
An effective release process in Building and Construction

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Abstract: The level of failure costs in Building and Construction is still at a high level. A major cause of failure costs is the use non valid or wrong documents / models in the process. The release process is about controlling the quality of documents / models in a structured way. The major three attributes of a document / model to manage it are its identity, its version and the (maturity) status of this version. In Building and Construction processes the status of a document / model is hardly used. The article proposes a release process in the environment of an extended enterprise based on the natural principals of releasing information. This basic release process will be extended to implement concurrent engineering, the aspect of mutual involvement, in a structural way in the release process.

Keyword : Document / model release process; document lifecycle; document version and status

1 The current situation

1.1 Introduction

Why perform research on such a simple event of approving a created document and signing it to show it is ready? And if the document has to change it will be approved again and the latest date will show which document has to be used in the project. Further good communication and management have to assure that the Building and Construction process is efficient, effective and will deliver the intended results. Of course this formulation is a caricature of the real situation. But it illustrates the main motivation for this research. It is meant to prove that a good release process is obligatory for good Building and Construction process delivering the specified results with a minimum of

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failure costs. In other words good communication and clever organisations are not enough.

Although the reason for the research lays in today's Building and Construction practices the research has been broader and the proposal is generally applicable.

1.2 Common practice today in Building and Construction

It is common practise that documentation defining buildings and constructions is a collection of documents ordered in folders per discipline and often located at different locations. And of course, in different systems too, but this is not considered as the major issue.

A document in this article is a unit of information of any kind related to physical objects to be realised. Thus models are included.

Because documents are changing the information is not in the document but in the document version often called revision.

A document has a lifecycle within the release process meaning the document version goes through a number of maturity statuses. This status, sometimes called state, is a projection of the maturity of the document or model and is telling the user where it is in its release process and for what activities the document is allowed to be used.

Fuzzy meanings in daily practice of essential characteristics of a document are leading to unidentified document versions and improper use of documents.

For example it is quite common that revisions are handled rather careless. For example a document revision C has to be changed. In order to avoid a high number of revisions the author of the document will change the revision when the change is fully completed and submitted for release. In the meantime he has distributed a few alternative documents to get comments and approval. The result is that there are more document versions than proper identified versions. It will be easy to use non proper information.

Another example is the fuzzy use of the status of a document. Building and Construction processes usually use a pseudo lifecycle of two statuses DRAFT and FINAL. It is called a pseudo lifecycle because in case of a change of a final document the status of the new document version is not set to DRAFT but is left FINAL. In general this means that the status of a document version in Building and Construction does not give its user any information. This easy leads to improper use of the document varying from carrying out a complete analyses where only professional comment was expected until shopping on the bases of documents that were not supposed to be released.

1.3 Leading problem

The leading problem is that in spite of many new IT tools applied within Building and Construction and experimenting with Systems Engineering (Blanchard 2008)[1] the amount of failure costs seems to increase[2].

Consider fig. 1 representing a single activity given in a diagram with input, output, control and tools. The development process is a series of these individual activities. Errors on business levels arise when individuals in the project do not deliver the needed results, e.g. documents on which buildings and constructions are based.

