VISI Re*visi*ted

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Abstract. In this paper we investigate the use in practice of the VISI standard. The goal of the VISI standard is to arrange the cooperation of the parties in construction projects. Application of the VISI standard is not without troubles. The VISI standard is based on the DEMO methodology. We used the Hevner Three Cycle View and Sein's ADR to understand *what* and we used interviewing and process mining to understand *how* the development and use of VISI has been. We conclude that an overall cycle over the three cycle view is necessary to see that the right process is followed in using scientific knowledge to design artifacts that solve practical problems.

Keywords: VISI · DEMO · ISO standard · Enterprise engineering · Enterprise ontology · Process management · Action research · Design science research · Action design research · Construction sector · Large infrastructure projects

1 Introduction

In the Dutch construction sector for large infrastructure projects cooperation between parties is becoming ever more important. With 'parties' is understood all companies and principal(s) that realize an infrastructure object in one project. The number of parties involved in one infrastructure project has risen and responsibilities have shifted. In order to improve the cooperation, in 1998 the VISI[1] project was started. This resulted in 2003 in the VISI standard and the VISI standard resulted in 2012 in the ISO 29481 standard[2]. In the Netherlands the use of the VISI standard is widespread and since 2012 its use is mandatory. The application of the VISI standard is not without trouble, so the owner of the standard, CROW[3], wants a new version of the VISI standard that overcomes the problems.

[1] VISI is a registered trademark of CROW. It is an acronym of *Voorwaarden scheppen voor het invoeren van standaardisatie ICT in de GWW-sector*, which can best be translated to "Creating conditions for introducing standardization ICT in the infrastructure sector".

[2] ISO 29481–2 was prepared by Technical Committee ISO/TC59, Buildings and civil engineering works, Subcommittee SC 13, Organization of information about construction works.

[3] CROW is not-for-profit knowledge partner for (decentral) government, contractors and consultancy firms.

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CROW wants insights from science to be taken into account. In this article we investigate the problems and try to define an approach for solving the problems.

VISI is founded on the DEMO (Design and Engineering Methodology for Organisations [1]) methodology. The core of the VISI project was convinced that the theory of DEMO was the right one to apply, because it is founded on communication theory. This leads to the following questions:

- What is the process of design and implementation of the VISI standard?
- How do projects that follow the VISI standard for structuring communication, implement the VISI standard?
- How has the improvement cycle of the designed artifact VISI been?

The remainder of this article is structured as follows. In Sect. 2 we write about research approaches for IT. In Sect. 3 we describe the case study of the VISI project and the use of VISI in construction projects. In this section the results of the VISI project are described and how VISI is used in practice. In Sect. 4 we discuss the results of the VISI case study and draw conclusions.

2 Research Approach

In [2] we wrote about the three cycle view of design science (DS) from Hevner [3], see Fig. 1. The left cycle, the relevance cycle, are the issues described and analyzed in Subsects. 3.1 and 3.2 and discussed in Sect. 4. The VISI standard itself is a designed artifact (middle cycle). The DEMO methodology and process mining theory are for our situation part of the knowledge base. We wrote in [2] also about action research (AR) as most appropriate method to study social phenomena and as a way to respond faster to environment's demands. Sein in [4] proposes to combine AR and DS into a new method Action Design Research (ADR) in order to combine theory with practice and thinking with doing, see Fig. 2. Hevner has primarily a cyclic view and Sein has a staged view. Keeping in mind nowadays practices like Agile, Scrum and Lean that focus on delivering

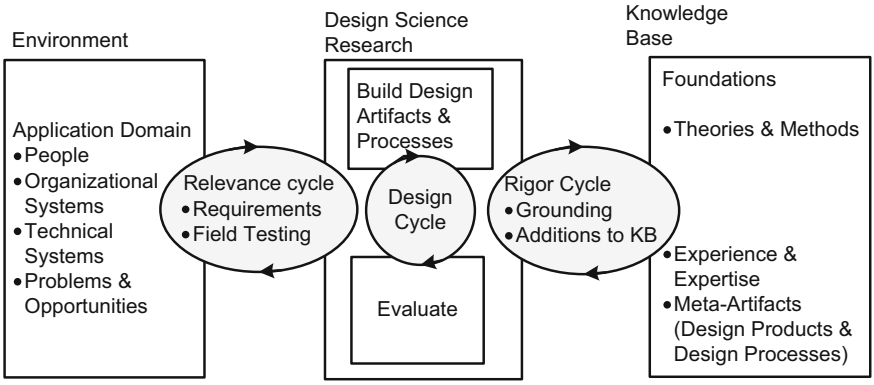

Fig. 1. Three cycle view of design science, Hevner [3]

