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Design communication within fast-track building projects

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ABSTRACT: The factor time within building projects is on high pressure because the need for faster delivery of buildings is rising. Within fast-track, complex building projects the design process is an important key to fast-tracking. Based on case analyses of fast-track design processes (den Otter, Prins 2001) it became obvious that design processes function poorly within fast-track projects. Improvement of design methods, techniques and instruments is needed to facilitate these high-pressure design processes as well as high professional skills of the design team members to collaborate and communicate effectively. Solutions might be found in integral design methods with an increased level of collaboration and communication facilitated by electronic media for design information flows.

In this paper, design communication facilitated by extranets within fast-track, integral design processes is analysed and modelled. Special attention is given to electronic mediated communication of design teams facilitated by reflection and action learning to increase the inter-activity of these design teams.

KEYWORDS: Fast-track design management, design communication, collaboration, integral design, concurrent design, information behaviour and electronic mediated communication.

1 FAST-TRACK DESIGN COMMUNICATION

The aim of fast-track design is to shorten the throughput time of the design process. Based on the control aspects of project management (time, money, and quality) shortening of time should not necessarily increase the delivery costs of the designed product for the client or should decrease the quality of the designed object. Recent developments within the area of architectural design management gave some evidence that also creative architectural design processes can -and ought to- be planned and managed to improve the effectiveness of these kind of processes. As showed in analyses of fast-track cases, due to delays in the design phase the preparation and realisation phase of the project are stressed and failure risks and building costs rises (Otter & Prins 2001).

To analyse as well as to improve fast-track building projects two systems of control aspects must be considered in their mutual dependency. One system consist of the three coherent elements: time, money and quality, the other system of the coherent elements: people, process, and object (Otter & Prins 2001).

1.1 Design communication

Design communication, in terms of design information exchange through communication channels and media, will be analysed and organising tools to improve the communication, based on the use of extranets, will be modelled and discussed.

A design process mostly is defined as a sequential process in which progress is measured in terms of used time and remaining time left, because the time to deliver is restricted by the client. On the other hand, the design process is highly cyclic and iterative by nature through which a team of designers
develop satisfying solutions to the client’s demands (Friedl 2000). Within this field of tension, the effectiveness of communication and understanding between the participants in a design team highly determines the progress of the design process (Paashuis 1997).

Paashuis states about collaboration and communication within integral design processes concerning New Product Development (NPD): communication follows collaboration. Stoter (1997), however, declares that effective communication enables collaboration between participants in a team. ICT tools are used nowadays by organisations because it is expected that its use improves communication effectively.

Extranets are introduced as new, powerful media to improve communication of teams and organisations because of their features concerning exchange of electronic information: speed, overview, transparency, version, and status control, as well as easiness of use. However according to de Wilde (2000) new inventions have to prove themselves in the field and mostly will not be used for the purposes they were designed for. Another important aspect is the underestimation of the dynamics of society.

The information environment of a design team can be described as a fickle information environment (den Otter & Prins 2002) in which commonly available communication tools and methods are used. Designers have a certain desire to communicate using a wide range of communication means (Donker 1999).

The use of an extranet will change the information environment because it influences the use of the other communication means and tools of a design team (Davenport 1997). It might be that an extranet formalises the communication within these design teams too much. It might also be experienced as threatening because of “big brother effects”. For these reasons it might easily kill the creative, cyclic design process (Otter & Prins 2002). Within this view the implementation and use of an extranet by a design team is not the change to an electronic communication environment but rather the change to a new situation in which it is not clear at all how this new communication tool should be used effectively.

Because this is not clear, in this paper the most important items of communication and information exchange will be discussed. Based on the conclusions of this discussion a model for improvement for the effective use of an Extranet as a group communication tool is presented and explained in its functioning. Within a Dutch PhD research project the functioning of an extranet with the purposed model will be tested on its effectives to design processes.

1.2 Collaboration versus communication

In this paper, it is argued that a new communication tool needs a change in the collaboration of the design team and needs to be managed to become effective. According to Paashuis, people often have difficulties co-operating and communicating inter functionally on their own initiative, because it forces them to go beyond their existing roles, responsibilities and authorities. Reymen (2001) states that “People who do not do so, will likely not be triggered by a method to do so”.

Design communication is of essential importance to facilitate the progress of the design. Human communication is defined by Cherry (1966) as “the establishment of a social unit from individuals, by the use of language or signs” and “the sharing of common set of rules, for various goal-seeking activities”.

