International Journal of Design Sciences & Technology

Volume 23
N°2

2019

ISSN 1630 - 7267

International Journal of Design Sciences and Technology
Design Sciences, Advanced Technologies and Design Innovations
Towards a better, stronger and sustainable built environment

ISSN 1630 - 7267

15, avenue de Ségur,
75007 Paris, France.
Tel (Fr) 01 45 51 26 07 - (Int.) +33 1 45 51 26 07
Fax (Fr) 01 45 51 26 32- (Int.) +33 1 45 51 26 32
E-mail: ijdst@europia.org
http://www.europia.org/ijdst

International Journal of

Design Sciences and Technology

Volume 23
N° 2

ISSN 1630 - 7267

International Journal of Design Sciences and Technology
Design Sciences, Advanced Technologies and Design Innovations
Towards a better, stronger and sustainable built environment

- TURK, Žiga (University of Ljubljana, Slovenia)
- ZAHEDI, Mithra (University of Montreal, Canada)
- ZARLI, Alan (CSTB, France)
- ZREIK, Khaldoun (University of Paris 8, France)

Validating design principles for creative collaboration

Frans van Gassel[1], **Isabelle Reymen**[1] and **Ger Maas**[1]

[1] Eindhoven University of Technology, f.j.m.v.gassel@tue.nl

Design Science Research (DSR) lacks accepted validation approaches to validate its outcomes (design principles and design solutions). The quality of such a validation has to be ensured so that the outcomes of DSR are as methodologically thorough and as practically relevant as possible. This study introduces a pragmatic validation approach to ensure the quality of design principles. It uses a three-step approach, combining (1) evaluating the design solution as a case in practice, (2) qualifying the implementation of the set of design principles, and (3) assessing the validity of evaluation and qualification results. The validation approach is illustrated by assessing the evaluation results of a creativity facilitation course (design solution) developed according to a set of design principles

Keywords: design meetings, design principles, design science research, pragmatic validation

1 Introduction

Design Science Research (DSR) is a research approach, described by Simon [20] [21] and based on the approach of the design sciences, which develops generic knowledge and understanding to solve field problems. A field problem is a problem that occurs frequently in practice and for which there is no solution. By designing and evaluating a product or process the knowledge and understanding of the problem will be achieved. This research approach is further described by Van Aken, Romme and Andriessen [2, 24, 25, 27].

DSR [24] links practice with research findings [16] using *design principles* and *design solutions* as research outcomes. Figure 1 depicts this approach based on the *research-design-development cycle* adapted from Van Burg, Romme, Gilsing and Reymen [29]. The research-design-development cycle uses arrows to visualize knowledge and practice streams in design science research. The practice stream, flowing from right to left, develops new products or processes and provides practical experience. The knowledge stream, flowing from left to right, develops new scientific knowledge through the research activity *reflection-in-action* [18]. These knowledge and practice streams continually repeat themselves with changing characteristics. Design principles are "normative ideas and propositions, grounded in research, that serve to design and construct detailed solutions" [16]. The design principles will be derived from research findings and will support the design manager to shape, organize and lead complex developing processes and creative meetings.

A design principle can follow the so-called CIMO logic: "In this class of problematic Context (C), use this Intervention type (I) to invoke these generative Mechanisms (M) to deliver these outcomes

(O)" [5]. In this study the descriptions of the design principles follow this logic.

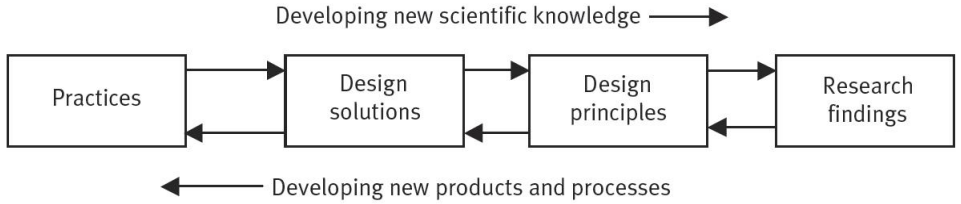

Figure 1. The research-design-development cycle (adapted from Van Burg et al. [29]).

According to Van Aken and Van Fenema [26], assessing the validity of design science research outcomes differs from explanatory research with regard to strategy and objectives. When the interventions, the system of interest, and/or the desired outcomes are too complex, it can be useful to evaluate a series of case studies that solves a field problem.

The quality of the validity assessment of design science research outcomes has to be ensured so that the research is as methodologically thorough and practically relevant as possible [2]. Methodological thoroughness means the results are reliable and valid, the reporting is transparent, the research design is explicit, and the conclusion is unambiguous, plausible and generic. A practically relevant design is one that is explicitly workable and useful, tested in practice, and the client finds innovative and valuable. Pragmatic validation [26] has been proposed for validating DSR outcomes. A *pragmatic validation,* according to Kvale and Brinkman in Van Burg [28], is "the extent to which the research creates guidelines that generate the desired outcomes when those guidelines are actually applied". It is unclear, however, *what* such a validation approach looks like in practice. Verschuren and Hartog [36] recognized this problem and developed an approach for validating design solutions. This study focuses on an approach for validating a set of design principles. Our research question is stated as: *How can design principles be validated in a pragmatic way*?

The paper contributes to DSR and more specifically to the validation process of this type of research. Based on a literature study, a validation approach has been developed, which is illustrated by assessing the evaluation results of a creativity facilitation course solution developed according to a set of design principles. Especially in the domain of (building) design management, where experiments in a laboratory environment are hardly possible, our approach seems very useful. The paper first introduces the pragmatic validation approach (Section 2), which is followed in the research. Then discusses the application of the validation approach to the case, being a creativity facilitation course, in the Sections 3 to 6. The paper ends with a discussion and conclusion of the research.

2. Pragmatic validation approach

Our pragmatic validation approach assesses the validity of the evaluation results of a design solution developed according to a set of design principles and assesses the quality of the implementation of the set of design principles. We split our validation approach into the following three steps: (1) Evaluating the design solution as a case in practice, (2) Qualifying the implementation of the set of design principles, and (3) Assessing the validity of evaluation and qualification results.

In Figure 2 the three steps are connected with each other by arrows that stand for input or output.

In this figure the arrow *Course* – the sample of this study – is part of the practice stream, and the arrows *Evaluation results* and *Qualification results* can be considered as the knowledge stream. The activities in the knowledge stream can be considered as reflection-in-action, as introduced in Section 1. In section 4, *Applying the validation approach to the case: Method,* the three steps will be described in detail.

