# Development of a cost-effective environment supporting remote collaboration

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**Abstract:**
While PC-based systems have long been offering sufficient quality for one to one interaction, video conferencing with digital document sharing between meeting rooms has been reserved for expensive high-end solutions. This paper describes key points for establishing a collaboration solution supporting a physically dispersed organisation with sufficient usability, functionality and quality based on smart assembly of off the shelf components.

Keywords: Work systems design, Collaboration technology, Power grid operators.

## 1. Challenge

In a three-year research project supported by the Norwegian Research Council, Institute for Energy Technology (IFE) and a Norwegian power grid company perform a pilot study to identify and describe the capabilities that power grid companies must possess in order to deliver in a future market. Through identification of main drivers for transformation and description of competence needs, "Collaboration" was identified as a key organizational capability supporting a wide range of operative decisions (Reegård et al. 2019). Based on the identified requirements from the organisational capability development analysis the following high-level goals for the collaboration solution were identified: 1. Suitable technology and arenas for interaction within and between locations 2. Cross organisation competence in interaction as a working method 3: Expertise in user support for interaction tools. 4: Adaption of interaction to external parties' preconditions. Requirements were developed for both the human, process, organisational and technological elements of the collaboration capability. The challenge this paper addresses is how to identify and develop solutions that respond to the technical requirements.

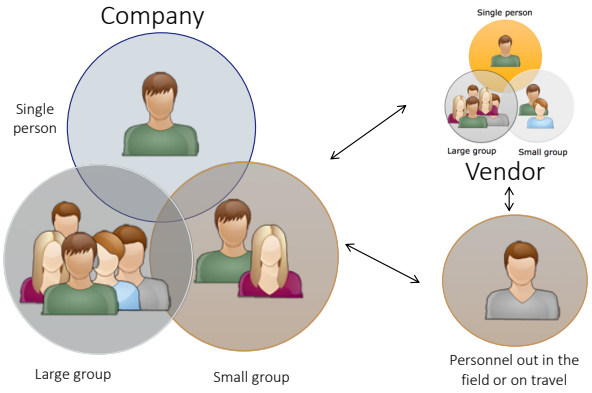


*Figure 1. Collaboration model*

## 2. Development activities

The following collaboration needs were identified in the organisation: 1: The digital collaboration arena is not limited to the collaboration room but have moved out to the place where people do their work. This means the office desk, out in the field, the home office and on travel. 2: Contractors´ and vendor companies should be able to interface towards the grid company collaboration solutions. These prerequisites were

developed into a model for collaboration as seen in Figure 1. All parties should be able to connect, share common digital surfaces and have good quality sound and video picture. New software collaboration platforms like Microsoft Office 365 and Google G Suite has made high-end expensive video walls unnecessary for most of the collaborations between a company's locations. When collaborating one-to-one or in smaller groups, the pc-based solutions can even improve the participants' experience of technological ease, nearness and availability of remote colleagues. The company under study had chosen Office 365 with Microsoft Teams as their solution. For the one-to-one collaboration situation, choice of equipment was pretty straight forward. Replacing the small and medium size video meetings with sufficient quality pc-based solutions need considerably more caution.

Results from the collaboration capability development described above were taken into designing a collaborative environment that would meet the requirements for flexibility and out of house connections towards other company locations and external actors. Based on experiences from collaboration environment development from integrated operations in the Norwegian petroleum industry (Drøivoldsmo et al., 2013) a pilot set-up was developed and evaluated with respect to necessary functionality. The solution supports PC-collaboration with video and possibilities for screen sharing between locations. As shown in Table 1 below, the basic equipment for each instance of the solution is laptop, personal or room video camera, microphone and loudspeaker. Meetings with larger groups (more than 10-12 people at one location) still require advanced hardware for adequate sound and video transfer and were outside scope for this development.

## 3. Outcomes

Three different collaboration arena solutions were developed, supporting small group size (3-persons) and medium group size (7-12 people) in addition to the individual remote user. Collaboration rooms had to be accommodated in existing buildings and adapted to these. Consequently, compromises were made regarding the size and capacity of rooms. A collaboration room is not a permanent work place and does not have to comply with the work place space and air quality requirements. However, the room size is important in terms of supporting activities in the room, especially having enough room to easily move behind the chairs (minimum .7m),