Design communication can be defined as a two-way process of exchanging messages, ideas, images, sketches, information and drawings between human beings, verbal and nonverbal, to facilitate the progress of the design (based on Stoter 1997).

Design communication uses a network of channels and media, verbal and non-verbal, on paper and electronic. It depends of three aspects: a) the activities of actors to communicate; b) the formal- and informal information processes of the design team; c) the complexity of the design information. These three mutually dependent aspects are defined as design information handling to generate, exchange, and publish design information. According to Galbraith (1995) and the contingency theory, an organisation can be defined as an information processing structure, within which information exchange and communication are important to the successfulness of the organisation.

Within the triangle of people, process and object (Otter & Prins 2001), information handling is
positioned in the middle because it is dependent of all three elements (Figure 1). Design team members depend on each others design information for their own progress as well as on overview to design problems and solutions worked out.

In this view the design process is the organised processing of interdisciplinary design information between design partners. Each design partner processes solutions to design problems related to his specific knowledge domain. Design team meetings are necessary to make choices as well as to resolve conflicts in solutions regarding the client’s brief, time, money, and quality.

For reasons of gaining time within fast-track design, it is necessary to work as parallel as possible. This is normally only possible when design partners are working in the same office space or on location of the project. In this environment, interaction between the team members creates a collective frame of references as well as a collective judgement for the design problems and their related solutions (Stoter 1997).

Integral design can be defined within this context as simultaneously designing parts of the design, keeping appearance to the status of the overall design (Stal 1999).

The distribution of design information between the design partners is of essential importance for the progress of the design. Design information that is already distributed is quickly outdated within fast-tracking design. Therefore, fast and easy to use information systems like extranets might be the ideal solution.

1.3 Fast-track design management

Within fast-track design management it is essential to select the members of the design team at the start of the design process because of the short delivering time of the design and to ensure parallel work as much as possible. Working parallel to each other is important to keep track on the progress of the design partners and the status of the produced work. For that reason a solution like working together in the same room as a design team and not coming out before a satisfying solution is reached seems to work very effectively and efficiently. The room enables the team to work together as a group, as well as in subgroups or alone. The walls of the room might be used for the display of schemes, diagrams, images, sketches, and drawings to keep overview. Keeping overview, working together, team dynamics, team spirit, and getting the “chemical reaction” in the team are keywords for this working method. In architectural design processes as well as in urban development processes, these kinds of methods are used successfully.

2 DESIGN COMMUNICATION ASPECTS, METHODS AND TOOLS

Facilities: i.e. channels, media, methods and tools used for design information handling influences design communication due to differences in information richness of the used media. In most cases, in the early design phase, designers need to make sketches of the design and tell their story. A receiver without the story cannot interpret the sketch in the right way. For this purpose face-to-face meetings as well as team meetings are necessary. However, to exchange schemes, drawings, and documents without having meetings, the design team needs tools to communicate such as the telephone, fax, email, post, groupware and extranets. This paper concentrates on information handling in the preliminary design phase. Within this phase design information is put into drawings, images, schemes and documents and less verbal communication is needed compared to the sketch design phase. The paper does not focus on object-oriented aspects. Object-oriented aspects were studied in research projects such as those reported by (Nederveen 2000, den Otter & Prins 2002).
2.1 *Methods and tools of design communication*

Within design communications the mostly used methods and tools for communication are:

**Methods:**
1. Face to face meetings
2. Informal group meetings
3. Formal group meetings
4. Discussions and brainstorm sessions

**Tools:**
5. Mail
6. Telephone
7. Fax
8. Email
9. Organisers/Groupware
10. Intranet and Extranet (Project websites).

2.2 *Information richness*

In terms of information richness the highest rate is scored by face to face meetings.

Media richness is defined as the degree/amount in which a communication tool offers the possibilities, within a certain time interval, to effect the desired change of understanding of people (Daft & Lengel 1986). Daft & Lengel introduced the media richness theory for organisational information; a control issue in this theory is media richness. The meaning of design information exchange is not only the change of understanding of people but to communicate about a) the actor’s proposals for changes as well as the actual changes in design; b) the reason for change as well as the impact of the change in total. For that reason, changes in design often need meetings. The chances of misunderstanding and misinterpretation are lower with a meeting then with a-synchronous communication.

The highest richness according Daft & Lengel is for face to face meetings the lowest for rules and procedures, written text and numeric documents.

