

FlexWork Blueprint No. 007

(Issue v.01 – 10/09/01)

Collaborative design and production

Achieving critical mass or joining distributed supply chains.

This is one of a series of 'blueprints' designed to illustrate models of flexible working. It is designed for use by business advisors as a resource when providing assistance to SMEs who are investigating flexible working for their business, or whose business development might benefit from consideration of flexible working.

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1. Overview

This blueprint describes distributed design and production activities supported by flexible working methods. It examines and illustrates critical features of distributed working where SMEs jointly participate in design or production work, and so is closely related to BP01 (distributed product promotion). The information is derived from a range of experiences to provide coverage of a wide range of issues relevant to distributed working of this type.

2. Rationale and Target Audience

Distributed working is increasing within larger companies at a significant rate. It is also increasing between companies, and involves SMEs in many cases. The first inclusions of SMEs in supply chains to larger companies have developed out of existing supply chains such as those feeding the automotive industries. In these early cases older technologies such as EDI were used to ‘integrate’ external processes to make larger companies more efficient, and so improved the efficiency of smaller players. More recently, the expansion of Internet usage and related technologies has encouraged a wider range of collaborative strategies. Flexible working methods can allow SMEs to engage as part of electronic supply chains to larger companies, and can also allow SMEs to work together. In both cases the main advantages are to exploit business opportunities requiring a larger mass of personnel, knowledge and skills than can be offered from a single site or a single company. The potential benefits for a company are numerous and include:

- Avoiding movement of people to temporary work locations.
- Allowing people to work on several projects from a single location.
- Opening business opportunities to exploit current skills and competence in projects where only part of the total required competence is available within the company.
- Allowing companies to embark on new business ventures to test future opportunity prior to expansion (‘operate first’ using external support before developing new internal support when idea proven).
- Allowing companies to exploit work opportunities focused on distant regions without investing in regional offices.
- Developing regional, local, or special ‘collective effort’ to engage larger business opportunities than could be taken on in isolation.

These benefit features are not entirely new and are seen in co-operative movements in regions such as Emilia Romagna and elsewhere. However, a key difference in flexible working techniques for collaborative working is that they can operate across trade sectors, and even across regional boundaries, taking co-operation to a much higher level of possibilities.

The flexibility offered by IST methods for flexible working underpins many activities within e-business. However, this blueprint is confined to the flexible working aspects and does not cover pure e-commerce issues. The guidance offered could be applied by literally any trade sector and in any region where a reasonable telecommunications infrastructure is afforded.

3. FlexWork Usage Description

The 'typical usage scenario' offered in this blueprint concerns the usage of flexible working techniques by a group of SMEs who collectively, 'for the purpose of illustration', are concerned with the design and delivery of a biomedical device for bio-assay of human fluid samples. The core illustration idea is based on the fact that routine urine samples are first tested for the presence of molecules above a certain size, and so may include the possible presence of indicators for a range of conditions. A research department in a University has identified the potential benefit of automating this first step because it currently wastes a large amount of skilled labour time on a task that produces mainly negative results. Their time should be diverted to analysing those samples with positive initial results to ascertain the actual indicators present for feedback to doctors awaiting detailed analysis.

The usage scenario follows the steps of developing and operating a flexible working team, and supporting IST infrastructure, from several organisations to address this illustrative task. It can be applied literally to any shared design and production work involving electromechanical devices, or with some adjustment to any collaborative design and/or production scenario.

3.1 Forming a Flexible Work System

The first steps in distributed flexible working in this kind of scenario involve identifying the team members and any subgroups to be involved. Their needs for communication, interaction, and shared information will provide demands and constraints that define the scope for using IST solutions to meet their requirements.

Team and Work-groups

In our illustrative scenario, the University department who had ownership of the overall concept and idea led the team. They recruited an ElectroMechanical production company with experience of products of a similar type and scale. They also recruited a Plastic Casings company capable of ‘packaging’ a product ready for laboratory deployment. For the production of user manuals and labels they intended to engage a company of Technical Authors with experience of medical products.