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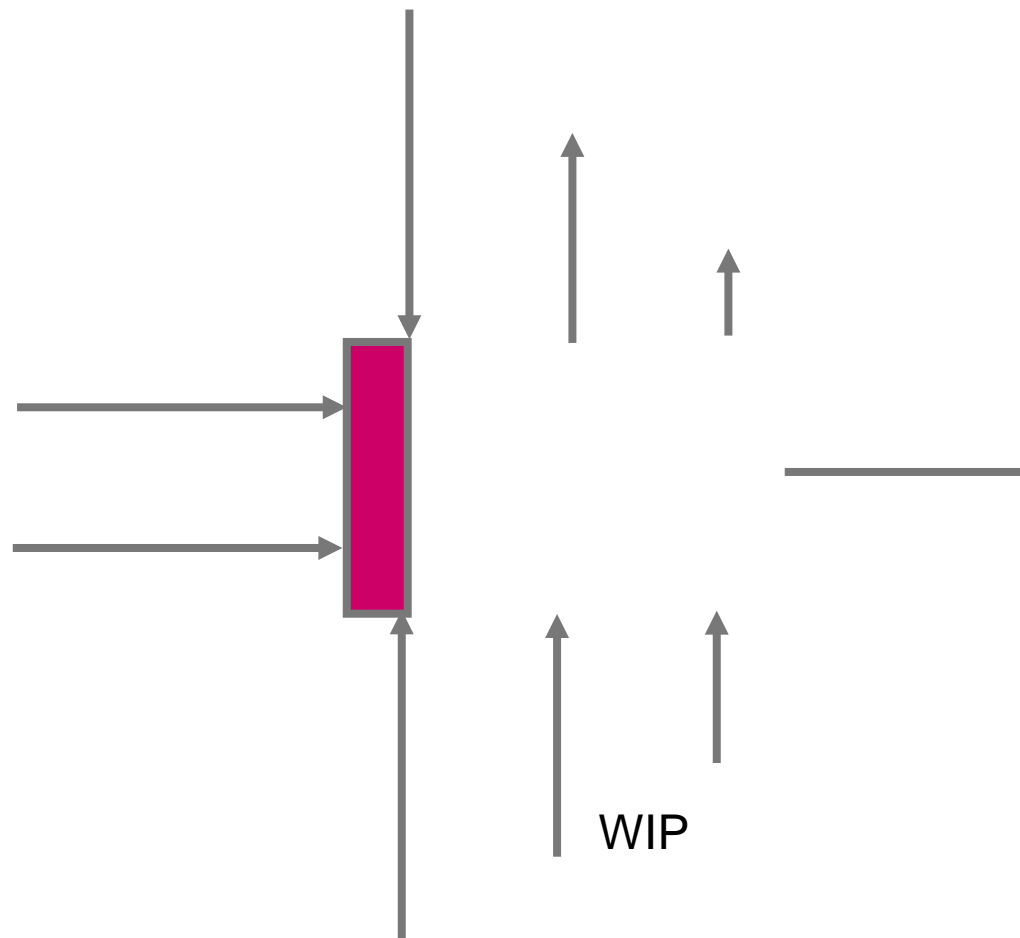


Figure 1 The process of creating a document (or part)

Basic causes for not delivering the required results are:

1. Insufficient management and communication;
2. Insufficient skills and experiences of individuals;
3. Insufficient tools, including libraries and procedures, to do the job;
4. Flaw order and or input documents (requirements).

Guess[3] and Watts[4] are discussing flaw documents or requirements as the main cause for failure in industrial product development. Veerman[5] and Vrijhoef[6] are more concerned with management and communication. Reefman did in 1994 an evaluation of the project New Headquarter Fire Department of The Hague and also concluded that wrong documents are a relevant cause for failure costs (Internal document AEGOR / HBM).

This research is dealing with the problem of flaw and erroneous input documents. Due to false input documents the individual designer, engineer and other project workers will encounter the following problems related to their input documents:

- Documents are missing;
- Documents are not consistent;

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- Documents are not clear for its users;
- Documents are not valid.

Output cannot expect to be all right if the input is not good. This means a basic question is how to get (and keep¹) good documents in the product development process. This research is about how to get good documents in Building and Construction projects.

The definition of a good document is given by Guess (2002)[3] as clear, concise and valid. Pels (2008)[8] has add to this: “ - and consistent with related documents.” Special attention needs to be given to the word valid. Valid means that two conditions have to be fulfilled:

1. Following the document by the letter will result in the intended result, Guess (2002)[3];
2. The document has been authorised to be used in the project, meaning the project or programme management is accountable for all consequences of using the document.

The research approach is looking to industry e.g. recognized authorities Guess and Watts and a literature study on what is going on to improve the Building and Construction process especially regarding document release.

To obtain good documents it is assumed that there is a need for a release process with requirements to assure the quality of the document process and to assure the quality of the document content.

1.4 Overview of current Research

This chapter is an exploration about how researchers are thinking about improving the Building and Construction process with special interest for efforts to obtain good documents.