1. face to face → informal → formal with report
2. group meetings → informal → formal with report
3. telephone (voice, emotion, interaction)
4. email (response, ease of use, distribution possibilities, procedures)
5. fax (written text and sketches, ease of use) disadvantage: not digital text
6. post: addressed information.

Extranets are not measured and listed. Extranet communication concerns information that is not addressed to a particular person but that is published for a specific group; it can be compared to the information richness of journals and newspapers.

2.3 *Information behaviour*

Information behaviour has to deal with the skills, habits and backgrounds of design participants (Davenport 1997). It concerns information sharing, information overload and how to handle multiple meanings. Design team members, i.e. designers, design specialists as well as engineers, are regarded as knowledge and information workers. Often personal and organizational knowledge to a certain extend is shielded from others in the project environment, while this is what is actually their personal value added to the design.

This inhibits true collaboration. So the level of information sharing is rather corrupted by psychological factors bound to the characteristics of professional behaviour. Within design teams, a collective, coherent and consistent project knowledge base is of essential importance to improve the performance of design teams (den Otter & Prins 2002). Specifically on the level of technical design specifications, the sharing of design information as well as status and version control is important.

2.4 *Information culture: formal and informal design communication*

Formalising specific communication media within design teams might kill partly the creative design process or just fail to function and being bypassed by other informal communication media. (Dickson 1996, Capron 1999). Extranets are part of the formal communication because of the restrictions, rights and rules to use the tool. Email can be considered informal as well as formal communication depending on how it is used. An example of formalising e-mail communication is, when an e-mail
message is printed by the receiver or sender to be used as evidence for appointments, statements or agreements in a team meeting.

With regard to the grapevine, the organisation’s informal communication network (Robbins 2001), the hypothesis is raised that also informal electronic communication has to be taken into consideration to establish formal electronic communication. Changing media of communication takes time to get acquainted to by the users and will temporarily decrease flows of information through that media.

In that respect it is important within all information cultures to keep informal communication media open. This is especially important during the changes within organisations. The change to electronic design communication through an extranet is one of those. Without informal communication these changes will not be successful (Ouchi 1980, Stohl and Redding 1987, Sproull L. and Kiesler S.1998). As soon as the team members experience the benefits of the features of the new channels of information exchange (for instance the use of an extranet to publish design information for purposes of the design team) they will be more willing to change their communication behaviour.

3 EXTRANET FEATURES

As stated before, extranets are important to improve design communication for reasons of speed, overview e.d. The tool is important because constant overview on the progress and status of design and pro-active behaviour to actual, frequently updated design information is needed in fast-track design processes (den Otter & Prins 2001).

Intranet-extranet communication differs from email communication because design information is not addressed to a receiver but published for a specific group of people who have access.

Depending on the information behaviour of the viewers in terms of interactive or non-active behaviour the sender will get a response or not.

Stoter (1997) states that the use of intranet - extranet enhances the interactivity of the group working with the tool. However, due to differences in information behaviour, group members might lose interest when design information in the intranet is not updated frequently and with the same interval in time for all partners in the team. Due to this, failures might happen and wrong design information might cause conflicts in later phases of the design.

Attributes of an Extranet are: a) Transparency; b) Sharing of information; c) Progress of the information exchange process; d) Assimilation of information; e) Control of content: reduction of failures by up-to-date and non-redundant information. An Extranet might contain electronic sketches, images, drawings, documents as well as notes and diagrams.

Based on these attributes the possible effectiveness of the use of an extranet might be:

1. Direct effectiveness: overview. By means of an extranet the design team members can get an overview of the status of the design process and the work that still has to be done.

Insight view: by viewing drawings and documents according to their status and version number one can get a better view in the phase of the process and the possibilities for management of the information flows.

Interaction: depending on the rights of a design team member, one is allowed to view or to comment drawings, documents, and proposals for changes.

Failure reduction: because of the overview, conflicts and redundant information can be noticed more easily and actions taken to prevent failures.

2. Indirect improvements that can be expected are related to the overview, the information assimilation, the decreased search time for design information, and re-use of developed solutions in other projects. In addition, better design decisions can be taken in a shorter time.

