

Tailored implementation in Emergency Medical Services: a validation study

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Samenvatting

Titel: Op maat gemaakte implementatie op de ambulance: een valideringsstudie

Inleiding : Adherentie van evidence-based klinische richtlijnen is niet vanzelfsprekend bij ambulance-professionals. Een theoriegerichte, op maat gemaakte implementatiestrategie, kan de eerste stap zijn om adherentie te doen toenemen. De innovatie-contingentie theorie van Van Linge is de basis van dit onderzoek. Drie bestaande diagnostische instrumenten voor op maat gemaakte implementatie zijn gebaseerd op deze theorie en meten de waargenomen kenmerken van de innovatie, de organisatie en de innovatie-attitude van de ambulanceprofessionals.

Doel: Het aanpassen en valideren van drie bestaande diagnostische instrumenten voor op maat gemaakte implementatie, als de eerste stap om het succes van implementatie en het trouw volgen van evidence-based klinische richtlijnen in de context van ambulancediensten te vergroten.

Onderzoeksvraag: Wat is de inhoudsvaliditeit van drie gevalideerde en bestaande instrumenten voor op maat gemaakte implementatie, die zijn aangepast aan de context van ambulancediensten?

Methode: Een kwantitatief en beschrijvend design met experts om instrumenten aan te passen en te valideren in twee rondes.

Resultaten: In totaal zijn er 45 items gevalideerd door vier experts in de eerste ronde en vijf experts in de tweede ronde. Na de eerste ronde zijn er 21 items aangepast, drie verwijderd en vier toegevoegd. Na de tweede ronde zijn er 34 van de 46 items inhoudelijk valide gebleken met een item-inhoudsvaliditeit van .78 en hoger (I-CVI). De schaal-inhoudsvaliditeit (S-CVI/ave) van de drie instrumenten is excellent met scores van .92, .98 en .97.

Conclusie : Deze inhoudsvaliditeitsstudie van diagnostisch instrumenten binnen ambulancediensten is de eerste stap in het ontwikkelen van gevalideerde instrumenten binnen implementatietrajecten bij ambulancediensten.

Aanbevelingen: Een derde ronde met experts wordt aanbevolen om de 12 niet-valide items aan te passen en te beoordelen, rekening houdend met de subschalen. Het bepalen van betrouwbaarheid, bruikbaarheid en voorspelbaarheid van de aangepaste instrumenten is de volgende stap in het valideringsproces.

Trefwoorden: validering, op maat gemaakte implementatie, ambulancedienst, inhoudsvaliditeit, innovatie-configuratie model

Abstract

Title: Tailored implementation in Emergency Medical Services: a validation study

Background: Adherence to evidence based clinical practice guidelines (EBCPG) is not self-evident for emergency medical care (EMS) professionals. Theory-based tailored implementation may be the first step to improve the adherence to EBCPG. The innovation-contingency theory of Van Linge is the foundation of this study. Three diagnostic instruments are developed, based at this theory, taking into account the perceived features of the innovation, the organization and the innovation-attitude of the professionals.

Aim: To adapt and validate three existing diagnostic instruments for tailored implementation, as a first step to enhance the success of implementation and adherence to EBCPG in the context of EMS.

Research question: What is the content validity of three validated, diagnostic instruments for tailored implementation, that are adapted to the context of EMS?

Method: A two-round quantitative, descriptive design with experts to adapt and validate the instruments.

Results: A total of 45 items were validated by four experts in the first round and five experts in the second round. After the first round, 21 items were revised, three were removed and four were added. After the second round, 34 items of the 46 items were judged to be content valid with an item content validity index (I-CVI) of .78 and more. Scale content validity (S-CVI/ave) is excellent with scores of .92, .98 and .97.

Conclusion: This study of content validity of diagnostic instruments for use with EMS professionals is the first step in developing validated instruments in implementation processes in EMS.

Recommendations: A third round with experts to adapt and reassess twelve content invalid items is recommended taking into account the subscales within the instruments.

Determining reliability, usability and predictability of these instruments, is the next step in the validation process.