Each organisation contributed one key member to a steering group, and further members who participated in work groups. It was necessary to identify the likely tasks to be performed by each group, and their interaction requirements as a basis for infrastructure definition.

Steering Group

The Steering group was led by the University, and had a member from the ElectroMechanical and Casings companies. Its purpose was to define and manage the design and production tasks, and to ensure a marketable product. Their primary tasks were meeting to review progress, including consideration of design materials and test results. For asynchronous discussions they would need email contact and the ability to provide attached files. For monitoring progress they would need access to shared information on demand. For distributed meetings they would need at least audio conferencing, and on occasion would need shared simultaneous access to both texts and visual materials such as drawings and diagrams.

Concept Group

The Concept work group was led by the University, and had a member from the ElectroMechanical and Casings companies. It contained the lead members from participating companies and had the same membership as the steering group. Its purpose was to develop and refine the existing concept towards an outline specification, and to monitor conformance of work to this specification, making adjustments where needed. For asynchronous discussions they would need email contact and the ability to provide attached files. For monitoring progress they would need access to shared information on demand. For distributed meetings they would need at least audio conferencing, and on occasion would need shared

simultaneous access to both texts and visual materials such as drawings and diagrams.

ElectroMechanical Group

This group was led by the ElectroMechanical company who provided several members, and included one person from the University and one from the Casings company. Its purpose was to take the outline specification from the concept group and turn it into a detailed specification for pilot build. They then would oversee build development and testing, and approve final build. They had to work closely with the casings group to deal with integration problems. For asynchronous discussions they would need email the ability to attach files. For monitoring progress they would need access to shared information on demand. For distributed meetings they would need at least audio conferencing, and often would need shared simultaneous access to both texts and visual materials such as drawings and diagrams.

Casings Group

The Casings company led this group and were supported by a single member from the electromechanical company. They reported to the concept group within concept meetings addressing product and image issues. The group took the overall concept definition and outline specification from the concept group, plus detailed specifications and assembly drawings from the electromechanical group. They first developed an outline design and production scheme for casings, and developed this to a prototype for integration and proof in the working prototype. Their communication needs were identical to the electromechanical group.

Packaging Group

This group was chaired by the lead of the concept group and included the lead from electromechanical and casings, plus the external technical author. In parallel with other group developments, this group were responsible for informing and overseeing the work of the technical author producing (via his own company team) manuals, labels, and other associated texts. Their communication needs were identical to the electromechanical group and included requirements for simultaneous discussion of high resolution images.

3.2 Team and Group Communications

General Features

The collaborative work system is based around the people, information flows and interactions necessary for conduct of the work. The tasks conducted by individuals are mainly design and modelling tasks aimed at realising a technical solution that fulfils the concept model. The interactions within groups require support for discussions, displays, and demonstrations, involving texts, graphical documents, and images of 3-dimensional assemblies. Asynchronous discussions can be supported by email via specific distribution lists with attachments of documents and diagrams. Live (synchronous) discussions can be supported by audio conference, where materials have been already distributed, or by data conference where images or documents can be shown at will and amended to illustrate discussion points. Access to shared information may be on-tap and so requires a shared file space with appropriate access control.

Team and Group Communications Infrastructure

To support a distributed team as suggested in the illustrative example, a clear view of the required infrastructure must be developed at the outset. Using the illustrative example as a basis, it is clear that some kind of Extranet could be beneficial as a core element. An Extranet is effectively the extension of a local Intranet to allow controlled access by external participants and in this case would allow the lead organisation to ensure continued control of all documents and communications.

The core of the Extranet approach is provision of a private web site for placement of files, and display of contents to users who can download them. Contribution of files can be to a fixed filing structure, or can be adapted by users to meet needs. Access control can be arranged to ensure teams access only those folders or files necessary for their tasks. Version control can be made automatic or can be left to users to organise as suits them. Housekeeping (e.g. deletion or archiving of old versions) can be made responsibility of a single agent, or left to teams and users to organise for themselves. In each case, control methods must meet the needs of participants for security and safety of information.