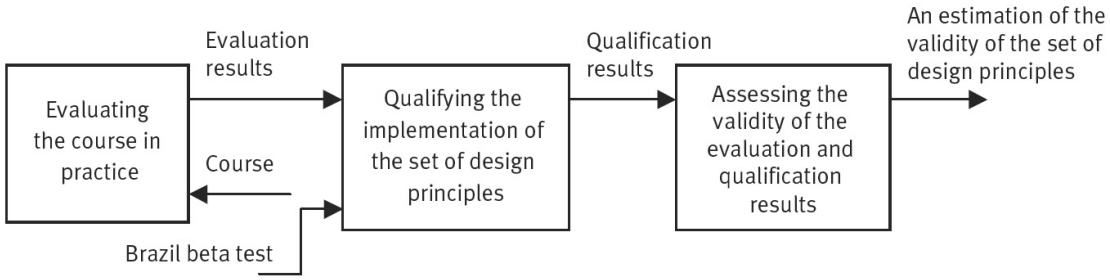

Figure 2. Activities to validate the set of design principles.

Evaluating the design solution is the first step of the validation approach. According to Swanborn [22], the evaluation of a *design solution* is "research consisting of advice about the design, guidance during implementation and, particularly, evaluation of the effects of an intervention on society". More specifically, we propose implementing the design solution and measuring the learning outcomes by conducting a written survey among the participants.

The results of the evaluation can be used to qualify the *implementation of the set of design principles* [28]. This qualification can provide an estimation of the validity of the set of design principles. Some types of evaluation research are more effective than others. We use Veerman and Van Yperen [35], who have formulated a ladder that can help determine the effectiveness of interventions. This ladder is divided into four levels of explanatory power: (i) descriptive, (ii) theoretical, (iii) indicative, and (iv) causal. To qualify the implementation of the set of design principles, we compare the coherence in the results of implementing the design solution with the set of design principles.

For *assessing the validity of the evaluation and qualification results,* we use the method developed by Ropes [17] known as plausible rival explanations. This method first identifies plausible rivals and then explains how these rivals can be disqualified. Yin (2013) explains that "the use of plausible rival explanations remains an extremely promising but still underdeveloped procedure for strengthening the validity of case study evaluations". This means that this approach is useful for this study. According to other researchers [37, 38] mentioned in Ropes [17], rivals can be classified as either craft rivals (i.e. null hypothesis, threats to internal and external validity, bias on the part of the researcher) or real-life rivals (i.e. plausible rival explanations that are related to the intervention, implementation and theory and to the external circumstances).

Our method thus combines existing methods into an approach for pragmatic validation of a set of design principles. This unique approach is illustrated with a case on assessing the evaluation results of a creativity facilitation course (design solution) developed according to a set of (previously published) design principles.

3. Case to illustrate the validation approach

The specific case chosen for this study deals with a creativity facilitation course that has been developed, tested and evaluated. The creativity facilitation course – based on a set of design principles – can enhance creative and collaborative working during face-to-face design meetings; often these meetings in the Architecture Engineering and Construction (AEC) sector are not planned, organized or conducted with adequate knowledge or skills. The set of design principles is developed to increase the level of knowledge and skills. The set consists of 15 design principles that can be briefly described as follows [32]: plan a detailed meeting plan, invite a variety of participants, explain working methods in a simple way, have participants listen to each other, put a reluctant participant to work, create rhythm in activities, reformulate the question, don't be afraid to deviate from your meeting plan, continually change the circumstances, take participants out of their comfort zone, let the participants do the work, let the hands do the thinking, alternate between strict and lenient, close the meeting with perspective, choose the working method most appropriate for your meeting. *S*ome of the design principles were published early on in order to encourage scholars to experiment with them. The article entitled 'Experiences with collaborative design by constructing metaphoric objects' by Van Gassel [31] described not only the method of working with design principles but also presented questions for measuring the experiences with the method.

4. Applying the validation approach to the case: Method

Since the set of design principles is evaluated in practice, in a complex, actual social environment and not in a laboratory, our evaluation will be conducted at the indicative level [17]. This indicative evaluation research shows that the formulated goals are reached, the problems are decreased, the skills are enhanced, and the clients are satisfied. In the remainder of this section, we follow the three steps of our approach: (1) Evaluating the creativity facilitation course in practice, (2) Qualifying the implementation of the set of design principles, and (3) Assessing the validity of evaluation and qualification results.

(1) Evaluating the course in practice

The course is developed in four steps, using the design principles as a basis. The first step was to derive the learning objectives from the set of design principles. The second step was to compose the course program based on the derived learning objectives, the sub-aims, and the prerequisites. The third step was to compose a leaflet to recruit participants. This leaflet gives the title of the course, an explanation of the use of design principles, etc. The final step was to describe the learning outcomes. For more details see the study of [32] pages 89-96.

The course has been evaluated by implementing the course program in practice and then measuring the learning outcomes. We describe here how the sample and the measurements were chosen.

The sample. The best way to evaluate a creativity facilitation course is to implement the course a number of times. From 2009 until the spring semester of 2014, the course was given ten times to 99 BAM Group employees. The 56 participants of the first six courses (which took place between the spring of 2009 and the spring of 2012) were invited by email to complete a questionnaire. It was also announced during a networking meeting of ex-course participants that the effects of the course would be measured with a questionnaire. The course participants were then asked via a telephone call from a research assistant if they would come to an appointment with the researcher of this study, so that the questionnaire could be completed in his presence. The course participants

held various positions such as director, manager, supervisor or engineer and worked at one of the Dutch BAM operating companies. The course also became a part of the program at BAM Business School [4]. Royal BAM Group is a European construction group that is comprised of operating companies in five home markets. It is active in construction, mechanical and electrical services, civil engineering, property management, and public-private partnerships. Employees of the BAM operating companies were eligible to take part in the course. These six courses were attended by various professionals from the AEC sector, creating a representative sample to evaluate the creativity facilitation course, despite the fact that all of the participants are employed by one large company.

The measurements. To evaluate the course, the learning outcomes must be measured, and the participants' characteristics must also be examined in order to gain insight into the sample. The participants' characteristics (independent variables) are 'completed education', 'subsidiary company work', 'work experience' in years, 'job description', and 'date of training', as indicated in Table 1.

The learning outcomes (dependent variables) are the following: Regarding skills: 'knowledge of creative and collaborative thinking', 'creative behaviour', 'enhancing creative behaviour', 'creative leadership behaviour', and 'enhancing creative leadership behaviour'; Regarding attitude: 'course satisfaction', 'facilitating design meetings per month after course', and 'working on learned skills after course'.

According to Kirkpatrick and Kirkpatrick [11], the most important evaluation measurement is that of the extent of the course members' change in behaviour; however, they state that it is also necessary to measure the level of learning because a certain level of learning is required in order to achieve a change in behaviour. Therefore, in this study, the effect of teaching the 'knowledge of creative and collaborative thinking' has been measured.