Based on the assumption that without proper exchange of design and engineering data and ditto accessible libraries it is not possible to achieve major improvements in Building and Construction processes there is a lot of research and development going on in the information and communication technology, ICT. Examples are:

- The development of Building Information Model BIM (Nour 2010[9]);
- COINS, a Dutch initiative to handle, create and view 3D intelligent objects in a multi company, multidisciplinary project (Schaap 2008[10]);
- Gellish, a common language for the exchange of information between different systems (Rensen 2005[11])

Modern PLM systems, as developed in industry, have a lot of technological possibilities like the lifecycle management of documents, complete with workflows. But if users do not know the processes they want to execute the system might end up as an expensive archive and failure costs will not drop. It was Shelburne(2006)[12, 13] who followed very consequently the path of “Processes first, tools have to follow”.

Typical is the reaction of the commission Veerman reporting on the situation of the “Noord Zuidlijn” project of the City of Amsterdam. All advices for improvements are

¹ Keeping good documents is done in a good change process which is outside the scope of this paper. The change process is discussed in Reefman (2011)7. Reefman, R.J.B. and G.A.v. Nederveen, *A well controlled integral product model in Building and Construction (BIM always up to date)*. to be published in 2011.

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dealing with better communications and better cooperation between the stakeholders of the project. (Veerman 2009[5])

Vrijhoef 2009[6] is doing research in the supply chain of Building and Construction projects and reports savings of ten percent by an open and transparent co-operation of the project partners. A maybe more structured approach of Supply Chain Management can be found in Mathews (2005)[14] about integrated project delivery (IPD).

However these issues have only an indirect impact on the quality of documents and realised buildings and constructions are based on these documents. Things are going wrong because output documents from activities do not comply with the specifications or input documents on one or more places in the development process.

There is more to say about the quality of documents in industry. Guess (2006)[3, 15] reports that an average engineer is spending 40 to 60% of his time in interfering activities which did not go right the first time. Wortman (2001)[16] states in his work about Six Sigma that about 75% of what is going wrong at realising the product finds its origin in design and engineering¹. There is no reason to expect that things are better in Building and Construction.

Ahire (2000)[17] shows the importance of design management and process management for the product quality but does not come down to the level of documents. Coates (2004)[18] is coming closer to engineering, distinguishes a number of key elements to optimise engineering operations under which task management but doesn't speak about engineers product: the document. Eloranta (2001)[19] describes three main process lines, the business line, the product development line and the realisation or material line. Following Guess [3] one can argue that the material line always has to be a projection of the product development line so it is not an independent axis. This leaves us with a business line with business issues and a product development line with document issues as covered in this paper. Also Eloranta describes the important role of documents with their lifecycles, statuses and versions. Stubblefield (2000)[20] discusses that a document has to be authorised and shows the different worlds of creating engineering documents and the administration of documents. -

Saffadi (1997)[21] even adds another document lifecycle. It is an overall lifecycle from creation, in use until archived, but it is not a lifecycle of importance for the underlying study.

The lifecycle can be considered as a sequence of maturity statuses until and including released. More details on document naming, versioning and lifecycles are discussed by Pels (2010)[22] and Pels (2007)[23]

Two authors go quite far describing processes to get and keep good documents. These references are Guess (2002)[15] and Watts[4]. Both authors are discussing single company industries. The main difference with Building and Construction is that Building and Construction projects always are performed by consortia, so one is dealing with an extended enterprise.

Research to improve Building and Construction processes has different focuses. Popular are ICT topics and standardisation and also supply chain management.

¹ If this is true there exists an opportunity to double the productivity of design and engineering and save 75 per cent of the failure costs.

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It can be concluded that it is generally accepted that a document has a version and that a version goes through a lifecycle with phases called status. Also it may be concluded that the management of documents is considered important. Release processes are mentioned but rarely really worked out. Answers on why, what and how are not given. And there is certainly not much information about the requirements for an effective and efficient release process. This article will try to give some more detailed answers.

2 Release Process

2.1 A natural release process or the basic lifecycle steps

To discuss a release process of a document version means discussing its lifecycle.

Let us consider an engineer writing a letter to a lawyer, which is another professional in another professional environment, speaking another language. The letter first has to be written. After it is written it will be judged or the lawyer will understand everything that has been written as intended by the author. Eventually the letter is signed or authorised meaning the author, our engineer, takes his responsibility for the content of the letter. In the writing of this letter one sees three basic steps and related roles in the lifecycle of this letter:

1. Creation;
2. Judging;
3. Authorising.

The author of the letter fulfils all three roles. He is the creator, the judge and the authority that releases the document.