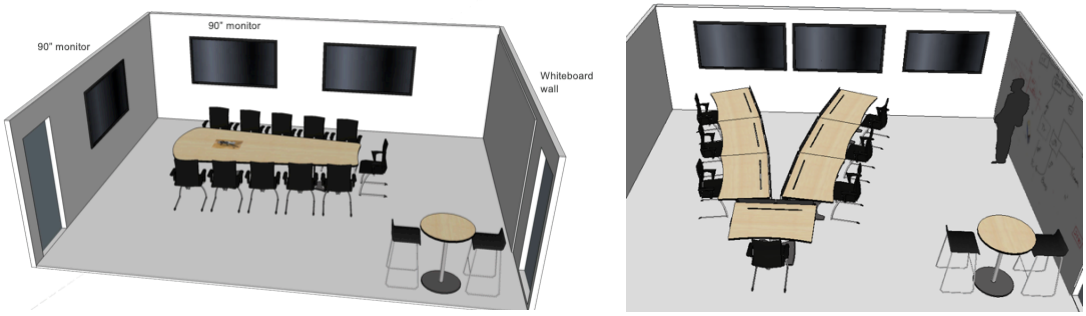


*Figure 2. a) and b) Example layouts with use of one or two screens for video conferencing*

sufficient distance from the table to the monitors (1,5m) and wall space for drawing boards. Examples from rooms built are shown in Figure 2. Technology selection and installation were done through several iterations. A variety of off-the-shelf technologies for sound and picture were tested, with and without switch solutions for screen sharing. We landed on the Barco Clickshare

as the basic hub for input both for the 3-7. and 7-12-person size rooms, see Figure 3. This made the switch and control touch panel superfluous saving cabling and equipment cost. Cost estimates for Table 1. alternative B and C cover one monitor solution only. The Barco Clickshare CSE-800 has a cost of approx. 3500€. Cabling and installation costs are not included in the estimates.

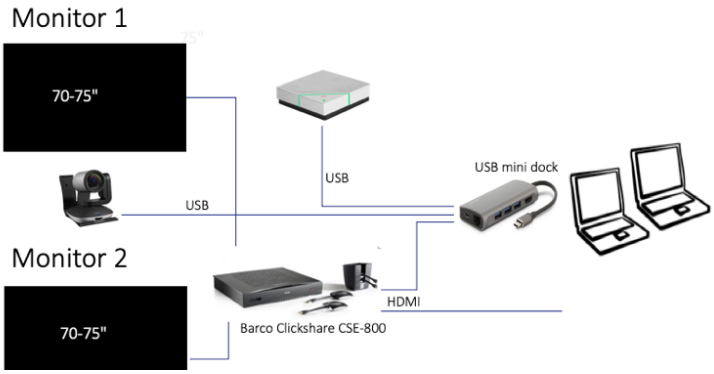


*Figure 3. Sketch with overview of basic components in the configuration of equipment*

*Table 1. Equipment and approximate cost for different size rooms*

| Solution | Room size | Monitors | Video | Sound | Sum |
|---|---|---|---|---|---|
| A. Single person | Cell office or landscape | Standard monitor 27”<br>350-500€ | External web-camera HD 1080p<br>80-120€ | USB PC headset with sound cancelling microphone<br>60-200€ | ≈600€ |
| B. 3-7 people | 15-20 m2 | Min. 2 x 70” or 1 x 80” HD 1080p monitor<br>4500+€ | HD 1080p video camera with pan/tilt and zoom<br>600-800€ | Table speakerphone<br>≈250€ | ≈ 5000€ |
| C. 7-12 people | >20 m2 | Min. 2 x 75” or 1 x 80+” HD 1080p monitor<br>4500+ € | HD 1080p video camera with pan/tilt and zoom<br>600-800€ | Ceiling mic with USB sound card. Mic ≈ 700€ Sound-card ≈150€ | ≈5500€ |

## 4. Recommendation for development of the collaboration technology solution

In order to harvest the benefits from investments in collaboration tools and arenas, the implementation must be targeted against the identified goals for organisation development and alignment with the company strategy for digitalisation. Building a solution supporting the collaboration capability of an entire organisation requires anchoring and mutual understanding of the requirements within the ICT-department. It is important to ensure quality in both ordering, construction and operating phases. If the goal of moving the collaboration arena to where people do their work shall be a reality it implies that all office desks, meeting rooms and field locations should have support for a common way of interaction. This includes selection of affordable solutions suitable for interoperability with contractors and vendors. Depending on the work domain, different parties will have more or less resources to make them compliant to operators’ solutions. Implemented the right way, PC-based solutions of today can deliver sufficient quality to support this functionality at an affordable cost.

## References

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