3. Reflection: by reviewing the actual meta-data of the extranet as well as the generated documents of the extranet. Meta-data concerns data about a stored document: data, time, owner, status and version, key words of the stored information. The stored meta-data show the exchange process of files within a time range. In a way this might be frightening to team members because of the “Big brother effect”. In a Dutch fast-track project the time, on workflow level, for a subtask was lowered with 50% and with a lower risk to failures due the use of an Extranet (Den Otter, Prins 2001).
4 COMMUNICATION MODELS

To study the effects of extranets within design organisations in the preliminary design phase, a PhD research project has been set up in the Netherlands. Within a nationally operating design organisation of over 1000 people, by means of experimental research, design teams are investigated on the changes in information handling due to the use of an extranet. The organisation is regionally organised. Within each region two design teams join the study. One team per region will use the extranet; the other functions as control team. The hypothesis is raised that a process model for electronic information management is needed for the effective use of an extranet by a design team.

Shannon and Weaver’s (1949) Mathematical theory of communication focuses primarily on a linear process, which basically comes from the sender and does not include the aspects of interactivity and meaning.

Newcomb (1953) developed a model with a social-psychological perspective. This model focuses on the interaction between people.

Within Newcomb’s model the orientation of person A to X as object of the interaction like the orientation of person A to person B and vice versa is focussed to the attitude and cognitive aspects (beliefs).

4.1 Electronic communication behaviour

To use an Extranet successfully, the communication behaviour of the design team members has to change (Stoter 1997) because: 1) the partners have to get used to share vital design information in an electronic network; 2) the different communication policies need openly be criticised for displayed design information to develop a general team communication policy; 3) responsibility for delays in progress in the design is clearly addressed to owners of design information by the use of the meta-data.

Because of differences in information behaviour, information sharing, and information politics (Davenport 1997) in a design team, the most important aspect of computer mediated design communication is the design start up of the team.

4.2 Inter-active, non-active, pro-active, re-active and active communication behaviour

Communication through the Internet by means of email and extranets influences the interactivity of communication, although the communication is on distance and a-synchronous. Most people like the convenience of giving response to a sender without calling him. Just sending a message back (Bälter 1998). This kind of communication is able to enhance interactive relations between senders and receivers. Interaction is a specific mentality that is expressed in the communication behaviour of persons and groups (Stoter 2000). According to Stoter communication as a mentality is dependent of values and norms, paradigms and power, ideals as well as dreams.

Although interactive behaviour might be enhanced by the use of email and an extranet, pro-active as well as non-active behaviour are necessary too. Within this research project the different forms of information behaviour are defined as follows:

– Active behaviour: taking part in a conversation, discussion or chat box. Also within email
communication active behaviour is recognised (Bälter 1998).

- Pro-active behaviour in communication can be defined as initiating to send messages through all kind of media.
- Non-active behaviour: viewing or hearing messages without giving response to the sender or the publisher.
- Re-active, giving response to a sender. If the receiver defines a new question for the sender he becomes a sender as well and the communication becomes inter-active.
- Inter-active: the cycle of action – re-action in which sender and receiver are changing. Jacobs (1998) defines inter-action as the real exchange and confrontation of thoughts, experiences, and lessons on all levels between people.

During work sessions when documents, drawings, and sketches are checked out, members are allowed to look into the website. However, because the actual information is being updated at that time, the Extranet temporarily becomes an archive.

Viewers should now act non-active and just scan the design information that is present.

5 INFORMATION MANAGEMENT MODEL FOR INTEGRAL DESIGN

Regarding earlier results of research concerning collaboration and communication in multidisciplinary design teams it can be expected that an Extranet, being a team communication tool, can be used effectively by a design team if it improves collaboration of the team through enhancing the interactivity between the team members by integral designing (Stoter 1997).

5.1 Concurrent design & engineering

The effectiveness of design information handling within a design team depends on the available means and tools of the actors, the skills of the actors, and the structure of the design process. The structure of the design process depends of the team leader, the appointments made with the team, and the planning of the project. In most cases the team leader is the architect who rather co-ordinates the design members in a democratic way instead of leading in a monarchical manner (Heintz 1999).

Within concurrent design, a form that is widely applied by design teams in the Netherlands, the architectural designers are generally leading in the design information flow. The architectural information is necessary for the other team members to design their part of the design work, more or less sequentially but with certain overlaps.

Within fast-track design for complex building projects, due to the enhanced technical complexity of the project and the pressure on throughput time, the most important flow of design information is not necessarily coming from the architectural designer but might come as well from other design specialists (Loon 1998).