Keywords: validation, tailored implementation, Emergency Medical Services, content validity, IC-model

Introduction

A challenge in many healthcare organizations is the implementation of evidence based clinical practice guidelines (EBCPG). Guidelines have the potential to improve healthcare and patient outcomes but adoption of these guidelines by healthcare professionals is inconsistent. (1) A gap remains between evidence based guidelines and evidence based practice.(2-5) Adherence to EBCPG by Emergency Medical Service (EMS) professionals is not self-evident. Studies have shown that EMS professionals are not compliant in treating acute chest pain according the evidence based guidelines.(6-8) Administering aspirins is low rated. Franschman et al. (2009) found a low adherence to guidelines for pre-hospital endotracheal intubations in patients with severe traumatic brain injury(9). Berben et al. (2011) found that the national EMS analgesia protocols in the Netherlands were poorly used.(10) Adherence to guidelines of positioning electrodes by defibrillating patients by EMS professionals was low.(11)

Improving the adherence to EBCPG may start at the beginning of the implementation process. Active implementation is needed to encourage the uptake of guidelines . (12) Evidence suggests that for the implementation of innovations no best strategy exists. (13,14). Baker et al. (2010) stated that the most important barriers must be identified and the most likely effective implementation strategy should be selected to influence the success of improvement strategies (15). To enlarge the adherence to EBCPG, a tailored strategy of implementation can be helpful to achieve improvement, after identification of barriers. In order to overcome these barriers, a theory based tailored implementation is needed to improve the adoption of an innovation like an EBCPG.(2,12,16) This theory has to pay attention to the complexity of an implementation process and all elements of an organization that are essential to the success of an implementation. (17)

A theory that takes account of the complexity of an organization is the contingency theory. This theory states that there is no best method for implementation, for every organization acts in a specific context(18). A model that takes account of this context is the innovation-contingency model (IC-model) of van Linge. (19). This model (figure 1) assumes that successful implementation demands a congruity between the characteristics of the innovation and the characteristics of the context. The discrepancy between requisite and existing condition can be bridged by tailored implementation strategies.(14)

Figure 1

The IC-model depends on three baselines: 1) configuration approach, 2) stratification of systems and 3) strategy-contingency approach. Within this first baseline, the IC-model describes four configurations, based on two dimensions: 1) team-oriented, 2) development oriented, 3) regulation-oriented and 4) goal-oriented. (figure 2). The second baseline of the IC-model is stratification of these systems in three layers: operational level, espoused values and basic underlying assumptions. The third baseline of the IC-model is the strategy contingency approach. The IC-model demands a fit between the characteristics of an organization and the innovation. Tailored strategies can be applied to overcome barriers (misfits), taking into account the three layers within the organization. The IC-model can be used as a basis for tailored implementation, using two instruments: one about the characteristics of the innovation (WIK) and one about the characteristics of the organization (WAK).

Figure 2

Innovations may not succeed because adoption of this innovation is suboptimal. For a successful implementation, the implementation strategy should take into account the innovation-attitude of the professionals. Rogers' diffusion of innovations theory states, that an innovation, that is perceived as having greater relative advantage, trialability, observability and compatibility along with less complexity, will be adopted more rapidly than other innovations(20). These subdomains can be measured using the innovation-attitude questionnaire.

In order to increase the success of implementation of innovations in EMS, a diagnostic instrument to expose the (mis)fits of an organization and an innovation, would be helpful. No diagnostic instrument for implementation of innovations within the context of EMS is available yet. Adaptation of the previously mentioned instruments and validating these adapted instruments could be the first step to enhance the success of implementation of evidence based practice guidelines in the context of EMS. (21,22)

Problem statement

To improve the success of implementation and the adherence to EBCPG in EMS, tailored implementation could be useful. Theory-based diagnostic instruments like the WIK, WAK and the innovation-attitude questionnaire are available but not validated for the context of EMS.

Aim

To adapt and validate three existing diagnostic instruments for tailored implementation, as a first step to enhance the success of implementation and adherence to EBCPG in the context of EMS.

Research question

What is the content validity of three validated, diagnostic instruments for tailored implementation, that are adapted to the context of EMS?