The survey was conducted by having the participants answer written questions. The measurements of the eight independent variables is described in more detail below. The complete survey is available on the website 4TU.Centre for Research Data [30].

The first dependent variable, '*knowledge of creative and collaborative thinking*', was measured with a multiple-choice test containing 16 questions with three possible answers and one open-ended question. The questions tested whether the participants remembered, understood and were applying the basic elements the course was supposed to have taught them. These basic elements are the following: 'creative and collaborative thinking' (2 questions), 'rhythm' (1 question), 'techniques' (5 questions), 'creative thinking skills' (3 questions), 'processing ideas' (4 questions) and 'preparation for a meeting' (1 question). The design of the test is based on the educational testing service manual written by Baldwin, Fowles and Livingston [3] and it includes a correction for the guessing factor. The percentage of questions that would on average be answered correctly by guessing is 33% * 16 = 5.28. Six points were deducted from each participant's assessment score to account for this, so that the assessment scores ranged from 0 to 10. A score of 5.5 could therefore be regarded as 'sufficient'. This measurement delivered the average assessment score related to the variable 'knowledge of creative and collaborative thinking'.

The second dependent variable, '*creative behaviour*', aims to determine the level of creative behaviour of the course participants. Amabile, Conti, Coon, Lazenby and Herron [1] described the creativity of participating individuals and team members as the "production of novel and useful ideas in any domain". Creative behaviour helps the employee contribute to the organization's

innovation process. The creative behaviour of the employee can be influenced by the social environment. Based on this description, a measurement scale for 'creative behaviour' was developed by George and Zhou [8], whereby the questions were answered by the supervisor. This measurement scale was translated by Noordam [13] into a Dutch language, self-reporting questionnaire containing 12 items. The statements were adopted verbatim from a study by Van Sele [34] at Ghent University. An example of a statement is: "In my job I propose new ways of achieving targets". The other 11 items can be summarized by the following key phrases: I generate ideas, I generate technologies, I improve quality, I'm a source of ideas, I promote ideas, I'm creative, I implement techniques, I have new ideas, I propose new ideas, I have innovative visions, and I introduce new working methods. Scoring is based on a 5-point Likert scale: 1 = 'Never', 2 = 'Rarely', 3 = 'Sometimes', 4 = 'Often' and 5 = 'Always'. The total score shows the level at which the people completing the survey assess their behaviour as creative. For the Van Sele [34] study, the Cronbach's alpha – an indication of the extent to which the items in a questionnaire measure the same concept [7] was 0.92 for this set of questions. This measurement delivered the average assessment score related to 'creative behaviour'.

The third dependent variable, '*enhancing creative behaviour*', measured to what extent this behaviour had been enhanced. Since we were unable to conduct both pre and post-measurements, Kirkpatrick and Kirkpatrick [11] recommend asking the course participants to what extent attending the course had actually contributed to a change in his/her behaviour. This change in creative behaviour was also measured in the survey by asking, for each sub-question, "To what extent has the training contributed to a change in the mentioned behaviour?" Participants could choose from the following responses: 'to a large extent', 'to some extent', 'no change' and 'made it worse'. This measurement delivered the average assessment score related to 'creative behaviour' and 'enhancing creative behaviour'.

The fourth dependent variable, '*creative leadership behaviour*', aims to determine to what extent the course members are behaving creatively. When measuring 'creative leadership behaviour', questions related to leadership were adopted from a self-assessment entrepreneurship test [10]. According to Laevers and Bertrands [12], entrepreneurship is a powerful mix of two well-developed dispositions: self-directed learning and creativity. According to Geraets [9], in the self-assessment test, creative leadership consists of the following aspects: (i) Mobilizing and uniting, (ii) Synthesizing and structuring, (iii) Decision-making, (iv) Sharing and delegating, (v) Having an overview and re-adjusting, (vi) Coaching and (vii) Responsibility. All seven of these concepts from the self-assessment test have been formulated as multiple-choice questions and were converted to measure 'creative leadership behaviour'. A Cronbach's alpha is not known for the above measurement. This measurement delivered the average assessment score related to 'creative leadership behaviour'.

The fifth dependent variable, '*enhancing creative leadership behaviour*', measured to what extent the participant's creative behaviour was enhanced as a result of the course. After each item the course participants were asked to state to what extent attending the course had actually contributed to a change in the mentioned behaviour, using the following scale: 'to a large extent', 'to some extent', 'no change' and 'made it worse'. This measurement delivered the average assessment score related to 'enhancing creative leadership behaviour'.

The sixth dependent variable, '*course satisfaction*', measured to what extent the course participants were satisfied with the course. Their level of satisfaction was measured using one question and a 4-point Likert reply scale that ranged from 'Very dissatisfied', 'Dissatisfied',

'Satisfied' to 'Very satisfied'. This scale was taken from the *info-line* publication from the American Society for Training & Development (ASTD) [6].

The seventh dependent variable, '*facilitating design meetings per month after course*', measured how many design meetings the participant had facilitated (or helped to facilitate) after the course.

The eighth dependent variable, 'working on learned skills after course', was also measured using a question with a 4-point Likert reply scale that ranged from 'Never', 'Seldom', 'Sometimes' to 'Often'. This scale was taken from the work of Taylor-Powell [23].

The final question of the survey was an open-ended question asking for individual comments about the course.

(2) Qualifying the implementation of the set of design principles

The qualification of the implementation of the set of design principles involves considering the measurement results of the learning outcomes and demonstrating the coherence between learning outcomes and the set of design principles. A certain level of coherence is necessary because the measurements of these learning outcomes have not been directly derived from the design principles or the learning objectives. The qualification also involves considering the outcome of the beta test. In this section the methods used to measure the learning outcomes and to demonstrate the coherence between the learning outcomes and the set of design principles will be clarified and a report about the beta test will be cited.

Learning outcomes and coherence with the set of design principles. The mean of the following learning outcomes is considered: 'knowledge of creative and collaborative thinking', 'creative behaviour', 'enhancing creative behaviour', 'creative leadership behaviour', and 'enhancing creative leadership behaviour'. Further, the outcomes of 'course satisfaction' and 'working on learned skills after course' are depicted. Finally, the value of the variable 'facilitating design meetings per month after course' is mentioned. The coherence between the three learning outcomes, or the survey questions, with the 15 design principles is demonstrated in Table 6, where the 15 design principles are depicted horizontally. The following variables are listed vertically: 'knowledge of creative and collaborative thinking' which is divided into six sub-groups of questions: 'collaborative creative thinking', 'rhythm', 'techniques', 'creative thinking skills', 'processing ideas' and 'preparation'; 'creative behaviour'; and 'creative leadership behaviour'. The coherence can be demonstrated by matching the keywords in the text of the design principles with the text of the survey in relation to the survey questions. The following algorithm was developed in EXCEL to find the matches: =IF(ISNUMBER(FIND("keyword cell"; "question/answers cell"));1;0). This type of research tool originates from the methodology used to find bisociations. This methodology involves the substantive comparison of two texts from different domains in order to arrive at new knowledge [19]. From the text of the 15 design principles, 242 keywords were chosen (Mean 16.1, Max 26 and Min 10). The total number of possible matches is thus 6,050.