The communications component can be organised to ensure recording of all communications. For example, email aliases can be created so that team members are emailed via a single server which records and forwards all emails, thus ensuring a complete log of all interactions. This level of complexity can be avoided by direct email contact between participants, but relies on their own maintenance of communication histories.

The Extranet approach can support most asynchronous communications, and can also be made to support some level of synchronous communication. However, many users find that this level of complexity is not acceptable to smaller firms (see GroupWare, later).

Synchronous communications in this scenario rely mainly on live telecommunications links. Audio conferencing can be arranged between any telephone connections in the world, and support live discussions including consideration of materials previously distributed (texts, images, etc.). Data conferencing can include video-conference links so that team members can see each other and can make presentations of diagrams or objects for discussion. Data conferencing can also make use of T120 (standard) functions such as shared images and shared files that can be marked up or edited during discussion either to allow illustrative support, or to record decisions (amended texts, altered mechanical diagrams, etc.).

All of the above are easily available as collaboration tools contributing to a distributed group communications infrastructure allowing easy team working at distance. However, it is not the only set of options, and some bespoke options are available.

Specialist Tools for Group Working

A range of specialist applications are available for group or team working over telecommunications links. These are collectively referred to as 'GroupWare', 'TeamWare', and other similar terms. Well known and well documented examples include Lotus Notes and BSCW, and many similar products appear annually. They provide a kind of Extranet ensuring shared work-space and shared file-space, plus some level of access control, version control, and communications sharing. The major benefit is that they come pre-configured to some level and have established working methods and sources of support (e.g. user groups, discussion lists, manuals, etc.). The downside is that users can be tied-in to a product line, and the tools can be expensive for smaller organisations.

3.3 Team Working – Meeting Needs

Like any development group, teams using technologies for distributed working require clear management structures, lines of responsibility, and communication channels.

Management of the processes within such a venture (the top-down view) must ensure that all management requirements are met, or risk loss of control or loss of information. Access to all shared information spaces and communications logs is one way to ensure that managers of work processes can inform themselves of all aspects of work and progress. However, it is through reporting procedures that managers

usually ensure information and awareness necessary for fulfilment of management responsibility. That means managers must ensure the interactions between teams and groups are satisfactory and meet their needs for contact and exchange. The need for face-to-face meetings may not disappear entirely, and managers must monitor progress to identify requirements for physical meetings (for example, to reach consensus on particularly difficult issues).

Participants in distributed group working (the bottom-up view) must ensure their needs for information, support, and discussion are met. A significant risk is that design or production staff may not declare difficulties in using distributed collaborative working systems, fearing it is their fault and not that of the infrastructure or its design. Participants should be encouraged to report on their experiences in using such technologies, and meetings aimed to discuss this topic must be conducted early in usage, and then at appropriate times throughout usage – especially when changes to the infrastructure are planned or have been implemented.

The main aim of any collaborative infrastructure is to provide support to distributed teams to ensure they can work as effectively as they would if placed in the same building. This is a significant challenge and must be kept in mind by managers deploying such technologies. “Making the system work” can become a goal in itself, and this can be a significant mistake. The system is there to serve the organisation, and so “making the organisation work” should be the only goal of collaborative technologies.

3.4 Typical Experiences

Managing

Managing a work process relying on interactive technologies is becoming less of a novelty. The use of telephone, fax and email are well established, and are the first wave of team-working via technology. However, this kind of working has grown somewhat organically and seems like “common knowledge”, yet few managers ever stop to think about how people really use even the simpler technologies for remote collaboration. Adopting newer and more complex forms of collaborative technology require us, and give us opportunity, to really consider the place of technology in team-working. Managers who think they can buy an off-the-shelf solution for “plug’n’play” success usually find that they still must carefully analyse the dynamics of their work teams, the needs for communication and information exchange, and the specific tasks which can be supported by technology. Planning for flexible working usually avoids a host of errors of assumption, so a ‘reality check’ can pay real dividends.