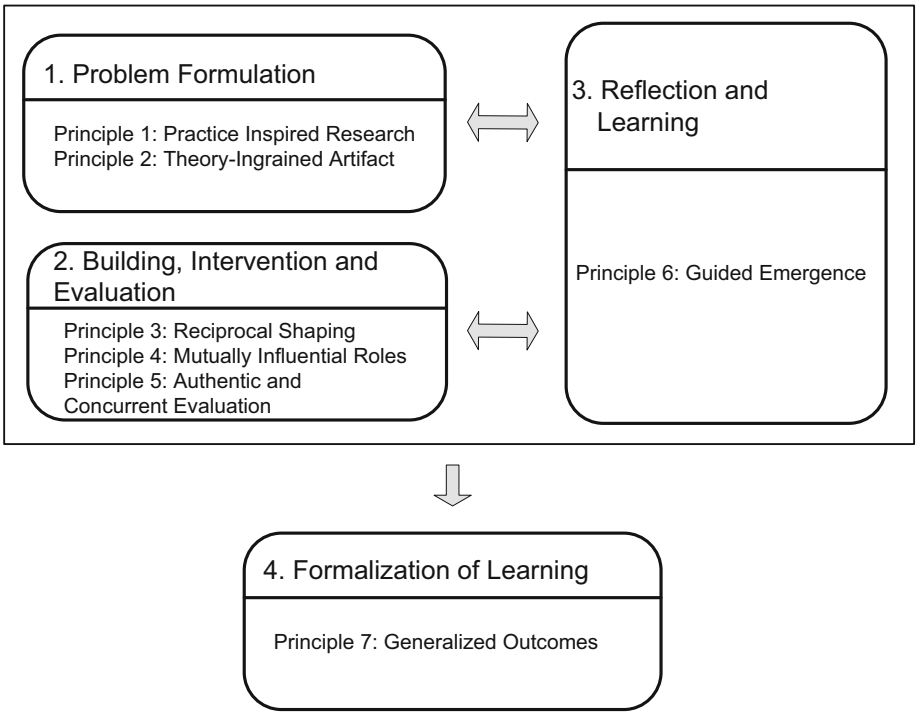

Fig. 2. Action design research (ADR) acc. Sein et al. [4]

added value fast, we will use Hevner and Sein to design our research method that is intended to deliver practical results fast and being thoroughly founded in science. The underlying epistemology we use is an interpretive one (see Myers [5], Orlikowski [6] and Chua [7]). In Action Research interviewing is the way of collecting data. We added *process mining* as a way to gather objectively data. Van der Aalst describes in [8] what process mining is. In our opinion the advantage of process mining with respect to VISI is that we have the facts about communication.

3 Case Study of VISI Development and VISI Use in Dutch Infrastructure Construction Sector

3.1 Introduction

In this section we describe and analyze in Subsect. 3.2 how the VISI standard was developed in the VISI project and in Subsect. 3.3 how it was used.

3.2 VISI Project

In the *investigation phase* (see Fig. 3 for a time line) the concept agreements of the VISI standard were developed. In this phase the choice for DEMO as

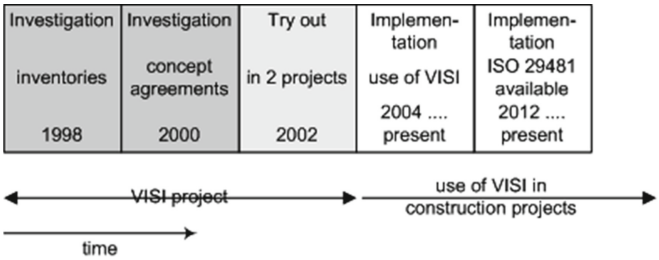

Fig. 3. Time line of the VISI project, extended with ISO standard; the VISI project ended in 2004, after that year the implementation started

underlying theory is made. The outcome consisted of the generic communication model (the existence of which was confirmed) and the table of contents of the VISI guideline.