Beta test. In 2005, a preliminary version of the design principles was published in scientific articles in order to invite users to experiment with them and to receive feedback about them. During vision design sessions, some design principles were applied in a bachelor's degree course for Fashion Design at SENAI CETIQT in Rio de Janeiro, Brazil [14, 15]. The lecturers of this course based their approach on the Handstorm method and the effect measurement was based on Van Gassel [31]. The introduction program for incoming students at the *Potifícia Universidade Católica* in Rio de Janeiro presents a Handstorm workshop. The Handstorm method is an approach

used to visualize and share the tacit knowledge and felt experiences of designers during creative meetings. One of the set of 15 design principles whereon the method is based is '*Let the hands do the thinking'*.

(3) Assessing the validity of the evaluation and qualification results

The *plausible rival explanation* method is suitable to further demonstrate the validly of the course evaluation and subsequently the qualification of the implementation of the set of design principles. This validity assessment (i) consists of identifying the plausible rivals and (ii) explaining how these rivals can be disqualified.

5. Applying the validation approach to the case: Results

We applied the validation approach to our case, following the method discussed above. The results are reported below.

(1) Evaluating the course in practice

The evaluation of the creativity facilitation course has been carried out by implementing the course and then measuring the learning outcomes.

Implementation. The implementation of the course has been described in the previous section. The course participants initiated collaborative activities after the first six courses, which potentially indicates that the skills they learned have reached some degree of internalization. The course participants organized three networking meetings (January 2011, September 2012, and June 2013) during which they exchanged experiences with facilitating design meetings by using poster presentations and by collectively practicing the new techniques. A number of course participants opened a BAM Portal, through which former course participants could offer their services as facilitators and from which information about creativity techniques could be obtained. Figure 3 shows some images of the course participants at work during the creativity facilitation courses.

Figure 3. Images of the creativity facilitation courses

Measurements learning outcomes. The 56 participants of the first six courses (which took place between the spring of 2009 and the spring of 2012) were invited to complete a questionnaire. As 44 of the course participants completed the questionnaire between October 2012 and January 2013, a response rate of 78.6% was achieved. Three course participants could no longer be contacted because they had started to work for a different employer. The researcher was able to meet 32 of the course participants. Upon completion of the questionnaire, the researcher provided explanations, answered questions, asked for further details about comments, and took notes. The remaining 24 course participants were subsequently invited to complete the questionnaire on their own and to return it to the researcher. Twelve of those course participants did so. Table 1 shows the measurement results (absolute frequency (N) and percent per sub-variable) of the independent variables. The variable 'completed education' shows that the course participants were evenly divided between those with a university education and those with a polytechnic education. Course participants from BAM Wegen, BAM Civiel and BAM Rail were well represented. The 'Job

descriptions' match with the jobs that were depicted in the methods section. Course participants from all six of the courses completed the questionnaire; the least represented course still had four participants who completed the questionnaire. The results of the variable 'work experience' are as follows: mean 18.53 years, standard deviation 7.872 years, maximum 40 and minimum 3 years. Most of the course participants had a considerable amount of work experience.

Table 1. Measurement results of four independent variables.

Independent variables	Abbr.	Sub-variables	N	Percent
Completed education	CE	Technical University	14	31.8
		University	6	13.6
		Polytechnic	22	50.0
		Other	2	4.5
		Total	44	100
Subsidiary company work	CW	BAM PPP	8	18.2
		BAM Wegen	5	11.4
		BAM Civiel	11	25.0
		BAM Infratechniek	2	4.5
		BAM Techniek	1	2.3
		Vitaal Zorgvast	4	9.1
		BAM Rail	4	9.1
		BAM Utiliteitsbouw	1	2.3
		BAM Leidingen & Industrie	2	4.5
		BAM Infraconsult	5	11.4
		Other	1	2.3
		Total	44	100
Job description	JD	Director	7	15.9
		Manager	20	45.5
		Chief	12	27.3
		Engineer	5	11.4
		Total	44	100
Date of training	DT	2009-1	8	18.2
		2010-1	9	20.5
		2010-2	7	15.9
		2011-1	4	9.1
		2011-2	8	18.2
		2012-2	8	18.2
		Total	44	100

The results of the measurements of the dependent variables have been described by the 'number of reactions', a 'score' on a scale (Mean), the 'standard deviation' (SD), 'minimum' (Min), 'maximum' (Max), and the Cronbach's alpha. These results are depicted in Tables 2-5. Some remarkable results shown in Table 2 are that CT scored 7.14 on a scale of 1 to 10 and the variables CB, ECB, CL and ECL scored between 3.008 and 3.541 on a scale of 1 to 4. The Cronbach's alpha for CL is low compared to the outcomes of the other variables.

Table 2. Dependent variables and measurement results.

Variable	Abbr.	N	Mean	SD	Min	Max	Cronbach's alpha
Knowledge of creative and collaborative thinking	CT	44	7.14[1]	1.488	10	16	
Creative behavior	CB	41	3.541	0.3667			0.816
Enhancing creative behavior	ECB	41	3.008	0.3670			0.839
Creative leadership behavior	CL	44	3.231	0.3145			0.384
Enhancing creative leadership behavior	ECL	44	3.390	0.4217			0.810
Facilitated design meetings per month after course	FM	44	0.325	0.022	0	1	

[1] Corrected for guessing factor 13.14 - 6 = 7.14

Table 3 shows the scores of seven sub-variables of the variable 'enhancing creative leadership behaviour'. These scores are the following: the number (N) of reactions, 'enhancing creative leadership behaviour' on a scale of 1 to 4 (Mean), and the standard deviation (SD) of the mean. The scores in Table 3 tell us that 'Overview and readjusting' and 'sharing and delegating' scored lower than the other sub-behaviours.

Table 3. Enhancing creative leadership behaviour (ECL) per sub-variable.