In a design and engineering process every activity is about creating and editing documents. In principle the document versions have to pass the same basic steps of create, judge and authorise. The only difference with writing the letter in the lawyer example is that the basic roles are fulfilled by different persons.

This natural release process differs from the common practice two step processes in Building and Construction as we saw before.

2.2 Other requirements for release processes

2.2.1 Quality and knowledge

Every product document is input for another activity. The quality of the content is also depending on the quality of the input used to create a document. Input documents need to be good. A Building and Construction process is a multidisciplinary, multi-company process. Normally documents are covering aspects related to different disciplines. Take for example a drawing of a wall. The architect is interested in form and location, the structural engineer in its strengths and the piping engineer in the size and location of a recess. It means the release process needs a number of reviewers covering all aspects of the requirement or document version to be good.

It is clear that the quality of the content of the document version depends also on the skills and experience of the author. Education and training however are outside the scope of this article.

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It is also clear that in most cases the author only has partial knowledge of the product to realise. This means that the release process needs a practical mechanism to bring all available knowledge within the project, within the different independent parties, into the document version.

This available knowledge is supposed to be present as well with the reviewers of the document version as well with the colleague designers and engineers in the project. There is also knowledge accumulated in the collection of released documents.

2.2.2 *Integrity of information*

Wortman and Guess indicate the tremendous importance of the integrity of information[3, 16]. The suggested final check by Guess[15] on the best possible good document is an audit. Within the audit it is checked or all agreed procedures have been followed and if not the involved officers have to redo their jobs.

2.3 *The development of an effective release Process*

2.3.1 *Introduction*

A good release process will result in good documents and vice versa a relevant portion of flawed documents in the project is a sign for a bad release process. The commonly used two step document lifecycle in Building and Construction misses a formal judge or review phase and is quite often non-used or not properly used as we saw before in the mentioned examples.

Starting with the natural release process and taken into account the extra requirements a new release process will be developed.

2.3.2 *Challenges*

In order to create good documents the following issues have to be improved:

- Define a good lifecycle for documents in which they are created, judged and released;
- Define and organise a release process in which all available knowledge is used to create good documents;
- Define and organise a release process in which all required aspects are judged and approved documents are authorised;

2.3.3 *Use of all available knowledge and concurrent engineering*

Within the scope of release and change processes the topic is not the knowledge in handbooks or libraries but the topic is about people and the knowledge in their minds, so the knowledge and experience people have and the knowledge that is directly accessible to them.

How to bring this knowledge into the process? One way to do bring this knowledge in the development process is by using multifunctional teams as is discussed for example in Blanchard[1], Martin[24] and Reefman[25].

Today multifunctional teams (MFT's) are especially used in the phase of defining the architecture of the product or building the concept design. In a similar way multifunctional teams are used to make proposals for complex change requests (Guess 2002)[3].

But within the scope of the release process, in order to obtain the maximum available knowledge into the content of a document version, one wants to bring together the practical knowledge of all designers and engineers at different parties and different locations in their daily work. The idea is that you only can bring the knowledge and

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experience of all involved designers and engineers into the daily work as people can react directly on each other's work. This means to realise one of the aspects of concurrent engineering, concurrent mutual involvement in a structural way in the overall project (Reefman 1995[25]). This should happen as early in the work as possible because than changes are cheap, thus preferably before release!

Within the IPM@[internal note AEGOR] approach this is realised by introducing a fourth status in the earlier mentioned natural life cycle for a release process. This status is called "POST". In this post-creation phase early in the lifecycle, the document version is open for responses from colleague engineers in other parties and or disciplines. They might react with their experience and skills on the document version created that far. This is considered as an effective and practical method of bringing available knowledge into the project. It is a balance between informal and formal communication with as side effect more individual involvement in the total project, more fun and good for the project.

The document lifecycle becomes now:

- IN WORK (Creation);
- POST (Observation);
- UNDER REVIEW (Judging);
- RELEASED (Authorised and valid).

2.4 Process

So far the author has arrived two a four step document lifecycle, three natural steps regarding creation, judging and release, extended with a fourth step, observation to capture the maximum knowledge available in the project. In this chapter the execution of such a release process is discussed. A release process with the discussed four step life cycle is given in fig. 2.

