicate official sources but refer to them using links.

II.   Problem Analysis

As explained in the introduction, training to console operators has much higher dispersion of training requirements when compared to training delivered to Space Station crew. It is then much more difficult to group requirements to obtain a coherent lesson catalogue trying to limit the effort at the same time.

We can then try to address training areas according to the current situation. An interesting parameter is the relation between the topic and the number of operators involved. The following areas are identified and studied:
A.   Basic training providing instruction common to all positions
B.   Specialized training for a limited number of operators
C.   Operational training related to basic interaction with infrastructure
D.   Operational training related to special interactions

These four groups address generic situations where applicability of collaborative training can be assessed. Later on specific scenario situations are broken down defining the working approach.

A. Basic Training Common to All Positions
This area does not present many differences with respect to the standard approach: lessons are designed for a wide audience and regularly delivered. The number of students justifies the development effort. What can be added is an on-demand fruition based on a Learning Management System. In the past this was not provided but the continuous availability can simplify the training delivery in cases where training sessions are not planned for a long period. Another common situation is the need of Proficiency Maintenance training for operators, especially valid for payload operators not working continuously.

B. Specialized Training
This category presents typically a smaller audience with respect to the previous one. For this reason lessons may be outdated due to their great number or not produced at all when the allocated budget is not sufficient. This is one of the key areas where collaborative training can be established and can provide best results. This new approach is not completely different from the standard approach of the current Control Centers, as training On-The-Job and

information exchange between operators are very similar. The advantage of this new approach is the concentration of the complete information flow in a single platform, where awareness is maximized.

C. Operational Training related to Basic Interaction

This group collects topics that are common to most positions e.g. voice loop interaction, use of workstation tools, and preparation of flight notes. The common characteristic is a high level of reuse, and then it is possible to prepare lessons and exercises for the operators.

Considering that many training lessons should be available on-demand (as an example, a refresher training for voice loop interaction) the relevant lessons and evaluations should be available on the Learning Management System to all operators.

D. Operational Training related to Special Interaction

Interactions that are dedicated to operators' special skills are classified in this group. Due to the limited number of participants for each argument a social approach may help. Collaboration between operators replaces the actual lessons when these are not planned, otherwise it is a good tool that fill-in the missing lessons before they are developed and provides continuous updates after their use.

III. Scenarios and Requirements

It could be interesting to collect and analyze common tasks that pop up frequently during Control Centers operations. The following list is far from being exhaustive but provides a first skeleton for the platform design where standard operations can be verified.

The term "documents" is here used as a generic term to indicate text, images, movies, presentations, podcasts, programs and anything that carries information.

A. Short information about a global event

An operator receives information that should be distributed to the whole community. The channel used is a message on the global area. The message should be short and links may be added if necessary. Other operators may add comments as well as links to the entry to complement the information. This is a global log and therefore messages length should always be minimized (equivalent to twitters). When it is necessary to extend the contents this is made with blogs. A global blog will provide major information with details. Short messages should link to the blog entries if possible.

B. Long information about a global event

As explained in the previous point, a global blog contains entries with detailed information. Blog entries can be integrated by other operators adding comments and links.

C. Short information about a limited scope event

Some information may be required only to a limited number of operators, e.g. one or more groups or one or more people. In this case the message shall be placed in the relevant areas (group or person) to limit the visibility. The message shall be short, may contain annexes or links and may be commented or transferred to other areas by other operators.

D. Long information about a limited scope event

The relevant blogs will contain detailed information. Comments will be enabled to the group participants. Comments within groups are very important for collaborative training as they are one of the major sources for information exchange and situational awareness.

E. Applicable documents relevant to the project or learning environment

These documents are critical in terms of configuration control. It is then dangerous to upload them in the system because this generates a copy outside of the configuration process. Documents shall be referenced by links in the training system whenever possible. When new issues are available a short message can inform the relevant operators about the event. Comments will be added to the messages if required.

F. Personal documents for reference

Any operator can collect a number of documents for personal use. These are stored in a private area and organized in an e-portfolio, with personal comments and explanations. These can be shared at any time, placing them in group areas where other members can reach them.

G. Group documents for reference

Some of the reference documents may be relevant for groups cross-training. They are then shared in dedicated areas, e.g. Columbus payloads, communications or other communities organized in groups. When other groups may be interested they can be informed using short messages in the global area. It is important that any relevant document is distributed as a link, avoiding duplications.