Sub-variable	N	Mean	SD
Mobilizing and uniting	44	3.64	0.487
Synthesizing and structuring	44	3.07	0.789
Decision-making	44	3.59	0.658
Sharing and delegating	44	2.82	0.896
Overview and readjusting	44	2.43	0.661
Coaching	44	3.30	0.701
Responsibility	44	3.77	0.476

Table 4. This table shows the level of 'course satisfaction' of the 44 course participants; thus 23 (52.3%) were 'satisfied' and 21 (47.7%) were 'very satisfied'.

Table 4. Level of course satisfaction.

Level of satisfaction	N	%
Very dissatisfied	0	0.0
Dissatisfied	0	0.0
Satisfied	23	52.3
Very satisfied	21	47.7

Table 5 shows the extent to which the course participants 'worked on learned skills after training'; approximately 90% had worked on these skills 'sometimes' or 'often'.

Table 5. Further work on skills after training.

Worked on skills after course	N	%
Never	0	0.0
Rarely	4	9.1
Sometimes	26	59.1
Often	14	31.8

The last measurement was an open-ended question that asked participants to give some comments about the course. Some arbitrarily chosen written comments from the survey are "Practice making the course participants enthusiastic", "Creativity techniques are suitable for analytical, policy and strategic sessions", "Small group dynamics due to diverse capabilities of the course participants". The researcher also noted the following verbal comments: "Got to know and respect participants during design meetings", "Also learned social skills", "I don't need to be creative, but the group does", and "It's important to give guidance to participants in a meeting". These comments illustrate why course participants were (very) satisfied with the course.

(1) Qualifying the implementation of the design principles

Learning outcomes and coherence with the set of design principles. In summary, the learning outcomes delivered the following scores: 'knowledge of creative and collaborative thinking': mean 7.14, on a scale of 1 to 10, 'creative behaviour', 'enhancing creative behaviour', 'creative leadership behaviour', and 'enhancing creative leadership behaviour': mean 3.008 – 3.541, scale of 1 to 4. The outcome 'course satisfaction' scored 100% *(very) satisfied*, and 'working on learned skills after course' scored 100% *sometimes or often*. The mean of the variable 'facilitating design meetings per month after course' is 0.325 times per month. These learning outcomes can be considered to be *good* based on the 5-point Likert scale (i.e. poor, fair, average, good and excellent).

Table 6 demonstrates the coherence between the learning outcomes and the set of design principles. This table shows that the number of realized matches is 345. In the table, the keywords were grouped per design principle, so that the number of possible matches was reduced to 375 and realized matches was 207 (Mean 13.8, Max 24 and Min 7). The design principles matched with the 6 questions on 'knowledge of creative and collaborative thinking' 59 of 90 (65.5%), with the 12 questions on 'creative behaviour' 51 of 180 (28.3%), and with the 7 questions on 'creative leadership behaviour' 98 of 105 (93.3%). The design principle 'constantly change conditions' had the highest number of matches (36 times) and 'choosing suitable methods' had the lowest (7 times). Table 6 shows that the coherence between the descriptions of the survey questions and the learning outcomes can be qualified as *fair* based on the 5-point Likert scale (i.e. poor, fair, average, good and excellent).

Beta test. In the survey conducted after the Fashion Design course in Brazil, the students gave the course a 3.75 on a scale of one to five (SD 1.28, N = 8), which means the students were satisfied with the course. Initially there was resistance from the students, but this disappeared during the practical exercises. The lecturers found that the results achieved by using the design principles were better than the designs sketched on paper. Pinheiro and Queiroz (2013) concluded that it is likely three of the stated design principles used in these vision design meetings led to *improved results* compared to when these principles were not used. Their article was published in Brazilian Portuguese but the English translation can be found in Van Gassel [32].

Table 6. Matching 15 design principles' keywords with the text of the survey questions.

		DESIGN PRINCIPLES														
SURVEY QUESTIONS		Produce an accurate meeting scenario	Invite a variety of participants	Explain method in simple terms	Have participants listen to each other	Set a reluctant participant to work	Give rhythm to activities	Reformulate the question	Don't adhere strictly to the plan	Continuously change the circumstances	Take participants out of their comfort zone	Make the participants do the work	Let the hands do the thinking	Alternate between strict and relaxed	End with perspective	Choose the most suitable method
KNOWLEDGE OF CREATIVE AND COLLABORATIVE THINKING	Creative and collaborative thinking (1-2)	1	4	2	5	1	2	0	3	4	2	2	2	1	1	0
	Rhythm (3)	3	2	3	2	1	9	4	1	1	1	2	0	2	1	0
	Techniques (4-8)	0	1	1	1	1	3	0	2	0	1	0	1	0	2	0
	Creative thinking skills (9-11)	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1
	Idea processing (12-15)	1	2	0	2	0	0	1	0	1	0	1	0	2	0	0
	Preparation (16)	3	1	2	1	1	1	1	1	1	1	1	0	3	1	0
CREATIIVE BEHAVIOR	I achieve targets	1	0	0	0	0	0	0	1	1	1	0	0	0	0	1
	I generate ideas	0	1	0	0	0	0	0	2	1	2	0	1	1	0	0
	I generate technologies	0	1	0	0	0	0	0	2	1	2	0	1	0	0	0
	I improve quality	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
	I'm a source of ideas	0	1	2	0	0	0	0	1	1	1	0	1	0	0	0
	I promote ideas	0	1	0	0	0	0	0	1	1	1	0	1	0	0	0
	I'm creative	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	I implement techniques	1	1	1	0	0	1	0	2	1	2	0	1	0	0	1
	I have new ideas	0	1	0	0	0	0	0	2	1	2	0	1	0	0	0
	I propose new ideas	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0
	I have innovative visions	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	I introduce working methods	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
CREATIVE LEADERSHIP	Mobilize and unite	3	1	2	1	1	1	1	1	2	2	1	0	1	2	1
	Synthesize and structure	2	3	2	3	1	1	2	3	3	2	1	1	1	2	0
	Decision-making	1	1	2	2	2	1	1	0	2	1	1	0	1	2	0
	Share and delegate	2	2	3	3	2	1	1	1	2	3	2	1	2	2	1
	Overview and readjust	2	4	3	3	2	1	1	1	2	2	3	1	2	2	1
	Coach	1	1	2	1	1	1	1	1	2	1	1	0	1	2	0
	Responsibility	3	2	4	1	2	2	2	1	2	4	1	1	2	4	1

(2) Assessing the validity of the evaluation and qualification results

This validity assessment consists of (i) identifying the plausible rivals and (ii) explaining how these rivals have been disqualified as much as possible. The craft rivals will be discussed first, followed by the real-life rivals.

The craft rivals. The first type of craft rival is the *null hypotheses,* which states that the results can be explained by coincidence. This rival has been disqualified as much as possible by conducting the field trial six times and by inviting all participants to complete the questionnaire. The scales used to measure creative (leadership) behaviour have been proven and statistical tests were carried

out to determine the Cronbach's alpha, see Table 2. Only the score for the creative leadership behaviour measurement was lower than the Cronbach's alpha standard of 0.7.