Methods

Design

This study has a quantitative, descriptive design. A content validation study, that uses an expert panel. Content validity was guided by the process that is described by Lynn using a modified two-stage process and has been evaluated by Polit et al.(23,24) The first stage, the developmental stage, has been modified. This stage normally includes identifying (sub)dimensions, generating items and assimilating these items into useable form. This study uses existing instruments. In the second stage, the judgment-quantification stage, the adapted items and instruments were judged by an expert-panel, using the item content validity index (I-CVI) and the Scale content validity index (S-CVI/ave). The I-CVI is the proportion of content experts giving an item a relevance rating of 3 or 4. The S-CVI/ave is the average I-CVI's for all items of the scale(24). (figure 3).

Figure 3

Instruments

Three existing instruments identify three main conceptual domains of influencing factors for implementation (*i.e. perceived features of the innovation (WIK), perceived features of the organization (WAK) and the innovation attitude questionnaire*).

The WIK and WAK are distracted from a 24-item Observed Team Configurations Scale of Van Linge by Timmermans et al(25). This instrument represents the four basic team configurations as defined by Van Linge, using a five-point Likert scale about (dis)agreement. The instruments have four subscales : 1) team-oriented configuration (α .91), 2) development-oriented configuration (α .89), 3) regulation-oriented configuration (α .87)and 4) goal-oriented configuration(α .76) (18,19,25)

The innovation-attitude questionnaire is a Dutch version of the Perceived Innovation Characteristics questionnaire using a five-point Likert scale about (dis)agreement.(26) The reliability of the subscales in this questionnaire is measured by Buwalda(27): 1) relative advantage (α .86) 2) trialability (α .87) 3) observability (α .80) 4) compatibility (α .87)and 5) complexity (α .76). Criterion validity of this instrument is shown by Hafsteindottir et al. (28).

Sample and participants

The expert panel consisted of national experts of EMS who met the inclusion criteria: an academic background, knowledge of or experience in implementation and a working experience of at least two years at an EMS. The experts were approached by the first author. A total of six experts was eligible as a part of the expert panel. All eligible experts met the inclusion criteria and consisted of two doctors, a staff member of the national institute for ambulance care, a former manager of an EMS, and two ambulance nurses. Experts came from all around the Netherlands. At least three experts were needed according to Lynn, to determine the content validity. (23,29) Contact between experts and investigators is minimized to avoid information bias.

The experts were asked individually by email to assess the instruments. They were asked to assess each item on predictive value of implementation success in EMS. In a letter that was sent with the instruments, the goal of this study was explained and the essence of the collaboration of the experts was explained. They could call or email the first author anytime they wanted if there were questions. In the email, a hyperlink was included to a program "Thesistools online enquêtes" where the experts could assess the three instruments. No patients are involved in this study, so no METC-declaration was needed.

Data-collection

In the first round, individual items were evaluated by the experts. Relevancy was indicated on a four-point Likert scale: 1 = this item is not relevant; 2 = this item needs major revisions to be relevant; 3 = this item is relevant, but needs minor revisions; 4 = this item is relevant. The relevancy was dichotomized in 'not relevant (score 1 or 2)' and 'relevant' (score 3 or 4). In this round, four experts rated all items and according to Lynn and Polit, all experts must rate an item 'relevant', to establish content validity. (23,24,30) (table 1) This means that only items that scored a 3 or 4 by all four experts have an I-CVI of 1.0. Items with lower I-CVI will be removed or adapted. Adaption was based on the feedback and suggestions of the experts, the opinion of the investigators and the literature.