H. Questions and discussions

Operators should collaborate answering questions and doubts and providing operational hints. Two approaches are possible. The first is based on discussions: a question is introduced as a message on the group or global area and comments are provided by the skilled operators voluntarily. Another possibility is the implementation of forums, where questions and answers are grouped. This solution may be more efficient as forums might have global accesses to act as global information exchange where all the users may look for information and contribute. The produced material could be reworked and provide material to the learning management system for redistribution in form of documents and lessons.

IV. Proposed Implementation

The proposed approach for training has many similarities to other training environments. It is then reasonable to consider a platform implementation based on existing products where the special requirements are fulfilled with tools' configurations. The market of open source tools is preferably considered due to budget restrictions and better configurability characteristics.

The platforms currently under installation and configuration for training are both open source and free software. The basic tool is Moodle (www.moodle.org) to implement a fully featured Learning Management System with built-in capabilities integrated by plugins if required. Another tool added to the system to provide e-portfolio and social collaboration functions is Mahara (www.mahara.org). Mahara provides full integration with single point of access with Moodle. Mahara as well can be functionally integrated with plugins if required.

V. Documents Storage

Control centers operators produce and process a great deal of documents, as payload operations documents, simulation and operations reports. Their localization is not easy for other operators that may be interested in part of their contents. In additions updates are difficult to distribute. The social training tool cannot be considered as a documentation management system as dedicated systems are already operating in all the Control Centers environments. However the tool can be used as an intermediate layer for information awareness and notifications management. This means that standard configuration control processes are implemented as usual where documents are generated. Documents may be replicated or referenced by the collaboration platform to simplify their access, but the original version takes always priority. This is similar to the indication of "for training purposes only" usually present on procedures and documents.

VI. Follow-on Activities

As soon as we have the collaboration platform in use, next step can be its use as a feeder for a lot of other processes. Material collected in feeds and wikis can be re elaborated to provide inputs for standard instructional design. This could lower its costs providing information already reviewed and assessed, speeding up the data collection process.

When the lessons are prepared, the same platform set up for collaboration can effectively operate as Learning Management System (LMS) to deliver lessons and training activities to all the Control Center operators.

An interesting extension to the learning system is the implementation of virtual classrooms. This allows interactions between instructor and students. While most of the material presented before applies to off-line learning, virtual classrooms move toward online learning. An open source implementation is available by

www.bigbluebutton.org. It is a web conferencing tool developed for education and can be integrated with Moodle using a plugin.

Virtual classrooms are an established product but they are not commonly used in the space business. In particular most of the Control Centers operators training is performed collecting all participants in a physical classroom. Virtual classrooms cannot totally replace direct training but they can cover a huge variety of needs that are currently not fulfilled. In particular virtual classrooms can provide quick answers to specific needs in a short time, close to quick consultancy and support. It is evident that physical training sessions with a typical delay of three to six months cannot support these needs. Good balancing between physical and virtual classroom lessons could fulfill requirements otherwise incompatible. Direct interaction between operators during classroom lessons can then coexist with on-demand specialized virtual lessons.

VII.   Current Project Status

The project is currently in a preliminary phase. The preliminary design and the tools are defined. The platform is set up on an internal development server, where users, groups and all the necessary information are configured. A group of test subjects is starting to share information and documents. Later on there will be a prototype revision and an assessment of the results to define improvements and changes to propagate to the final version.

Altec is actively developing an expertise about training and knowledge management in the Control Centers environment. Control centers and engineering support infrastructures for PMM and Columbus are an excellent test bed for training development.

VIII.   Expected Results and Conclusions

The main characteristic of the proposed approach is the maximization of both the information supplier and consumer. In theory the whole Control Center community collaborates to increase the common knowledge. In practice a set of participants has additional control tasks: training and focal points are in charge for organization set up and information verification, with the former more focused on the collaboration guidelines and the latter on contents validation.

Appendix A
Acronym List

COL-CC   Columbus Control Centre
EAC   European Astronaut Centre
LMS   Learning Management System
MPLM   Multi-Purpose Logistic Module
PMM   Permanent Multipurpose Module

Appendix B
References

Software Programs
[1]Moodle Open Source Course Management System (CMS), http://moodle.org.
[2]Mahara Open Source E-portfolios, https://mahara.
[3]BigBlueButton Open Source Web Conferencing, http://www.bigbluebutton.org.