The second type of craft rival is *threats to the internal validity.* There are several craft rivals in this category; each of these will be successively described hereunder.

To disqualify the rival referred to as 'history' – i.e. *the effect may be the result of a different event that took place between the pre- and post-measurements* – the course participants were explicitly asked to what extent the course had contributed to all of the specific items regarding creative (leadership) behaviour. This additional question also disqualified the rival referred to as 'natural development and growth' – i.e. *course participants become smarter, cleverer, more experienced, etc. between the pre- and post-measurements*.

The rival 'testing' – i.e. *the effect of taking the same test again* – has been disqualified by having the course participants complete the questionnaire only once.

The rival 'instrumentation' – i.e. *variance of the measurement instruments between the pre- and the post-measurements* – has been disqualified by conducting only one post measurement, whereby 32 course participants completed the questionnaire in the presence of the researcher and 12 emailed their completed questionnaires. Of the five learning outcomes that were scored, two differed significantly for the group that responded via email compared to the group that responded in person. In the presence of the researcher, the course participants scored higher on 'knowledge of creative and collaborative thinking' (CT) (7.47 (N = 32) compared to 6.25 (N = 12)) and scored higher on 'enhancing creative leadership behaviour' (ECL) (3.460 (N = 32) compared to 3.202 (N = 12)).

The rival 'statistical regression*' – i.e. when groups were selected for their extreme scores, this led to a distortion of the mean* – has been disqualified by comparing the current results to those from the previous measurement of the 'creative behaviour' of 43 BAM employees made by Van Luijtelaar [33]. The mean score for 'creative behaviour' (CB) for these employees was 3.2344 (SD 0.68436) and for the course participants the score after the course was 3.5407 (SD 0.36568). The performance of a t-test indicated that there was a significant difference between these two groups (Sig. = 0.012).

The rival 'distortion through selection' has been disqualified because all participants of the course were invited to participate in the survey. There was no selection.

The rival 'loss of respondents' has also been mostly disqualified. The response rate of course participants in completing the questionnaire was 78.6%. A number of participants were not reachable because they had moved to BAM International or started working for another company.

The third type of a craft rival is *threats to the external validity,* which has been disqualified by presenting the results of the survey to some of the course participants. The results have been endorsed by the course participants.

The last type of craft rival is *bias on the part of the researcher*. The course was largely designed by the primary researcher and conducted in collaboration with a professional trainer. This trainer also conducted the intake interviews so that the course program details could be amended to suit the existing skills of the course participants. The trainer also provided feedback on the design of the questionnaire. This collaboration limited any bias on the part of the researcher.

The real-life rivals. The rival 'direct or mixed' – i.e. *the assertion that a different intervention is partly responsible for the result* – has been disqualified based on contact with participants after the course. The researcher was present when 32 of the 44 questionnaires were completed and gained insight into which other interventions had taken place. For example, the researcher took part in design meetings organized by former course participants and network meetings in which the trainers gave additional training. It was found that participating in these meetings boosted the participant's motivation to learn during the course.

The 'implementation rival' – i.e. *the assertion that the implementation method of the intervention is responsible for the result* – has been disqualified because well-established measurements were used for measuring the creative (leadership) behaviour.

The threat of the '*rival theory'* – i.e. *the choice of the research approach influences the conclusions relating to the validity* – has been minimized because the approach *design science research* is the most suitable for this study.

*The '*super rival' – *i.e. the assertion that both the studied intervention and the attained results are part of a much larger and more powerful process that is responsible for the result* – is present; a number of course participants worked in an environment in which the learned competences could not be applied or where the manager did not provide any space for such opportunities. As a rule, it was advised during the course that the skills be used in personal conversations and in self-initiated progress dialogue.

The 'social rival' – i.e. *the assertion that a dominant social political or economic situation is responsible for the result* – has been excluded by asking the participants during the survey to what extent the course had affected their creative (leadership) behaviour.

Summary results. The results of the first sub-topic, *Evaluating the creativity facilitation course*, show that the measurements of the learning outcomes can be considered to be *good*. When evaluating the course for further research, a pre-measurement of the learning outcomes must be carried out. In addition, attention must be paid to the survey questions to measure 'creative leadership behaviour' to enhance the Cronbach's alpha.

The results of the second sub-topic, *Qualifying the implementation of the set of design principles,* are the demonstrated coherence and the results of the Brazil course's beta test. The coherence can be considered to be *fair*. By re-composing the survey questions for the variable 'knowledge of creative and collaborative thinking' (CT), the focus must be placed on the knowledge about the set of design principles. The table also shows that the coherence between the design principles and the survey question 'creative leadership' was higher than the questions about 'knowledge of creative and collaborative thinking', and much higher than the questions about 'creative behaviour'. The Brazil beta test showed that it is likely that three of the design principles used in these vision design meetings led to *improved results* compared to when these principles were not used.

The third sub-topic, *Assessing the validity of the evaluation and qualification results,* summed up a series of activities that could be used to disqualify the rivals. The *plausible rival explanations* method has made the rivals visible and has provided insight into the activities that have been performed to try to disqualify them; however, the use of the method did not lead to perfectly reliable conclusions but increased the transparency of the research. This transparency is one of the requirements of a pragmatic validation.

6. Applying the validation approach to the case: discussing quality of criteria

6.1 Reliability

The researcher has striven to achieve maximum practical relevance and the greatest possible methodical thoroughness, which is necessary for a design science research approach. The researcher has chosen to implement the course at a construction firm as part of the existing educational program in order to achieve the maximum practical relevance. The greatest possible methodical thoroughness has been achieved by implementing the course six times, by using existing knowledge, by initiating a beta test, and by evaluating the course on the 'indicative' level.

The research was conducted within the researcher's professional practice. Such commitment leads to comprehensive research, but it can sometimes also lead to tunnel vision. However, collaborating with other researchers and publishing results in symposia proceedings between 1990 and 2015 ensured continuous reflection.

6.2 Validity

To validate the set of design principles, a pragmatic approach was chosen because the interventions, the system of interest, and the desired results were too complex to conduct a causal research. Implementing a course in practice is complex and causal research requires the researcher to make concessions regarding practical relevance. Validation requires testing in practice to determine whether the set of design principles works using evaluation research.

The plausible rival explanations method has been used to enhance the validity of the results. A rival in this study was the self-rating question, which can be disqualified by further research by doing a pre-measurement. When designing the research, this method can be useful for identifying the rivals, without having to make too many concessions regarding the practical relevance.

