Evolution of multi-display and distributed collaboration environments in StatoilHydro

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ABSTRACT
In this paper, we present some of the lessons learnt in StatoilHydro when it comes to building and deploying multiple display environments (MDE), or what we call integrated collaborative environments. The company has since the turn of the millennium deployed 250 various fit for purpose multidisplay and distributed collaborative environments. This work has provided input to the process of distilling design guidelines for MDE systems and interfaces. At the same time it has given profound input on how such MDEs and interfaces can be seen as common information spaces and what it takes to establish these across large organizations.

Keywords
Design guidelines of MDEs, Human Factors, function allocation, common information spaces, large scale collaborative systems, oil and gas industry.

INTRODUCTION
StatoilHydro is a partly state-owned Norwegian oil and gas company with around 30 000 employees that operates globally in 40 countries. The main business areas of the company are exploration and development of new oil and gas fields, operations and maintenance of a number of oil and gas assets. The company also has refineries and operates a leading petrol station chain in Scandinavia and the Baltic states. The last five years StatoilHydro has installed close to 250 multiple display collaborative environments. These environments range from typical collaboration rooms normally for 6-10 people with one or several PCs, whiteboards, SmartboardsTM, large visual displays and telephone-videoconferencing facilities to fit for purpose caves or visualization rooms developed for presenting and analysing subsurface data, see Figure 2. From these facilities any internal information resource/software environment can be launched; groupware, real-time visualization and analysis tools, MS Office etc. The lessons learned from both building and using these collaborative environments have been substantial. In this position paper we focus on two aspects of this process:

- The process of distilling design guidelines for MDE systems and interfaces
- The nature of these MDEs in relation to theory and methodology on specific aspects of common information spaces (CIS) and CSCW more in general.

We have been involved in planning and implementing such collaborative spaces in Statoil Hydro since 2003 [1,2,3]. Also, empirically and analytically, all four authors have an extensive history of involvement in research, development and deployment of groupware based systems in related [4,5] as well as completely different contexts [6, 10].

DISTILLING GUIDELINES

The importance of understanding MDEs in a wider business context
A key lesson is that the work with MDEs has to have to be strongly aligned with a number of actors that make up a wider business context. Most major oil companies and globally operating service companies address their future way of doing business as oil exploration and operation enabled by information and communication technology. In the espoused version this is the integration of people across geographical, organizational and disciplinary boundaries, integration of processes in terms of business alignment and vendor collaboration. This is the setting in which the MDEs appear, in an integration process that involves real time-data from facility sensors, protocols, fiber-optics, standards and others. In our case real-time data and information are made available from a remote location, typically the down-hole reservoir/well of an oil and gas asset or from a process

facility through a high-capacity fiber-optic infrastructure. This hybrid network of sensors, equipment, hardware and people taking and acting on decisions is the field the oil and gas industry in Norway describes as ‘integrated operations’. The backbone infrastructure associated with integrated operations is a number of collaboration rooms or common information spaces where heterogeneous professionals collaborate to optimize oil and gas production,see Figure 2. It is important to acknowledge that this is the setting in which these MDEs are situated. They are part of an *information ecology* where people adapt to changing work demands, sustain and control scarce resources and live with continually evolving information and communication. An information ecology is a system of people, practices, and technologies in a particular “local” environment [7]. Local here means both virtual and real presence in a collaborative environment and “local” will as a consequence of this increasingly have a more global meaning, since people can be globally distributed but virtually and locally present. The virtual, local and global are key features of an information ecology and it is not just a traditional ecology bound in a particular space [8]. The key issue is that if the discussion on MDEs is confined within the borders of a single isolated space this will make the discussion pretty uninteresting because such an MDE will in most cases interact with data, information and people located elsewhere. .

Methodology and guidelines

In our large scale deployment of MDEs we found out early that the existing methods for evaluating such spaces in the oil and gas industry (the CSCW and HCI-communities excluded) were compliant with and based on work in various types of control rooms/centres, ref ISO standards like ISO 11064-1 and ISO/DIS 6385. In such a case the MDE is a hub or obligatory passage point in which all data/information is presented and all decisions taken. This is not the case when MDEs are regarded as information ecologies. This means that the traditional command and control metaphors inherent in many existing function allocation methods were improper to evaluate the new emerging network-based practices. The “control room metaphor” was so pervasive in our business that we had to develop new ways of thinking to escape established principles. A new methodology called CORD was developed to address these issues. The CORD MTO methodology employs scenarios to analyze functions and possible function allocations (between man and machine and between various geographical locations). The three step method (operational experience review, analysis and allocation of functions and the development of a new work organization) ensures that both normal operating conditions and operational discrepancies are subjected to analysis. As such the methodology provides a foundation for detailed design and later verification of the resulting working environment and work organization. The challenge is not just the HCI and ergonomics but to address how both human, organizational and technological elements interact within and across these MDEs. This means that the installed IT infrastructure and the shape of the rooms are pretty static but the practice associated with the use of the facilities is not visible in the standards at all. We still suffer from the fact that function-based work representations such as hierarchical task analysis, organizational flow charts, standard operating procedures, etc., seldom adequately represent the complexities of work as practiced, see [3,6,9]. Consequently design decisions based on such abstractions lead to less ideal design. Our work shows that there is a gap between the functional abstractions of work of the sort used to inform function allocation and design and the processes that are required to make those functions work in everyday practice. The challenge is that we might be making our allocation decisions on an incomplete view of the work, with the consequence that our ability to design an effective MDE is poorer. It has been difficult to specify what is needed by the humans to make the functions work [9]. The work practices that evolve around the MDEs and the technology/material elements of the MDEs both change over time, causing the allocation of functions also to change.