In the second round, the revised and added items were assessed by the experts on a four-point Likert scale for their relevancy: 1=irrelevant; 2=somewhat relevant; 3=quite relevant; 4=highly relevant.(31) The relevance was again dichotomized in 'not relevant' and 'relevant'. The I-CVI was computed and to establish content validity, all five experts must rate an item as relevant, according to Lynn. (23) (table 1) However, according to Polit(32), who evaluated

the CVI and made recommendations, an I-CVI of .78 or more would fall into the range considered excellent, using five experts or more. The S-CVI was computed using the averaging approach (S-CVI/ave) according to Polit.(24)

Table 1

Data-analysis

Data were analyzed by the principal investigator (RvL) and the first author(TB) after the first round. Items were removed or added, if consensus was reached by the investigators. Items were revised in an iterative way, considering the theoretical framework of the instruments and the context of EMS. After consensus was reached, items were definitive revised. If an I-CVI did not meet the cut-off point of 1.0, discussion was indispensable. All items were discussed by the investigators and judged, until consensus was reached. After the second round, items were judged, using the I-CVI. Items should have an I-CVI of .78 or more with five or more experts to have excellent content validity.(32) Items with an I-CVI of <.78 were removed. The goal for S-CVI is .90 to be excellent, but should be at least .80 to have an acceptable content validity. (23,24)

Results

Main results

The first round was during February and March 2014. Four of the eligible six experts responded. Two experts did not respond. The second round was during the end of April and the beginning of May 2014. A total of 5 experts of the eligible six judged the revised and added items. For the experts could respond anonymously, it is unknown why experts did not respond and it is unknown which of the experts did respond.

WIK

From the 12 items belonging to the WIK, six items did not meet the 1.0 cut-off point. These items were revised, based on the feedback and suggestions of the experts. One item that did have an I-CVI of 1.0 was revised, based on the suggestions of the experts. No items were eliminated and three items were added. Finally 10 items of the WIK were (re)judged. After the second round, 13 out of all 15 items were rated 'relevant' with an I-CVI of .78 or more. The S-CVI/ave of the adapted WIK after removing the invalid items is .92. (table 2,3)

The original WIK consists of four configurations. The feedback of the experts related to the development-oriented configuration, was ground to adapt this configuration into tailored-care-configuration. Deviation from a protocol in a responsible manner to achieve patient-related goals, is a valuable addition to cover the context of development-oriented configuration. In the EMS-context, development is, according to the experts, associated with tailored care and deviation from protocols to achieve this goal.

Education and training, ergonomics, and safety are important items and should be added as items to the WIK according the suggestions of the experts and the opinion of the investigators. The investigators have determined that these items can be related to human resources (HR). The dimensions of HR are internal and controlled. Internal for professionals are the center of this configuration and controlled for the organization is responsible for facilitating the conditions of HR. At last, the revised WIK, exists of 5 configurations. (figure 4)

Figure 4

WAK

The WAK consisted of 12 items, of which five items did not meet the cut-off point of 1.0 after the first round. Three of these items were revised, based on the feedback and suggestions of the experts. (see also table 1) Two items were not revised, despite an I-CVI of .75. No feedback or suggestions was given by the experts, while the opinion of the investigators was that these two items were very relevant. No items were added or eliminated. One item with an I-CVI of 1.0 was revised, based on the suggestions of the experts. Finally four items were (re)judged in the second round. After the second round, nine out of 12 items were rated 'relevant' with an I-CVI of .78 or more. The adapted WAK has an S-CVI/ave of .98 after removing the invalid items. (table 2,3)

The original WAK consists of the same four configurations as the original WIK. The feedback and suggestions of the experts, did not lead to an adaptation of these configurations within the WAK list.. In all items 'unit' is substituted by 'organization'. One item was revised based on the feedback of the experts, despite an I-CVI of 1.0. In the second round, the I-CVI decreased to .60. Therefore, the original item will remain.

Innovation-attitude

The innovation-attitude questionnaire consisted of 21 items. From these items, 11 items did not meet the cut-off point of 1.0. Of these 11 items, two items were eliminated and one item has not been revised, despite an I-CVI of .50. The feedback of the experts suggested an interpretation bias of this item. Three items with an I-CVI of 1.0 were revised based on the feedback of the experts. One item with an I-CVI of 1.0 was eliminated because of an overlap with another item according to the judgment of the investigators and the experts. One item was added based on the suggestion of the experts. In the second round, 11 items were (re)judged. After the second round, 11 out of 19 items were rated 'relevant' with an I-CVI of .78 or more. The adapted innovation- attitude questionnaire has an S-CVI/ave of .97 after removing the invalid items. (table 2,3)

The original innovation-attitude instrument contains five subdomains. These subdomains remain in the adapted instrument. One item about safety was added to the subdomain of relative advantage. The removed items were a part of the subdomains complexity, compatibility and relative advantage.