In the *try-out phase* (2002–2004, see Fig. 3) the VISI model was verified in two infrastructure projects and the results were discussed in group decision sessions with the project managers of infrastructure projects. The project managers confirmed the results and that marks the coming into existence of the VISI standard: the first version of the VISI guideline.

VISI as standard can very well be compared with EDIFACT (see *e.g.* [9]). EDIFACT is a standard for electronic data interchange that provides a set of semantics and syntax rules to structure data, an interactive exchange protocol and standard messages which allow multi-country and multi-industry exchange. Just as EDIFACT, VISI is a business language so all stakeholders in the network are capable of understanding the responsibilities of the actors in executing business transactions. The VISI standard consists of:

- Interaction Chart or Framework for an infrastructure project. This chart is not formally part of the guideline and is a model of the communication in the construction sector. This model is independent of the way of cooperating that is contractually agreed.
- Principles and fundamentals. This consists of a description of parts of DEMO and of a way to design a framework. In this way of working, VISI deviates from the DEMO methodology while VISI recognizes other statuses and doesn't implement the complete transaction pattern.
- Specification of interaction framework and messages in XSD and XML formats.
- A software program, called Promoter, that generates a machine readable scheme in which all messages are defined, based on a framework. Software makers use this Promoter in developing VISI software.

3.3 Implementation of VISI

We looked at the developments in the standard and in the use of VISI. *Developments in the VISI-standard*

After the first version of VISI standard in 2003, there have been new releases in 2008, 2011, 2014, 2015, 2016. Governance and control is arranged: changes are prepared in the technical committee and approved in the steering group. In the governance and control organs science is not represented.

The developments in the standard have all been more (detailed) prescriptions for the form and content of the messages. The concept of *status* has been abandoned in 2014 release in favor of the concept of previous message determining the next message.

Table 1. Messages of process proposal for change

Proposal for change		
Acceptance of proposal	Acceptance of proposal, no financial consequences	Denial of proposal
Offer for change	Message of accomplishment	Withdrawal of proposal
Acceptance of offer for change	Acceptance of accomplishment	
Work completion statement		
Acceptance of work completion statement		

Developments in the use of VISI

For this purpose we analyzed the data of five projects that applied VISI software for communication. This data is analyzed with a process mining tool (ICRIS process miner) and for one case we interviewed the contract manager of the principal and the manufacturing engineer of the contractor. We used process mining mostly to learn about the processes of transactions, this is the messages that are sent consecutively from start (this is a message of a transaction before which is no other message) to finish (this is a message after which no other message follows). Table 1 gives the messages of an example process. From the names of the messages it is derived that it is a process of one transaction. In the simple example of Table 1 the DEMO pattern of request-promise-state-accept cannot be recognized. We see also a change of result in the transaction: first it is a proposal for a change, next it is an offer (proposal with a price) for a change and at last it is a work completion statement. And moreover a distinction is made between a proposal with and without financial consequences. With the process miner it is also possible to make a list of all start messages. From this list we learn that the use is for contractual changes, delivery of contractually agreed documents, work completion statements and the report of the constructors meeting. For all transactions it holds that they are between principal and contractor. The framework that is applied, is not documented, we can only reconstruct it with the

process miner. We use here a simple example, in the data of other projects we saw much more complex processes that exist of up to ten transactions and those processes had the same properties as described here. New transaction types were about external judgment of a proposal or document. Judgment transactions are solely found within the organization of principal. From the interviews with contract manager and manufacturing engineer we learn that both were satisfied with how their communication was supported by VISI software. They delivered their wishes for the set up of the communication and between the two of them they had an appointment how to use it.

In the above paragraph we elaborated on some aspects of the use of VISI. Because of considerations for the length of this article, we summarize and do not go into detail here all our findings from interviews and process mining:

1. The use of the DEMO methodology is essential.
2. VISI applied the DEMO theory in a different way by defining other statuses than DEMO and during the use of VISI software the concept of status was abandoned.
3. VISI applied DEMO not completely.
4. VISI doesn't recognize the possibility of revoking a communication act.
5. VISI focuses on *coordination* solely, while coordination and production shouldn't be considered separately.
6. Several issues in the project context were important: the core group with its stable composition, the members of the core having decision power, commitment of top management, use of a participative approach towards project managers of construction projects.
7. After the first release of VISI standard the shift towards an IT based approach for defining and supporting the communication scheme of a project (project specific framework).
8. Users of VISI-software in a construction project are satisfied how it supports the communication.