The implication for us has been to consider the richer context of work as part of the work that is been undertaken in MDEs. This is a development process we have not found fruitful to put in our guidelines. The StatoilHydro guideline describes the more stable enabling platform for collaboration, but not the collaborative practices themselves, see Figure 1. These collaborative practices are developed with a less instrumental approach and documented elsewhere [1,2.5].

Important issues related to guidelines are;

- The challenge is that the practice with the MDEs is not just confined within the MDE but is often the consequence of interaction with the external information ecology. There should be an up-front analysis (room purpose) addressing for which purpose the MDE is to be used. Even though the users have some notions of usage this will always change and a key design criteria is to design for enough flexibility (and articulation work) to be able the adopt to such changing practices. We have used several methods to conduct this analysis; ethnography, interviews, and various types of workshops like mock-ups both in the start-up phase and after a more stable pattern of usage have developed. In most cases such an analysis is connected to an organisation development initiative.
- Existing methods for function allocation between (humans and machines) are not proper to analyze the dynamic patterns that develop in distributed information ecologies, since they do not have a good way to handle the dynamics of improvisation and articulation work [7,8].
- A minimum level of standardization and symmetry is important in these MDEs. Similar solutions with similar interfaces should exist between various MDEs. When users switch between MDEs this creates nuisance, frustration and hurdles to collaboration.
- The amount of training and ongoing support to the users must not be underestimated. The ability to work and collaborate in such information ecologies is a skill that needs to be developed.
- Technical specifications related to videoconferencing, sound systems, presentation media, projection, PCs get very quickly outdated and needs to be followed up by dedicated personnel.

ROOM PURPOSE

ROOM DESIGN

- ROOM SIZE AND CAPACITY
- LAYOUT

TECHNICAL EQUIPMENT

- VIDEOCONFERENCING.
- SOUND EQUIPMENT
- PRESENTATION MEDIA
- PROJECTORS AND PROJECTION SURFACES
- PC-EQUIPMENT
- CONTROL SYSTEM
- CABLE MARKING AND CABLES
- POWER REQUIREMENTS AND EMERGENCY POWER

WORKING ENVIRONMENT

FURNITURE

NOISE

TEMPERATURE AND VENTILATION

LIGHTING

SURFACE TREATMENTS

Figure 1. Content of guidelines

MDES IN RELATION TO COMMON INFORMATION SPACES IN CSCW

In our research on MDE we have focused on the role such ‘shared’ information spaces play. We see that the MDE filled different functions according to which community of knowing it involved. The existing CSCW literature on common information spaces (CIS) [1,2,6,8] was helpful here. In this paper we have to simplify this into two major findings.

- When used by a homogeneous community MDEs often become arenas that enable the improvement of identity, self-confidence of the group in addition to improving the language, tools and practices of the community [2]. In such a setting the MDE develop a stabilized configuration rather quickly. We discovered numerous examples where the MDE as a CIS became ‘shared’ because it was the language, models, theories of a homogeneous community that were embedded in the interaction and the objects of the CIS/MDE. The use of specialist tools and shared objects could be extremely complex and focused at the same time.

- The MDE often with the same platform (employing the same guidelines principles) used concurrently by several communities represents ‘sharedness’ of a different kind. Here we have found many instances showing that diversity between various communities are handled in collaboration with much more temporary and loose forms of collaboration and sharing. Objects tend to be used more in spur of the moment, and the MDE has very few stable boundary objects [1,2]. Here the shared CIS or MDE is a short-lived arrangement that constantly needs to be re-negotiated from situation to situation. It represents a short-lived common ground for decision making in the cross-disciplinary team. This work has to be undertaken each time. Ambiguities are seldom sorted out once and for all [1]. The different communities of knowing used the MDE to constitute a shared context in which a wide range of heterogeneous information could be interpreted and improvised. Even though computers were used in the same way during the meeting it was mainly general tools like spreadsheets, MS Word documents and MS PowerPoint presentations that were in use. A domain specialist hardly used his/her specialist tools in discussions with other communities of knowing. The MDEs in these examples never achieved a closure in the sense that it established a common understanding once and for all between the heterogeneous communities. When a representative from one community discussed issues with a representative from another community they both had to improvise to make their representations less complex. Some important information and uncertainties would almost inevitably be lost and the participants got ambiguous information and representations.

CONCLUSION

This short-paper has presented some key lessons learned from a longitudinal research on MDEs. Although there exist a large body of relevant research on related themes as for example ‘control rooms’ and ‘common information spaces’, we argue that such studies do not to a large extent capture the impacts and complexity of a changing socio-technical context around these environments. In our study, issues sometimes physically remote from the MDEs themselves and changing business environment and actors highly influence the introduction and adaptation of MDEs. Secondly, our study potentially advances the insights on CIS in CSCW through illuminating how MDEs provide a ‘light-weight’ and temporary CIS for different disciplines.

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Figure 2: Various configurations of StatoilHydro MDEs