A more or less linear structured design process, led by the architectural flow of design information, might cause conflicts later on in the design process.
when the other design specialists are designing the object from a different perspective.

5.2 Integral design

Within the concept of integral design, all team members, architectural as well as specialist designers, are working parallel from the start, closely together in an intensive, iterative process. This process is chaotic and unstructured in the beginning due to the uniqueness of the project and its complexity (Stal 1999, Friedl 2000). Linear planning systems fail in these structures. Design information flows are unstructured and chaotic. Integral design or fast-track design differs from concurrent design because within a fixed period of time (time box) all the team members work parallel on their part of the design. Concurrent design is more focussed on the definition of output of the sub-tasks of the participants, the overlap in output and the tuning of the chain.

5.3 Virtual information exchange sessions (VIS)

Keeping overview, as well as tracing the different views of design members to the design problem is of vital importance for the success of the design regarding the demands and expectations of the client. To enhance the inter-activity of the team members electronically, Virtual information exchange sessions (VIS) should be held. During a VIS session, actual electronic drawings, sketches and documents are viewed in order to:

1) To get information for own purposes, i.e., to reflect on the information of the design participants and to get an overview on the actual process and status of the work;
2) To give response to information of owners and to exchange new thoughts and ideas based upon the work done.

In Figure 6, VIS-1 and VIS-2 are positioned within fixed time boxes (t). The virtual sessions should be held within a fixed period of time and repeating, i.e. every day at a specific time. An important function of the VIS is the overview function. All design members can determine their own position in the design process and compare this position to the others. To inform each other about the status of the ongoing work, each design team member should keep an electronic logbook as a viewable file in the Extranet in which the work done is explained. All team members have to participate in a VIS.

This is a completely different situation for the team members then just using viewers during work sessions to view each other’s work. In that situation the viewer looks at a copy of old information because the actual information is checked out by the user for updating and change of information to make. Response to displayed design information might even cause misinterpretation, irritation or failures in the design work.

The time needed for a VIS has to be settled by the team but it is expected that it will take approximately one hour or one hour and a half, depending on the number of design participants.

By repeating VIS’s for the whole preliminary design process in a time frame with fixed intervals (t1-t2-t3 and so on), a system of time boxing develops in which the design team can interact electronically as well as verbal through Design Meetings (DM).

The ABX-model of Newcombe shows the difference in communication within this configuration because the actors will communicate differently, being aware of the fact that their messages are viewed or commented by the other team members. The design team will be able to trace the actual process and gets a real-time overview over a highly iterative, creative process. The self-management of the process might enhance as well as the collaboration
within the team. However the method will only be effective if team members experience benefits of the system for themselves in their work and get feedback. Creating inter-action through an extranet might enhance the trust within the design team and improve the collaboration within the team.

5.3 Design start up & design meetings

The duration of the time boxes and the moments for Virtual Reflection Sessions should be appointed during the design team start up meeting (DSU). In fact this is the start-up meeting of the design team in which the planning of the design information handling and communication has to be settled. Because of the social aspects to get to know each other the meeting should have a rather informal character. The openness and assimilation of the information should be explained and a simple protocol for the interaction of the members and the organisation to use the VIS should be appointed. The VIS sessions are an instrument for the design team to get overview over the gathered information, status of the design and the progress of design in relation to earlier expectations.

Design team meetings (DM) will still be needed to make choices and decisions as well as to reflect to the process. The outcomes of the VIS: the electronic logbook information compared with the Meta-data of the Extranet supports the team to reflect on the mutual process to improve effectiveness in future.

The number of VIS meetings between design meetings isn’t fixed but has to be appointed by the team and repeatedly scheduled. The team should judge the effectiveness of the VIS and change options of the sessions when needed. It might be that the VIS are sufficient for the team to make progress. However, when different interpretations occur during VIS, a team meeting has to be appointed.

Experiments with the use of electronic a-synchronic media for reaching consensus within groups show that it is harder to reach consensus then within a normal group meeting (Sproull and Kiesler 1991). However, by the use of VIS, being virtual meetings for the team, the content of a team meeting changes. Other choices then before have to be made based on the outcomes of the VIS as well as choices about the process itself in terms of discussing improvement of the effectiveness of the information handling of the team and the team members. By using an extranet with VIS, team members are well informed about the progress of design and the design information is well spread over the team.

Instead of informing the team about the progress in relation to planning and time, the meeting can be used by the project or design manager to become more effective as a team. Because everybody is well informed solutions might be found more easily then before. Regarding these items team meetings change of character.