Table 2

Table 3

Discussion

Statement of principal findings

The aim of this study was to adapt and validate three existing diagnostic instruments for implementation, as a first step to enhance the success of implementation of EBCPG in the context of EMS. After two rounds of consulting an expert panel, three existing instruments have been adapted. Of all 46 items, 34 items were judged 'relevant' with an I-CVI of .78 or more. This implicates, according to Lynn, that 12 items should be eliminated or further investigated.(23) After eliminating the 12 invalid items, the S-CVI/ave are excellent with scores of .92, .98 and .97.

Validity

To increase internal validity, contact between the investigators and the experts was limited as well as the experts mutually. Experts were now able to judge the instruments without information bias. It is possible that the experts did not understand their task the right way,

which might have led to response bias. Items were only revised, added or eliminated after the investigators reached consensus which improves the internal validity. Generalizability of the instruments is limited to EMS in the Netherlands for the Dutch EMS-professionals are homogenous. Compared to professionals of other countries, they are heterogeneous. The educational level of EMS-workers in the Netherlands for example differs from other countries as well as the allocation of duties at an ambulance.

Reliability

The adaption of three instruments, made a shift in the subdomains of these instruments for items are added, removed and revised. The subdomain HR-oriented configuration for example was added at the WIK. Revised items are judged at item-level in this study and no internal consistency has been tested. Construct validity is not tested and remains uncertain for the degree to which it measures the underlying constructs in the revised instruments. After removing 12 items, the S-CVI/ave may improve, but a shift in subscales of the instruments is inevitable. The subscale complexity in the innovation-attitude questionnaire for example would lose 6 of its 7 items, which influences the construct validity and reliability of this instrument.

Strengths and limitations

This validation study has contributed to gaining and understanding in what is relevant at innovation-, organization- and innovation-attitude level as predictors of implementation success in the context of EMS. This understanding is the first step in developing a reliable and valid diagnostic instrument for tailored implementation in the context of EMS in the Netherlands. However, this study has some limitations.

The low number of eligible experts is remarkable. Finally only six experts were eligible for this study, and not all of them responded. The experts seemed to be homogeneous but for the backgrounds really differ a lot, it might be a more heterogeneous group. This might have influenced the different judgments of the items. The inclusion criteria to have an academic background was probably the main reason that the number of experts was low. A higher number of experts would have led to more feedback and suggestions.

The high number of items that did not meet the cut-off point of .78 is striking. Possible causes are insufficient operationalization of the underlying construct, the absence of construct specification to the experts or biased experts. A stronger panel and a third round is advised by Lynn and might lead to a higher number of content valid items(23).

Comparison other studies

This study is the first study to measure I-CVI and S-CVI of these three instruments. Several barriers to successful implementation of EBCPG in EMS are described. Insufficient training, lack of common governance and lack of available resources are obstacles for successful implementation in EMS.(22). In this study, some feedback of the experts was aimed at training and education. Items about training and education were added and appeared to have an I-CVI of 1.0. No suggestions or feedback about a lack of common government was given. The main reason for that might be the different governmental organization in the Netherlands, compared to other countries. In the Netherlands, all EMS's are commonly arranged and have shared protocols. Human resources are a part of available resources. As described before, a lack of resources may be an obstacle for successful implementation. According to the feedback of the experts, this configuration is added at the WIK. It can be concluded that most barriers for successful implementation in EMS as described by Lang et al, are recognized by experts in the Netherlands and are used in the adapted instruments(22).

Wensing et al. stated that it is unclear how to identify important determinants the best way and how to match implementation interventions to those determinants(33). They refer to a meta regression analysis of Baker et al. (15) and concluded that most tailored interventions studies are not clear about for example explicit utilization of a theory when developing the intervention. Utilization of a theory when developing an intervention is quite explicit. The IC-model offers different interventions, based on the different configurations and the three layers. Once the instruments are used, tailoring can be applied, using tailored interventions, based on the IC-model.