2.4.1 Phase 1, creation of the document

The activity to create a document starts with an order. In the initial stage the document is only identified and has no version yet. When the engineer starts to create content the document gets its first version and the maturity status is IN WORK.

The engineer creates a drawing, model or any other document describing something of the product or building to be realised. On a certain moment in time the engineer considers the document mature enough to show to the colleagues of other disciplines. The author will promote the document version to the next lifecycle step "POST". While the engineer continues the development of the document version the colleagues can observe the work done so far and give comments.

When the document is ready it will be promoted to UNDER REVIEW to be judged. This can be done by the engineer but there is also an argument to let this promotion done by his manager as a kind of check or pre-review for documents involving many aspects or with a high impact on the project.

The document version starts with the status IN WORK. This is a kind of private situation, except the creator nobody can see this version. This looks logical, but it is not. It implies a lot of choices! For example the choice is made that the document version is made by one person and not a number of persons. Another choice is that before a certain maturity is reached nobody has any access to the document version other than the author. Other choices are possible for example that each document version in each status is readable for any project member.

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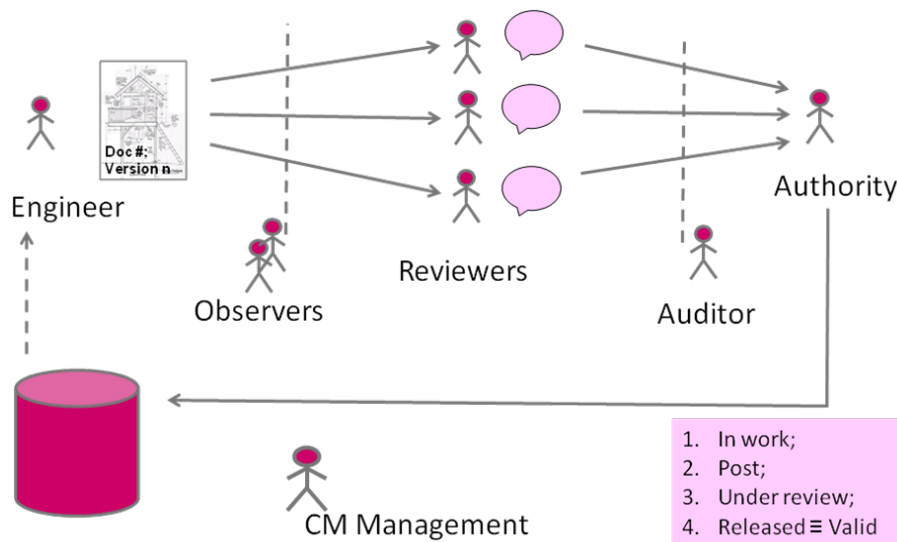


Figure 2 The proposed release process

2.4.2 Phase 2, observation of the document

The maturity status of the document or model is POST.

The objective of the observation is to stimulate the involvement of the single engineer in the overall programme or project to bring in his or her skills and experience in the development of the product or building. Seeing the work of the creator of the document version each observer can react from his point of view, with his or her knowledge. Giving comments is not obligatory neither is the creator obligated to do something with the comments. It is a controlled way of informal information exchange in the early stage of the process of document creation.

For example a structural engineer reacts to his colleague at the design office that with the current load on the structure the thickness could be 50 % and the wall would still be strong enough.

The Post phase is a situation “For information only”. No one is allowed to do anything else than comment on this document version.

Pels [personal discussions] argues that because the author of the document version is still going on developing the version and nobody is obliged to do anything it is also possible to have one status In Work in which all observers can see the document version and comment. The author of this paper argues that observation is a logically different status, as well informal from a communication point of view, no obligations, as well formal from a process control point of view, a formal request for comment. Furthermore the author of this article wants to take into account that Building and Construction is dealing with an extended enterprise so the observers of the document version will cross enterprise borders. A clear separate lifecycle status will be needed to formulate and agree procedures between the project partners. But still the other choice should be workable as well. More choices have to be made, like who should be assigned to be an observer, the choice of the author every engineer involved, might be impractical and not an attractive

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invitation to the invited individual to supply a real contribution. It seems practical to assign observers like reviewers depending on the aspects related to document. The POST status will end automatically when the document version is promoted to UNDER REVIEW.