Data triangulation – the use of different samples, spaces and persons – carried out by initiating a beta test, has enhanced the generic applicability of the set of design principles. Lecturers of the bachelor's degree course for Fashion Design at the Federal University of Juiz de Fora in Brazil used some of the design principles to plan, organize and conduct a vision design session. The lecturers evaluated the course with a questionnaire that was created by the researcher of this study and which was published in conference proceedings [31]. This evaluation indicates that the students were satisfied with the results of the course. Initially there was resistance from the students, but this disappeared during the practical exercise. It seems likely that three of the stated design principles used in vision design meetings led to improved results compared to when these principles were not used. The lecturers published the results in a scientific article [14]. This beta test shows that the use of design principles works for the course in Brazil.

Methodological triangulation – the use of two or more research strategies, in this case desk research, case study, six experiments and survey research – has ensured the greatest possible methodical thoroughness.

6.3 Generalizability

The set of design principles has been generically formulated so that the set can be a robust basis for attractive and broad applications for creative and collaborative working. In particular, the set of

design principles for creative and collaborative working is generic enough to be used for design courses at a university. As mentioned above, certain design principles were used to develop a bachelor's degree course in fashion design at the Federal University of Juiz de Fora.

The design principles have also been used to compose curricula for three courses at the Eindhoven University of Technology. There is no reason to believe that the set of design principles for creative and collaborative working is not applicable for other university design courses.

7. Discussion

This paper aimed to answer the following question: *How can design principles be validated in a pragmatic way*? A pragmatic validation approach is necessary because design science research can be so complex that the strategies and objectives of explanatory research are not suitable. Therefore, Van Aken and Van Fenema [26] state that "the validity of design science research outcomes is justified on the basis of descriptive and pragmatic validity".

Based on literature, a pragmatic validation approach has been developed. This approach has been illustrated with a case assessing the evaluation results of a creativity facilitation course based on design principles for creative and collaborative working. This research contributes to DSR an approach to validate a set of design principles in a pragmatic way. It uses a three-step approach, combining (1) evaluating the design solution as a case in practice, (2) qualifying the implementation of the set of design principles, and (3) assessing the validity of evaluation and qualification results. Our pragmatic validation approach ensures methodological thoroughness and maximizes practical relevance. It uses the evaluation theory of Swanborn, the indicative levels described by Veerman and Van Yperen, and the plausible rival explanations method developed by Ropes for assessing the evaluation results.

The pragmatic validation approach has the following limitations. (i) The approach is limited to design science research, which links practice with research findings according to the research-design-development cycle depicted in Figure 1. The validation approach has been tested by only one design solution, namely, a workshop type of course. It would be useful to test the validation approach on more design solutions, such as a Massive Open Online Course (MOOC). (ii) Moreover, the best level of evaluation – the level *causal* – has not been chosen. The *indicative* evaluation level was chosen for the course because the course had been implemented only once in practice. In future research the higher evaluation level *causal* should be chosen, as there is now more data available regarding the impact of the interventions on the outcomes. (iii) Furthermore, the *plausible rival explanations method*, according to Yin [37], covers a wide range of validity aspects and makes them visible, but it did not lead to clear, reliable conclusions.

The case application also has some limitations leading to some recommendations for further research. (i) Course member experiences were measured with a survey. The learning outcomes were only measured at the end of the six courses. In this study the participants were asked to rate what they had learned during the course. This form of self-assessment is weaker than taking measurements before and after training. In future research it might be better to measure the knowledge and behaviours of participants at the beginning and at the end of each course. (ii) The usefulness of the set of design principles was determined by measuring the coherence between the text of the questionnaire and the keywords of the 15 design principles. This coherence can be considered *fair* but there are clearly differences between the learning outcomes 'creative behaviour' and 'creative leadership' in relation to the design principles. Further research can more

explicitly test the course participants' knowledge of the set of design principles as a part of the evaluation and can increase this coherence. (iii) The design principles have been used to develop a creativity facilitation course for the AEC sector in the Netherlands. After implementing and evaluating this course, the design principles were validated. The design principles were also used to develop a course at a university in Brazil. Further research should validate a set of design principles for other sectors, such as the ICT sector, healthcare, and government.

8. Conclusions

The DSR approach delivers, with help of the *research-design-development cycle,* a method to validate a set of design principles in a pragmatic way. The approach consists the following three steps: (1) Evaluating the design solution as a case in practice, (2) Qualifying the implementation of the set of design principles, and (3) Assessing the validity of evaluation and qualification results.

The study leads to the following contributions: (1) A creativity facilitation course – based on a set design of principles – as a solution to a field problem. (2) A survey to measure the learning outcomes of a creativity facilitation course. The method of measuring the variable 'knowledge of creative and collaborative thinking' has been devised by the researcher. The scale of 'creative leadership behaviour' is a modification of a scale from the literature. (3) A plausible rival explanations method, based on Yin [37], to analyse the data and enhance the validity and reliability of evaluation results. The procedure consists of identifying the plausible rivals and then explaining how these rivals can be disqualified. The method covers a wide range of validity aspects and makes them visible, but it did not lead to excellent, reliable conclusions. The method will be more valuable when used during the design of the practice-based research.

Acknowledgements

We would like to thank Cécile Claessen (ABLE BV), Tim Welling (BAM Business School), Janet van Laar (BlueFlow) and Thomas Paauwe (TU/e) for their contributions to this study.

Bibliography

[1] **Amabile TM, Conti R, Coon H, Lazenby J, and Herron M**. Assessing the work environment for creativity. *Academy of Management Journal* 39: p. 1154-1184, 1996.
[2] **Andriessen D, Greve D, and Butter R**. *Methodisch grondig? : dimensies van onderzoek in het HBO : openbare les 10 april 2014*. Utrecht: Hogeschool Utrecht, 2014.
[3] **Baldwin D, Fowles M, and Livingston S**. Guidelines for Constructed-Response and Other Performance Assessments. Educational Testing Service, 2008, p. III, 21 p.
[4] **BAM**. BAM Business School : opleidingsaanbod 2010/2012. Bunnik: BAM Business School, 2010, p. 128 p.
[5] **Denyer D, Tranfield D, and Van Aken JE**. Developing Design Propositions through Research Synthesis. *Organization Studies* 29: p. 393-413, 2008.
[6] **Falletta SV, and Combs WL**. *Evaluating Technical Training: A Functional Approach : evaluation & research*. Alexandria, VA, USA: ASTD Press, 2007, p. 16 p.
[7] **Field A**. *Discovering statistics using SPPS : (and sex and drugs and rock 'n' roll)*. London [etc.]: SAGE, 2009.
[8] **George JM, and Zhou J**. When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *Journal of Applied Psychology* 86: 513-524, 2001.
[9] **Geraets V**. Beïnvloedende factoren voor ondernemingszin bij studenten in het hoger onderwijs. In: *Toegepaste Economische Wetenschappen*. Hasselt: Unversiteit Hasselt, Belgium, 2007, p. VIII, 136 p.
[10] **Goossens H, and Verrue J**. *Instrumenten voor de screening van studenten hoger onderwijs en de observatie van de leeromgeving : ondernemingszin (h)erkennen*. Leuven: CEGO Publishers,, 2004.