Working

The many kinds of work and workers involved in design and production each have their dependencies on other work tasks and other people. These relationships and ways of working always have historic development within a professional sector and within a company. Working in a distributed collaborative environment often exposes workers to needs for support, information or interaction that has not been planned to the last detail. In such cases it is easy to negotiate and develop support and information exchanges that suit personal requirements. However, a collaborative work system relies on it being 'systematic' (for operational and management reasons). Therefore, workers should ensure that they declare any such practices to fellow team members and to managers to ensure that unmet needs are recognised, and that the 'home grown' solutions can inform planned improvements to the systems in use.

Meeting

A critical area for flexible working of distributed teams is that of meeting. Design and production relies on people being able to really exchange views and ideas in an open and constructive way, and so meeting at distance is an area for careful consideration. Managing such meetings often requires improved efforts and strategies to ensure full participation among members who may become 'viewers' of proceedings rather than participants. Structuring agendas to ensure that each must present progress, problems, positions and ideas, can go a long way to avoiding passivity or just missing information.

Of equal importance is the use of facilities within meetings. Even in an audio meeting, a difficult discussion point can be addressed by immediately emailing a missing or edited diagram to all parties. In meetings using video or T120 data conferencing, participants can make creative use of opportunities if they learn how to use them. Not only can documents and diagrams be shared for simultaneous viewing, but users can develop new ways to utilise electronic facilities. One company regularly plugs a video-feed into a T120 session to allow participants to see a production line in operation (to illustrate new technologies in operation) – so the scope of meetings is not restricted to 'the office'.

Normal meeting dynamics can also be maintained in distributed scenarios. For example, face-to-face meetings sometimes decide to break into side-meetings to develop solutions to problems under discussion and then re-convene to share proposals. Technology users sometimes feel plugged-in to a live event, and do not consider that the normal freedoms apply. They can do anything that can be achieved in a face-to-face meeting except share the same coffee!

4. Technology Notes

The scenario discussed in this blueprint is illustrated via a single example, and discussed under a broader set of headings. In both cases the technologies used for support are described from a usage point of view, and not from a technical or product perspective. The set is briefly summarised below.

Email – provides the basic element of asynchronous communication. It can be routed via a single server to allow archiving of all communications, or can be direct and so reliant on users maintaining their own file history.

File transfer – can be achieved by attachment to emails for urgent dispatch or to ensure broad receipt. It can also be achieved via a shared file space on an accessible server, and so must be declared to interested parties via email. In both cases access control must be considered if restrictions apply.

Shared file space – can be structured against a workplan or developed by its users to meet needs as defined in the progress of work. In the former case there is more likelihood of communicating a single model to all users, but requires careful consideration of emerging needs. In the latter case the need for development of an explicit model is avoided, but the risk of confusion must be addressed by ensuring changes are communicated to all interested parties. In practice, it may be necessary to start with a pre-defined structure and to then give control to sub-teams or groups to manage their own local structure. Use of proprietary solutions (BSCW, Lotus) provides more support for structuring but does not avoid the essential problems.

Audio conferences – can allow cheap and effective meetings. Because the visual channel is lost the meeting co-ordinator must work harder to ensure all participants are included in discussion. It may not be apparent that someone is not happy with a discussion thread, so explicit testing of agreement is necessary. Audio meetings which refer to documents or images risk 'losing' participants unless the speaker makes up for the loss of gesture with extra verbal information (refer to pages, refer to diagram parts, be specific).

Video and Data conferencing – video allows a close approximation of a shared meeting room. It cannot allow for random access by individuals to the shared visual environment (cannot always look at specific persons to check reactions). For this reason it may suffer from some of the restrictions of audio-only and so the same solutions apply. Where possible, all attendees should be on screen. For both video and data-conferencing, an external agent may be required (MUX) to mix signals into a common viewing stream if more than two sites are connected.

5. Business Structural and Process Issues

As for all distributed collaborative working, the structural and process issues are determined by the nature of work distribution. Collaborations involving participants from more than one company, or more than one department, effectively create a ‘virtual company’ or ‘virtual team’ for the purposes. This means that the co-ordinator may acquire what amounts to a new department and so must face some structural implications, as well as changes to business process. These are impossible to predict for all situations in a systematic way, but some general features have been highlighted in the text and are summarised here.