2.4.3 Phase 3, judging the document

The maturity status of the document or model is UNDER REVIEW

The document has to be reviewed regarding a number of aspects usually requiring specific specialists. For example the document version requires a validation on the dynamic behaviour of the structure and also a validation that it fulfils all requirements on environmental regulations and a validation that it can be produced within the available budget. The reviews may lead to adaptations of the document by the creator (of course in a new document version!) before it is accepted and validated to be good. The review is obligatory and the document version has to be approved or rejected. Disagreements have to be solved within the release process by a next level reviewer for example a design leader or the authority who has to release the document.

The review might be a process on its own. For example it might require a complete structural analysis to validate the strength of a building part.

The essential difference between observation and review is the difference between an informal advice and a formal validation. Consider that structural engineer doing a full structural analysis to validate the document version. Suppose he was one of the observers as well. In his role as an observer he would never execute a full analysis but instead he would, based on his skills and experience, give an advice like it was mentioned in the example of phase 2.

In case documents have to be adapted the creator starts to edit the document by copying the content of the document version UNDER REVIEW into a new version of the document which gets the status of IN WORK. The new document version will follow the release process from the start.

Again many choices have to be made for example who has which rights on which document versions and status. These choices are also depending on the organisation and contracts between the parties in the extended enterprise.

Several authors mention the importance of the integrity of the database amongst them Guess [3] and Wortman[16]. To assure this integrity it is advised by Guess to audit the process before a document version is accepted to be fed into the database as a released document version. The auditor confirms that all procedures have been followed in the correct way. If the auditor is not satisfied he will return the document to the responsible people to correct their work.

Reviews on specific aspects are scheduled first and in parallel. If there is a design leader or other line manager involved they might be scheduled in series after the reviews of the parallel specialists. The auditor is the last reviewer before the authority.

The authority is in fact a special reviewer; he promotes the document version to its released status, confirming project responsibility for the released document version.

2.4.4 Phase 4 authorising or releasing the document version

After authorisation the status of the document or model becomes RELEASED.

The last step is many times just a formality but a very important formality because with the authorisation of the document the legal entity, e.g. company or consortium, takes full responsibility over the document version.

Again choices have to be made like:

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- The document is available for all downstream activities.
- The document is accessible for all stakeholders of the project.
- The document version can only change within a formal change procedure.

2.5 Discussion of proposed release process for document versions

It has been discussed in the article that the used document statuses Draft and Final in Building and Construction are irrelevant in most cases and in case they are used in the right way it is just not enough, it misses the Review step.

The business reasons for an effective release process have been mentioned. But there is a social result too. On the job floor life is getting more fun, designers and engineers will have all the time to do the job they are hired for. They get good documents and are able to deliver the expected results in a shorter time. Via the POST status in the release process everybody on the shop floor is involved in the whole project, which also increases the fun in the job.

The importance of data integrity is taken into account by adding an auditor in the release process.

For document versions with only one relevant aspect to review, for example minor changes regarding just one aspect, the release process as described might be a little bit overdone. A fast track release process may do the job. In such cases one could follow a release process as proposed by Guess[3] and Watts[4] where the whole release process then goes along with the change process. Creation, judge and authorisation is done by two persons, the creator or author and an assigned user. In this case the authorisation is a delegated task, the responsibility stays with the project or programme management.

A PLM demonstrator, including organisation, roles and responsibilities with workflows for the proposed release process and also a change process conforming Guess[3] has been built at the University of Delft.

3 Conclusions

The objective of the study was to design a process to achieve good documents in Building and Construction processes meaning a quality assurance for process and content.

The objective is achieved by starting from the simple activity of writing a letter. It is concluded that such an activity is subject to a release process with three essential steps: creating, judging and authorising. These three steps are taken as the basic document lifecycle. All aspects related to the document version are reviewed in a structural way and the document version is properly authorised. The suggestion of Guess[15] is followed to add an auditor to the process to guarantee that all procedures have been followed as agreed. In order to establish a document version with maximum quality for its content, a fourth lifecycle step, for observation, has been introduced where all available skills and experience in the project will be accessed. It is a practical way of getting all available knowledge within the people in each document version.

Besides a confirmation that creating good documents is relevant for Building and Construction processes there was no reference found, discussing how to do that.