4 Discussion and Conclusions

In this section we discuss the findings from the perspective of DS and ADR.

First from the DS-perspective. Item 1 confirms that the rigor cycle has been walked through correctly. Items 2, 3 and 5 state that in the design cycle it is decided to deviate from the theory because the project members decided that this was the best they could do to get the standard accepted and applied in the construction sector. So, here is a decision taken that should have been tested in a relevance cycle. Item 4 is an issue that was still in development in DEMO, so this could have been an addition to the knowledge base. Item 6 has not much to do with the three cycles of design science but is an important condition for a successful (design) project! Items 7 and 8 are facts from the relevance cycle. The application of the VISI standard in construction projects is made with an IT-perspective and mostly by IT-people.

From the ADR-perspective (see Fig. 2) we see that the investigation phase was about Problem Formulation. At the end of investigation phase and during try-out phase Building, Intervention and Evaluation is recognized because in those phases VISI standard was defined and built. Also Reflection and Learning is recognized, because inventories were made and also the solution was found appropriate for application in other sectors than building. In our data we didn't find so much that points to Formalization of Learning.

In the implementation phase, when VISI is used in construction projects for communication between principal and contractor, design cycles and ADR-stages are not so well recognizable. There is a cycle of 1.5 year from determination of the content of a new release till the availability of the adapted software for use. In terms of design science, it seems that the relevance and design cycle are walked through regularly but only to the extent that software has been developed. In terms of ADR, it is only part of stage 2, Building, Intervention an Evaluation. It is good te repeat that VISI standard is about 2 things:

1. a theory about communication between people (Principals and fundamentals).
2. a specification for software that supports communication between people with digital messages (Specification of interaction framework and messages).

It seems that during the use of VISI (see Fig. 3) the development of VISI standard has not been based on research and science anymore. But referring in Sect. 1 to encountered problems, research and science are necessary and there should be a cycle that takes into consideration whether all aspects are dealt with properly, that the right process is followed and that the organization can deal with the implied change. This last aspect is different from the distinction in IT-dominant and organization-dominant BIE that Sein makes in [4, p. 42]. In Sein [4] it is about the content of the artifact to be designed, we aim at the impact of a change that an organization can handle or the answer to the question whether the organization will accept a certain change. We define this as a cycle that implies environment, design science research and knowledge base. By constantly taking into account where (in which cycle) what has to be done, we come ever closer to the desired result. In [11] Argyris *et al.* describe this aspect. Argyris *et al.* call this double loop learning. Single loop learning is design the artifact and improve it, while double loop learning also takes the followed process as subject for improvement. In Fig. 4 we represent this by a spiral over the three cycles according to Hefner. In ADR (Fig. 2) this aspect can be imagined implicitly in the double arrows, but it would be more clear if it was represented by a separate rounded rectangle called management of change. Double loop learning takes both the *what* (three cycles) and the *how* (organizing and controlling the process or project management) into account. In [2] we wrote about the participative project approach of Mulder [10] that has a large added value in AR research because of the coherence between this approach and decision making in an organization. Such an approach could help prevent the problems that are encountered in the application of VISI.

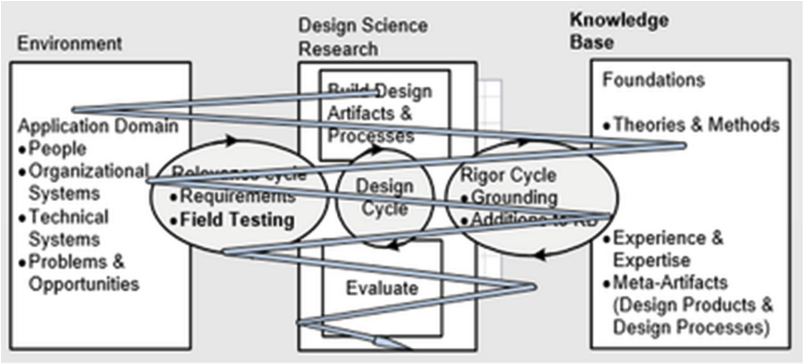

Fig. 4. Design science cycles with action research spiral

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