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THEORETICAL WORKSHOP - Strategic and Theoretical Challenges within the HILAS project

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Shareability of Lessons learned from Experiences and of HF Knowledge

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Abstract

This paper introduces basic notions about Organisational Learning and its relevance for HILAS, in order to discuss some challenges regarding sharing and shareability of lessons learned from critical experiences that might be shared among a rich variety of project partners and might be fed into early stages of aircraft design. In a way, what we need to solve and set up by the end of the project with respect to transformation of lessons from today into requirements for tomorrow's aircrafts, we need to live through already during the HILAS project. The paper addresses critical issues that we partly can start to resolve through the discussions in the workshop.

Introduction

A key issue in HILAS is develop strategies and means to identify and share knowledge on Human Factors (HF) in aviation. Two sources of knowledge are relevant. New HF knowledge is generated by scientific research and accessible by HF experts. Work Package 1.2 aims at building a pool of HF experts oriented on aviation as a resource for the industry. Furthermore, operational practice provides opportunities for learning lessons from critical experiences in work processes of any of the aviation partners in HILAS. A major challenge is to develop and support a process of sharing lessons between partners learned from operational experiences that help to improve these operations directly or through design.

First, we will highlight some basic principles and concepts about learning by organisations, because we need to understand what processes of sharing lessons and knowledge for learning within HILAS are about. Then, we explore content handling issues regarding lessons learned

On Organisational Learning

Principles underlying and the practical insights about organisational learning (OL) have been well described by (Argyris and Schön 1996). Learning by organisations cannot be taken for granted, because organisations can only learn through people. Figure 1 depicts the key processes and actions to invoke and maintain organisational learning (see also (Koornneef and Hale 2004; Koornneef and Hale 2004)). Argyris emphasises that learning should be embedded in the whole organisation as a part of its normal operation. It is not an add-on extra. This means, in terms of safety, that there must be an intimate link between the risk assessment process, which specifies what hazard scenarios there are, the management process, which establishes control strategies and practices for them, the operational process which carries them out and the learning process, which evaluates, improves and fine tunes these controls.

Learning from experience starts in an organisational unit that is performing activities for which its members already have their own "theory-in-use" in the form of routines, priorities and actions. These all set up expectations about how the activity will proceed and what consequences will arise from the actions take. The activities are conducted with resources made available to the unit and under objectives, values and means, which are also given to or imposed on the unit. Basic resources are knowledge, technology and equipment, organisational

structures, norms and rules, as well as the people who deploy these resources in working processes to realise the organisation's objectives.

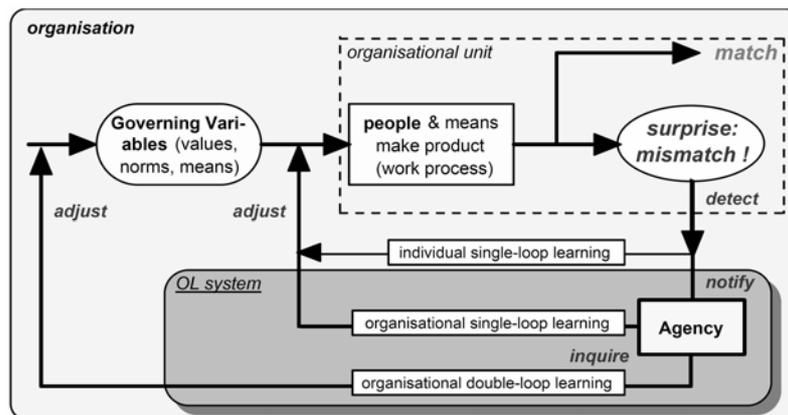


Figure 1: Organisational single- and double loop learning modified after Argyris (Koornneef 2000)