Creating good documents is not the complete story. The good document versions have been succeeded by good documents versions, meaning a qualified change process has to be implemented as well Reefman(2011)[7].

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Further research has to be performed on the application of document release processes in Building and Construction. Measurements before and after structural implementation of appropriate release and change processes have to be done to quantify the achieved reduction of failure costs.

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References

1. Blanchard, B.S., *System Engineering Management*. 4th ed. Wiley Series in Systems Engineering and Management, ed. A.P. Sage. 2008, Hoboken, New Jersey: John Wiley & Sons Inc. 537.
2. USP, *Faalkosten in de bouw naar hoogtepunt*. Land+Water, 2008(6/7): p. 53.
3. Guess, V.C., *CMII for Business Process Infrastructure*. 2002, Scottsdale: Holly Publishing. 164.
4. Watts, F.B., *Engineering Documentation Control Handbook / Configuration Management in Industry*. 2nd ed. 2000, Norwwich, New York: Noyes Publications.
5. Veerman, C.P., *Bouwen aan verbinding*. 2009.
6. Vrijhoef, R. and J. Wicherson, *Ketenintegratie Programma*. 2009, Centre for Process Innovation in Building and Construction: Delft.
7. Reefman, R.J.B. and G.A.v. Nederveen, *A well controlled integral product model in Building and Construction (BIM always up to date)*. to be published in 2011.
8. Pels, H.J. and R.J.B. Reefman, *Verbeterings voorstel voor INPUT en WERKPLANNING van Central Engineering*. 2008.
9. Nour, M., *A dynamic open access construction product data platform*. Automation in Construction. **19**(4): p. 407-418.
10. Schaap, H.A., J.W. Bouwman, and P.H. Willems, *concept De COINS-systematiek*. 2008, CUR: Gouda.
11. Renssen, A.S.H.P.v., *Gellish*. 2005, University of Delft.
12. Shelburne, D., *The struggle to take CMII global*, in *Presentations European CMII Users conference in Mainz, Germany 2006*. 2006, Areva ND US.
13. Shelburne, D., *Six Sigma, Processes, PDM, Training of people*. 2006.
14. Matthews, O. and G.A. Howell, *Integrated Project Delivery An Example of Relational Contracting*. Lean Construction Journal, 2005. **2**(1, April 2005): p. 16.
15. Guess, V.C., *CMII Training Material*. 2006, CMII Institute of Configuration Management.
16. Wortman, B., et al., *The Certified Six Sigma Black Belt Primer*. 1 ed. 2001, West Terre Haute, Indiana: Quality Council of Indiana.
17. Ahire, S.L. and P. Dreyfus, *The impact of design management and process management on quality: an empirical investigation*. Journal of Operations Management, 2000. **18**: p. 549-575.
18. Coates, G., et al., *Engineering management: operational design coordination*. J. Eng. Design, 2004. **15**(5, October 2004): p. 433-446.

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19. Eloranta, E., A.-P. Hameri, and M. Lathi, *Improved project management through improved document management*. Computers in Industry, 2001. **45 (2001)**: p. 231-243.
20. Stubblefield, W.A. and K.S. Rogers, *The social life of Engineering Authorizations*. Proceedings of the 3rd conference on designing interactive systems, 2000: p. 9-19.
21. Saffadi, W., *Document Life Cycle: A white paper*, A.S.f.I. Science, Editor. 1997.
22. Pels, H.J. *A Practical Theory of Versioning and Status Control in Product Lifecycle Management*. in *Proc. TMCE 2010*. 2010. Ancona Italy, April 12-16 2010.
23. Pels, H.J. and J.W.i.t. Anker. *Performance management of the engineering change process in a leading-edge technology environment*. in *ICE2007, The 13th International Conference on Concurrent Enterprising: Concurrent Innovation: an emerging paradigm for Collaboration & Competitiveness in the extended enterprise*. 2007. Sophia-Antipolis, France, 4 - 6 June 2007.
24. Martin, J.N., *Systems Engineering Guidebook*. 1 ed. Systems Engineering Series. 1997, Boca Raton: CRC Press. 281.
25. Reefman, ed. *Concurrent Engineering*. CAD CAM Handbook. 1995, Samson Bedrijfsinformatie.