[11] **Kirkpatrick DL, and Kirkpatrick JD**. *Evaluating Training Programs : The Four Levels*. San Francisco, CA, USA: Berrett-Koehler, 2010, p. XVII, 372 p.

[12] **Laevers F, and Bertrands E**. *Ondernemingszin (h)erkennen*. Leuven: Centrum voor Ervaringsgericht Onderwijs (CEGO), 2004.

[13] **Noordam H**. Creatief werkgedrag en het DISC Model. Een studie naar de invloed van werkomgeving op creatief werkgedrag. edited by Psychologie. UUFSWCSeO2006.

[14] **Pinheiro GM, and Queiroz Md**. Handstorm: uma prática para o design de moda / Handstorm: a fashion design practice. In: *REDIGE*. Rio de Janeiro, Rio de Janeiro, Brasil: SENAI CETIQT, 2013, p. 13 p.

[15] **Queiroz Md, Volpini JW, and Simão LMP**. Processo criativo: tempo para experimentar / Creative process: time to experiment. *IARA – Revista de Moda, Cultura e Arte* 8: p. 109-120, 2016.

[16] **Romme AGL, and Endenburg G**. Construction Principles and Design Rules in the Case of Circular Design. *Organization Science* 17: 287-297, 2006.

[17] **Ropes DC**. Organizing professional communities of practice. In: *FMG: Research Institute Child Development and Education (CDE)*. Amsterdam: University of Amsterdam, 2010, p. X, 252 p.

[18] **Schön DA**. *Educating the reflective practitioner: toward a new design for teaching and learning in the professions*. San Francisco, CA, USA: Jossey-Bass, 1987, p. XVII, 355 p.

[19] **Segond M, and Borgelt C**. Selecting the Links in BisoNets Generated from Document Collections. In: *Advances in Intelligent Data Analysis IX : 9th International Symposium, IDA 2010, Tucson, AZ, USA, May 19-21, 2010, Proceedings*, edited by Cohen PR, Adams NM, and Berthold MR. Berlin: Springer Berlin Heidelberg, 2010, p. 196-207.

[20] **Simon HA**. *The sciences of the artificial*. [Cambridge]: [M.I.T. Press], 1969.

[21] **Simon HA**. *The sciences of the artificial (3rd ed.)*. MIT Press, 1996, p. 231.

[22] **Swanborn PG**. *Evalueren : het ontwerpen, begeleiden en evalueren van interventies: een methodische basis voor evaluatie-onderzoek*. Amsterdam: Boom onderwijs, 2007.

[23] **Taylor-Powell E**. *Building capacity in evaluating outcomes : a teaching and facilitating resource for community-based programs and organizations*. Madison, WI, USA: University of Wisconsin-Extension, Cooperative Extension, 2008, p. 514 p.

[24] **Van Aken JE**. Management research as a design science : articulating the research products of mode 2 knowledge production in management. *British Journal of Management* 16: p. 19-36, 2005.

[25] **Van Aken JE, and Andriessen D**. *Handboek ontwerpgericht wetenschappelijk onderzoek: wetenschap met effect*. Boom Lemma uitgevers, 2011.

[26] **Van Aken JE, and Van Fenema PC**. Designing and Building Latent Networks for Effective Transboundary Emergency Preparation. In: *Academic of Management Proceedings*Academic of Management, 2014.

[27] **Van Aken JEJ, and Romme AGLGS**. Reinventing the future : adding design science to the repertoire of organization and management studies. *Organization Management Journal* 6: 2009.

[28] **Van Burg JC**. Kwaliteitscriteria voor ontwerpgericht wetenschappelijk onderzoek. In: *Handboek ontwerpgericht wetenschappelijk onderzoek : wetenschap met effect*, edited by Van Aken JE, and Andriessen D. Den Haag: Boom Lemma Uitgevers, 2011, p. p. 145-164.

[29] **Van Burg JC, Romme AGL, Gilsing VA, and Reymen IMMJ**. Creating University Spin-Offs: A Science-Based Design Perspective. *Journal of Product Innovation Management* 25: p. 114-128, 2008.

[30] **Van Gassel FJM**. Dataset thesis Handstorm principles for creative and collaborative working. 4TU Centre for Reserach Data, 2016.

[31] **Van Gassel FJM**. Experiences with collaborative design by constructing metaphoric objects. In: *Proceedings of the Symposium Design Research in the Netherlands 2005, 19-20 May 2005, Eindhoven University of Technology, The Netherlands*, edited by Achten HH, Dorst CH, Stappers PJ, and De Vries B. Eindhoven: Technische Universiteit Eindhoven, 2005, p. p. 63-70.

[32] **Van Gassel FJM**. Handstorm principles for creative and collaborative working. In: *Department Built Environment*. Eindhoven: University of Technology Eindhoven, TU/e, The Netherlands, 2016, p. 221 p. Availabele by https://dx.doi.org/10.6100/IR842445.

[33] **Van Luijtelaar LJHB**. The Bright and Dark Side of Creativity and Innovation. In: *Department Technology Management*. Eindhoven: TU Eindhoven, 2010, p. XI, 74 p.

[34] **Van Sele A**. Cognitief welzijn bij bedienden: een onderzoek naar de triple match hypothese. In: *Faculteit Psychologie en Pedagogische Wetenschappen*. Gent: Universiteit Gent, 2009, p. VI, 80 p.

[35] **Veerman JW, and Van Yperen T**. Wat is praktijkgestuurd effectonderzoek? In: *Zicht op effectiviteit : handboek voor praktijkgestuurd effectonderzoek in de jeugdzorg*, edited by Van Yperen TA, and Veerman JW. Delft: Eburon, 2008, p. 368 p.

[36] **Verschuren PJM, and Hartog RJM**. Evaluation in design-oriented research. *Quality & Quantity* 39: p. 733-762, 2005.

[37] **Yin RK**. *Case study research : design and methods*. Thousand Oaks, CA, USA: Sage, 2003, p. XVI, 179 p.

[38] **Yin RK**. Rival explanations as an alternative to reforms as "experiments". In: *Validity and social experimentation : Donald Campbell's legacy*, edited by Bickman L. Thousand Oaks, CA, USA: Sage, 2000, p. p. 239-266.