One of the normal expectations is that accidents will not happen. Sometimes, however, an operational surprise occurs in the form of an unexpected outcome. For HILAS we are interested in the surprises which eventually lead closer to danger to crew, passengers and aircraft during flight operations. If the individual detects the surprise and changes the way of working as a result, individual learning has taken place: "individual single loop learning" in Figure 1. However, for organisational learning to take place, the individual must notify a relevant learning agency. This process of notification needs to have as low a threshold as possible. Obstacles to reporting include fear of blame, undue administrative burden in addition to job workload, and experiences of hearing nothing from previous notifications. Figure 1 indicates that learning has not occurred until a solution is actually produced (Argyris 1982; Argyris 1992) and has been implemented. The learning process 'ends' when the process outcomes match the expectations according to that part of the adjusted theory-in-use when it is next invoked. Organisational single loop learning requires that the line manager can act to implement adjustments within his/her span-of-control. Organisational double-loop learning requires that the organisation has a willingness to change its operations, also when appropriate, at the level of goals (Argyris and Schön 1996).

Note that the role of the 'Learning Agency' - "Agent" in Figure 1 - is crucial for the organisation. Its members are "assigned" to learn for the organisation. But in order to function effectively, the agency must deal with understanding the operational context to interpret event reports or 'concerns' properly, but also to evaluate in advance whether a "lesson" message fed to the work process, actually will be picked up and implemented, thus changing however slightly daily practices. Consequently, for efficient and effective functioning of the learning agency, all relevant operational contexts need to be "embodied" by its members - selected from the relevant work processes involved. For example, the function of a "learning agency" at HILAS level requires members from the FO, FDT and M strands, with support from the KR strand. The individual members have domain expertise about normal work processes and their operational contexts, and, therefore are able to understand the occurrence of an event or critical condition; the same expertise combined in the "learning agency" allows proper judgment about the practicalities of a lesson that is being considered.

Identifying Organisational Learning Processes

Processes of organisational learning can be identified using the "SOL-model", see Figure 2 (Koornneef, Hale et al. 2005). Figure 2 depicts the basic elements and relationships as an organisational process for learning. The work process consists of the activities in which the incident or accident occurs, during preparation, execution or aftercare of an intended action. It forms the anchor point for organisational learning: incidents or other concern raising situations occur in these processes in a given specific local and organisational context, and lessons need to land here to improve control of operational risks.

The SOL-model shows functions or roles and communication processes in organisational learning, not organisational or technological structures. For instance, the role of the learning

agency is often fulfilled informally during a regular meeting of operators and line managers rather than by a formalised review board. Organisational memory might consist of standard operating procedures (SOP), training contents, or incorporated in group behaviour, also see (Koornneef and Hale 2004; Koornneef and Hale 2004). Any missing element or communication channel blocks the organisational learning processes.

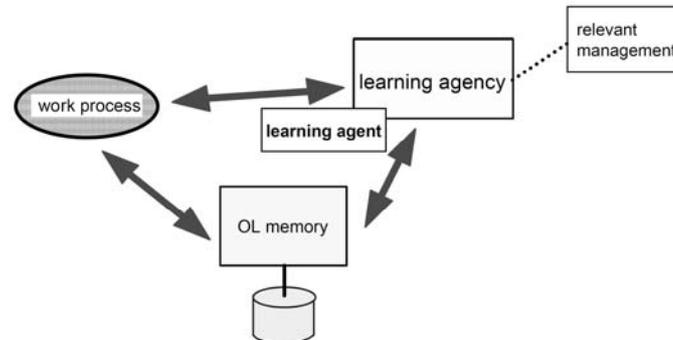


Figure 2: basic model of a system for organisational learning (SOL)

Lessons learned are stored into organisational memory that must be accessible by potential users. We focus here on filling organisational memory with lessons to share and retrieving lessons (selectively) for reuse.