Clinical utility

The adapted and validated instruments are in potential, in the future, usable for tailored implementation in EMS. It offers innovators in EMS a tool to discover barriers to successful implementation. Using these instruments in an implementation process, tailored interventions can be applied in order to overcome barriers.

Conclusion

This study delivers a first step to adapted and validated diagnostic instruments to map barriers and facilitators in EMS. These instruments take into account the features of the innovation, the department and the innovation-attitude of the professionals. A total of 34 items from the adapted instruments is content valid with an I-CVI of .78 or more. Removing the 12 content invalid items leads to an excellent S-CVI/ave. Concurrently this removal influences the construct validity of the instruments.

Recommendations

For 12 items remain content invalid, these items, and therefore the instruments, need to be evaluated again in order to obtain sufficient content validity at item level. This evaluation should take into account the subscales within the instruments. A third round with an expert panel would help to adapt and judge the content invalid items. The present experts might be biased for they have judged the items twice already. Other experts should be recruited.

The adapted instruments must be submitted to participants, to test reliability and internal consistency.

Furthermore, these instruments should be tested in an implementation process. The usability should be tested and the predictability of implementation success of these instruments for the context of EMS.

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Tables

Table1: proportion of experts (above the line) whose endorsement is required (according to Lynn) to establish content validity beyond the .05 level of significance (23)

Number of experts	Number of experts endorsing item or instrument as content valid								
	2	3	4	5	6	7	8	9	10
2	1.00								
3	.67	1.00							
4	.50	.75	1.00						
5	.40	.60	.80	1.00					
6	.33	.50	.67	.83	1.00				
7	.29	.43	.57	.71	.86	1.00			
8	.25	.38	.50	.63	.75	.88	1.00		
9	.22	.33	.44	.56	.67	.78	.89	1.00	
10	.20	.30	.40	.50	.60	.70	.80	.90	1.00

Table 2: Revised, added and eliminated items in numbers, including S-CVI

	Total items original instruments	Items valid with I-CVI of 1.0 after 1 st round judged by four experts (Lynn and Polit)	Revised items	Added items	Eliminated items	Total items adapted instruments	Items valid with I-CVI of .78 or more after 2 nd round judged by five experts (Polit)	S-CVI/ave after removing invalid items
WIK	12	6	7	3	-	15	13	.92
WAK	12	7	4	-	-	12	9	.98
Innovation-Attitude	21	10	10	1	3	19	12	.97
Total	45	23	21	4	3	46	34	-

WIK=perceived features of the innovation; WAK=perceived features of the organization; I-CVI=item content validity index; S-CVI= scale content validity index, average approach

Table 3: revised, added and eliminated items descriptive

Original item (WIK)	I-CVI (1 st round)	Feedback and suggestions experts	rationale	Revised item	I-CVI (2 nd round)
1)The way of using this innovation is fixed in a procedure, standard or protocol	1.0	<ul style="list-style-type: none"> Just like the National protocol ambulance care, protocols are fixed Because of the size of the group 	No adaptation of this item	NA	NA
2)The results that must be achieved by this innovation are concrete and measurable	1.0	<ul style="list-style-type: none"> Sometimes hard in ambulance care. Maybe formulate this item less concrete Legally and morally important 	No adaptation of this item	NA	NA
3)The way of using this innovation must be adjusted by the users constantly	.50	<ul style="list-style-type: none"> Alignment is not necessary if an innovation is applied in a protocol. Within the context of ambulance-care, it is hard because they work solistic 	Ambulance workers work solistic. At a scene they can only ask the opinion of their colleague. Adjusting is most of the time impossible because of the urge to react. Adjust previously or evaluate afterwards instead of adjust constantly.	The way of using this innovation should be adjusted previously and evaluated afterwards by the users.	.80
4)The way of using this innovation is different every single time	.00	<ul style="list-style-type: none"> Alternation is not possible per innovation It does not fit in ambulance-care, for uniformity is very important 	Uniformity is important according the feedback. Deviation can be made, but in a responsible way. If it is an advantage for the patient, deviation should be possible.	The way of using this innovation means, that the users may deviate from protocols in a responsible way	.40
5)This innovation is meant to make our processes more identical and repeatable.	1.0	<ul style="list-style-type: none"> I would apply the terminology identical and repeatable to uniform. Repeatable is a terminology that is not common in ambulance care 	Within the regulation oriented configuration and the espoused values layer, standard care is a policy goal. Uniformity is part of that	This innovation is meant to make our processes more uniform	1.0