A business can avoid investment in staff and space by recruiting resources from other businesses. This allows inclusion in business opportunities without any significant structural changes, although taking a lead role may cause ‘virtual departments’ or ‘virtual teams’ to appear as extensions of existing structure and process, and so may have impacts which should be estimated as part of planning.

Operating in this way will also impact the relationship with other businesses. Typically, this means moving from a competitive relationship to a ‘partnership’. What is good for the partnership is good for the group, and so specific concerns will also shift. For example, a company will shift its concerns over pricing from one of competitive pricing (with a previous competitor) to partnership pricing (with a collaborator), and issues such as balancing profitability across the consortium will be more important than, say, undercutting.

6. Deployment Advice

In general, as indicated under point 5., the adoption of collaborative teamwork across multiple organisations (or dispersed departments) requires as much a culture change as specific changes in trading practice. Company’s considering collaborations or partnerships of this kind should develop a clear model of how it will work, including cost implications (profitability) as well as operational considerations (new opportunities, staffing, process impacts, management, etc.). Any first steps into collaborations of this kind should be used as a formal opportunity to test the model and not only improve understanding, but also refine expectations.

Technical infrastructure changes should be designed not only to meet initial requirements, but also to serve any general requirements predicted by the future vision of collaboration. This can be eased by avoiding co-ordination responsibility initially, and joining a venture led by an experienced operator or a larger company with greater resources (a learning exercise).

Business advice should be sought from a regional support agency who may have experience in this area, and any technical advice should be checked with more than one expert to test agreement.

Participation in shared working between companies can expose substantial detail of the operational and strategic characteristics of a company, and so development of trust is required – tempered with caution. One way to ensure limited risk is to assemble a set of partners who have no obvious competitive relationships, and an obvious way to achieve this is to marry very different, but complementary, professional and business interests.

7. Related Cases

The web site at <http://www.flexwork.eu.com> includes a wide set of cases, technical briefings, and advisory documents. A large number of these are relevant to the themes in this blueprint. Items of specific interest include:

Regional cases:

Swed.pdf - Öckerö Telecentre - providing support for Volvo and Ericsson.
Aragon.pdf - Networking, collaboration and communication - telework and centres.
Gatine.pdf - Extending markets in the agro-food industry - telework and telebusiness.
Exeldat.pdf - Excel Data: Denmark's first satellite office
Fincoop.pdf - Sustainable Suburban Economy - Cooperative using teleworking.

Technology Cases:

c1 - BSCW shared workspace system
c2 - Construction site mobile operation support
c3 - Environment for the collaborative working of medical authors
c5 - Multi-site co-operative 3d design system for architecture
c10 - Concurrent engineering environment for building and engineering structures
c13 - Virtual enterprise product information model
c15 - Web-based tool supporting quality assurance and management of projects
c16 - Multimedia working for small companies (groupware)
c17 - Bringing broadband to SMEs (SME collaboration)
c18 - The intelligent building site (cicc)
c23 - Remote maintenance by specialist SME manufacturer
c24 - Tools for distributed publishing (groupware)
c25 - SME collaborative working in car industry supply chains
c26 - Distributed software production
c27 - Remote working for hazardous environments

8. Related Information Resources

The web site at <http://www.flexwork.eu.com> includes links to a large number of online resources, many of which are relevant to this blueprint. Resources of particular interest include:

<http://www.flexwork.eu.com/> – general flexible working resources

<http://www.gilgordon.com> – general flexible working resources

<http://www.eto.org.uk> – general flexible working resources

<http://www.flexibility.co.uk> – general flexible working resources

<http://www.telecommute.org> – general flexible working resources

<http://www.advanced-workplace.com/> - collaborative SMEs

<http://orgwis.gmd.de> – groupware tools / collaborative working

<http://www.usabilityfirst.com/csw.html> – CSCW and GroupWare Index

<http://www.ecatt.com> – e-business and flexible working

<http://www.regen.net> – regional regeneration partnerships