By using the Extranet as described, a design team is able to improve its own process and progress and is able to deliver a coherent product, more then before. Because results are visible for the team members as well as better controllable, it is likely that this enhances the pleasure of work and motivation. VIS’s function as measurement points for the team to monitor if everybody still is on track, who contributes (active, pro-active, re-active and non-active) in which way on which moment and what information is added. In this way stimulating continuous reflection in action (Schön 1987).

The awareness to conflicts will be enhanced because of the transparency of the generated design information.

When using an extranet, email with attachments shouldn’t be used. By using email attachments the Extranet gets out of control over the information exchange process and this double, later on, outdated information might cause failures.

5.4 Trust

Trust within the team that uses the extranet is necessary to neutralise “Big brother effects” (den
Otter & Prins 2001). Dependent of the understanding and trust to each other in the team, team members will be able to communicate on distance as well as asynchronous successful with less misinterpretation (Jarvenpaa, 1999). Charles Handy (1995) defined seven rules for virtual teams to co-operate: 1) Trust is not blind; 2) Trust needs boundaries; 3) Trust demands learning and openness to change; 4) Trust is tough; 5) Trust needs bonding; 6) Trust needs touch; 7) Trust requires leaders. Virtual organizations call for new forms of belonging. The potential exists for virtuality’s “3-I’s” of information, intelligence, and ideas to benefit not just organizations but also those with whom they do business and society as a whole.

5.5 Team dynamics

By the use of the Extranet team dynamics of the design team are influenced. The team might become more inter-active then before. Members of the design team have to express themselves along electronic media instead of face to face or in a group meeting. No reaction at all is also a reaction. Due to these aspects team members might react rather strange. To get the most of the use of an Extranet a model for the management of design information exchange and communication is necessary.

5.6 Action learning

A design team that uses VIS within an extranet should use action-learning principles during design meetings to analyse the use of the VIS and the effectiveness of the information handling of the team. Electronic information or communication systems should rather be seen as learning systems, instead of automation systems (Hauck & Nolan 1996). Action learning can be used for this purpose because of the reflection element in the system. The proposed method consists of three, sequential used, elements: a) programmed instruction; b) questions; c) reflection to the process.

Within the context of the use of VIS with an extranet the meaning of Programmed instruction represents the design knowledge currently being used in the team and communicated within the team through the use of VIS; Questioning means continuously seeking for fresh insights into what is not yet known about why the system is not working; reflection should concern the reflection to the effectiveness of the information handling of the design team and improvement of the effectiveness (Dean 1998).

The Meta data of the extranet delivers the team the necessary data for reflection. Based on the Meta data the team members are able to improve their own skills in handling design information more effective. Regarding the reflection to the process by the actors it is of importance to distinguish single loop and double loop learning (Argyris 1992). The actors within the design team have to be aware of their learning capabilities in terms of changes in active-, inter-active and non-active behaviour.

5.7 Collective mind

The content of the Extranet might become a collective mind (Kelly 1994) when all the team members develop collective information behaviour and information sharing. The flow of actual data and information into the Extranet will provide the team a vault with extreme valuable design object- as well as design process knowledge. A team, using an extranet with VIS in the way described, will become a knowledge-based community with high learning potential and will become more easily a centre of excellence in time and quality performance, self-generating and self-governing.

6 CONCLUSIONS AND FUTURE WORK

The aspects of design communication as listed in chapter 2 are discussed and a model for the effective use of an extranet based on the discussed items is generated.

Based on knowledge from literature it is concluded that an Extranet potentially enhances the collaboration within the team by facilitating the inter-activity through the use of reflection windows.

The presented model is expected to improve the effectiveness of the information handling. Regarding sender and receiver of design information, it is important to realise that within an Extranet the sender becomes a publisher and gets editing functions; the receiver becomes a viewer. Both will become inter-active communicators.
Finally, this is expected to result in improvement of the deliverables towards the client concerning decreased throughput time and enhanced quality of object and process.

Within the PhD research project mentioned, the extranet as well as the presented model for integral design with VIS will be implemented in multiple design teams and tested on its capabilities. It will be compared with the traditional design process without an extranet, in order to measure the differences. The model and the use of the VIS will be evaluated on effectiveness, which may then lead to adjustments to the model. At the end of the research project, beginning of 2003, the outcomes of the research will prove or disprove the raised hypothesis.

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