Learning Lessons Learned

Lessons are learned from critical operational experiences that occur during intentional operations and that may indicate a problem that needs to be coped with. Operations exist on the flight deck, in maintenance work, but also in design processes. And one incident provides opportunities for learning in different processes of (organisational) learning. Maintenance is needed to sustain flight operations, and flight deck design has a major impact on the behaviour of cockpit crew members, while also affecting the maintainability of the flight deck. So, the interrelationship between the respective strands is present.

Lessons that go back to appropriate work processes, implicate change in the process execution by adjusting human resources, hardware or procedures (or organisational factors), so that real-time operational readiness is improved sooner or later [(Nertney 1987): the lesson is learned by implementation into to the originating process and/or into other appropriate work processes of which the respective operational contexts are taken into account. Because organisations can only learn through people, a "Learning Agency" needs to be in place to realise this function (Argyris 1992; Argyris and Schön 1996; Koornneef and Hale 2004). Thus, we see that lessons learned stem from and go back to real-life operations that exist in a particular operational and organisational context. Reuse of such a lesson learned in another setting requires re-assessment in order to make the lesson fit the operational context.

Learning lessons from experience requires (human and other) resources that are limited. Hence, there is an incentive for not learning the same (type of) lesson twice or recurrently. Capturing such a lesson for reuse is then an obvious objective. This establishes the need for the 'organisational memory', see also (Koornneef and Hale 2004)

Sharing Lessons in HILAS memory

So, let us assume that we retain lessons learned in a way that is accessible for reuse. What makes such a lesson useful to be shared with other potential users? And how will potential users find out about the availability of lessons?

For reuse, a lesson learned once in a specific operational context needs to be:

- translated into the operational context in which reuse is considered, or
- generalised up to a meta level that applies in various operational contexts.

For instance, a change in a specific SOP for one type of aircraft might also be needed in a SOP for a similar, but different type. Also, at meta level we know that routine behaviour of humans comes with a failure rate of 10^{-2} - 10^{-3} ; this meta level insight helps to assess operations in a

specific context. The activity of translating a potential lesson to learn within the envisaged operational settings is basic in reuse of lessons learned before.

Thus, sharing lessons will be easier when operational contexts involved are similar. For instance, an airliner will more easily be able to share lessons from flight ops with other airliners than with maintenance providers.

In HILAS, the three 'aviation' strands FO, FDT and M represent different operational realities of airliners, manufacturers and maintenance providers. Workshops *within* each strand reveal already opportunities for learning lessons that can be shared. But what makes a lesson learned in - for instance - Flight Ops useful for Maintenance or Flight Deck design?

To answer this, different approaches can be identified, for instance:

1. add context knowledge to assess a "lesson learned" by one partner for usability within each strand... this implicates a "Learning Agency" function at HILAS level. For actual reuse, the *translation* of the lesson into the envisaged application context remains a necessity.
2. identify *attributes* and values that can be added to a lesson learned by the originating partner, which can be used as context markers for recognition by other potentials users. For instance, a lesson learned might be associated with a particular critical incident scenario that calls for real-time problem handling based on possibly modified SOPs, for intensified inspection and maintenance, as well as for an aircraft system redesign. The associated scenario subsequently provides a basis for assessment by other partners of the utility of the shared lesson.
3. when lessons cannot yet be learned, we may start with problem identification and *problem sharing*. To date, formalised methods become available that enable and support problem sharing, e.g. based on the concept of problem frames (Jackson 2000; Jackson 2006) in which context diagrams linked to problem diagrams lead to problem frames. Sharing problems might trigger problem solving within a network more rapidly.
4. just make a unselective ICT depository with a Content Management System to deal with sharing, e.g. see (Olds, Detmold et al. 2004). Keywords in retrieval requests should be enough for the CMS to return relevant lessons learned.

Each of these approaches will need to be considered in the design of the HILAS KMS phase 2.

Shareability

During HILAS, we have to find the most effective approach for generating and sharing lessons from experiences, as well as of new pertinent HF insights among partners. Right now, some case studies are being performed within the FO Strand. These case studies provide lessons learned that are sharable within the strand. Thus, these cases might be used as an example to explore the issue of sharing lessons learned in one strand with HILAS partners in other strands and to identify requirements for the learning system at HILAS network level. At network level we need to answer questions such as what makes a lesson learned in one strand useful for a partner in another strand and how learning among partners can be facilitated.

In WP1.4, we already have identified opportunities to translate operational concerns in Maintenance processes into a redesign issues for OEMs; yet, OEMs tend to listen better to Airliners... Whether such an observation taps on barriers for or challenges of enhancing practices of organisational learning at HILAS level, is yet to be discovered. In practice, viable organisations learn to do things right, including learning. Learning is focussed in a competitive market. Developments, however, also indicates need for new strategies, for instance, when major periodic maintenance is holding airplanes grounded too long and alternative work processes are sought to enable major maintenance during overnight stops.

In literature, different concepts address the problem of using knowledge acquired in one place by somebody else or elsewhere, such as the notions of 'shareability' (Freyd 2005), 'problem frames'(Jackson 2006), and SMM – 'Shared Mental Models' (Espejo, Schumann et al. 1996). Freyd states about "shareability" that

"Shareability refers to the extent to which information is shareable. Information has high shareability if it is easy to share between different individuals without loss of fidelity. Shareability theory (Freyd 1983; Freyd 1990; Freyd 1993) proposes that internal (e.g. perceptual, emotional, imagistic) information often is qualitatively different from external (e.g. spoken, written) information, and that such internal information is often not particularly shareable. The theory further proposes that the communication process has predictable and systematic effects on the nature of the information representation such that sharing information over time causes knowledge to be re-organized into more consciously available, categorical, and discrete forms of representation, which are more shareable." (Freyd 2005)

Thus, a way to facilitate sharing is by means of keywords in or attributes assigned to a lesson learned that form the key to raise attention from a potential user who can associate those keywords or attributes with the envisaged operational context. Such recognition can be supported by ICT tools.

Detection of Learning Opportunities

We started with the assumption that lessons from experiences are being learned by partners. However, detecting learning opportunities is hard and resources to assess identified opportunities are limited. In FO, the LOSA approach (Helmreich 2001; UTHFRP 2004) allows detection of operational surprises about crew – aircraft interactions. Other reporting methods in use might be valuable as well. In Maintenance, operational concerns and incidents may lead to lessons learned about problems in M that better can be resolved through lessons to learn in FO and/or FDT. And obviously, FO learns lessons that provide learning opportunities for FDT design.

There is a large variety within the consortium of HILAS partners with respect to opportunities to detect and learn lessons, internal practices of organisational learning from experience and competence to learn from new knowledge or lessons learned shared by other partners. During the project, we will have to learn to cope with this variety in a way - one might say - that allows organised and organisational learning and sharing tailored to the needs and opportunities of 'individual' partners.

In a partner organisation, daily opportunities maybe logged in concerns or notification reports, needing an internal follow-up. Case studies can help to clarify what makes a lesson learned internally worthwhile to be shared within the network. However, we also need a way of signalling that new lessons learned have been made available, without overloading potential users with data, e.g. by allowing 'lesson selection' filters.

Conclusion

In HILAS, we are facing a multi-actor network and distributed sources of relevant HF knowledge and lessons learned from experience that need to be become connected serving different information needs. A question to be answered is whether we can develop a selective content and context categorisation scheme to put tags to knowledge items for effective routing to network partners, which is sufficiently generic not to require propriety information shielding. Shareability of knowledge will be served this way, because the efficiency and thus the effectiveness of the network increase. There is also the question of how we can make it work within the project.

On Tenerife, it would be good if we can explore with partners from the FO, FDT and M Strands what (sorts of) lessons can be shared now already, respectively in five years time. And what it takes to makes use of lessons that are shared by other partners. Thus, we also develop field experience on realising a "learning agency" function at HILAS project level.

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