6)This innovation is meant to realize better patient outcomes	1.0	<ul style="list-style-type: none"> Better care does not equal better patient outcomes 	We do not agree the feedback. Better care should lead to better patient outcomes. Outcomes could be replaced by care. But outcomes are better measurable in comparison to care. No adaptation of this item.	NA	NA
7)This innovation is meant to improve the collaboration	.50	<ul style="list-style-type: none"> Collaboration between ambulances, but chain partners as well Because of the composition of the team 	Not all experts gave feedback. Nevertheless, collaboration with chain partners is very important within ambulance-care.	This innovation is meant to improve the collaboration as a team and with chain partners	1.0
8)This innovation is meant to respond to changes of the patient faster and better	.75	<ul style="list-style-type: none"> This is not the main goal 	Responding faster and better to the changes is not the main goal. Patient care is the goal within this item. Within the goal-oriented configuration, tailored care is a goal.	This innovation is meant to give the patient tailored care.	.80
9)This innovation evokes an efficient and established process to me	1.0	<ul style="list-style-type: none"> Handling according protocols! The formulation might be adjusted in the direction of the way of innovation 	Bureaucracy can be thrilling to many. It is the intention of this item. No adaption of this item, for the I-CVI is 1.0	NA	NA
10)This innovation evokes purposeful thinking and acting to me	1.0	<ul style="list-style-type: none"> The formulation might be adjusted in the direction of the way of innovation 	The experts feedback is not clear to us. Because of I-CVI of 1.0, no adaptation of this item	NA	NA
11)This innovation evokes a firm collaborating group or team to me	.75	<ul style="list-style-type: none"> Because of changing team constructions 	At an ambulance, teams are constantly changing.	This innovation evokes a firm collaborating team to me	.20
12)This innovation evokes	.75	<ul style="list-style-type: none"> No comments 	Movement is associated with literally	This innovation evokes a change	.80

Original item (WAK)	I-CVI (1 st round)	Feedback and suggestions experts	Rationale	Revised item	I-CVI (2 nd round)
movement and adaption to me.			movement of a body part. This item might be formulated less abstract	of my daily activities to me	
13)In this unit, the work is organized by procedures, protocols and standards	1.0	<ul style="list-style-type: none"> For the benefit of the worker as well as the patient It is a common benefit if a protocol is being supported broad 	No adaptation of this item, for the I-CVI is 1.0	In this organization, the work is organized by procedures, protocols and standards	NA
14)In this unit, the work is organized by planning and controlling results	1.0	<ul style="list-style-type: none"> Work on an ambulance cannot be planned. One does not know when to do something. Control of results is not common practice. 	No adaptation of this item. The I-CVI is 1.0	In this organization, the work is organized by planning and controlling results	NA
15)In this unit, the work is organized by consultation and reconciliation between workers	1.0	<ul style="list-style-type: none"> Consultation within the borders of the protocol 	Feedback and evaluation is important. Also within the team-oriented configuration. No adaptation of this item	In this organization, the work is organized by consultation and reconciliation between workers	NA
16)In this unit, the work is organized by responding flexible at situations and developments	.75	<ul style="list-style-type: none"> Protocol is protocol. New insights will only be widely accepted, if they are caught in a protocol Within the framework of a protocol 	It is clear that the protocol is a guidance in EMS. Deviation from protocols for the patients best is possible, but should be well documented and justified.	In this organization, deviations from protocols are made in a responsible way	1.0
17)In this unit, the policy is aimed at enlarging the unambiguously and predictability of care/work processes.	.75	<ul style="list-style-type: none"> No comments 	Within the regulation oriented configuration, supply-oriented care is an important theme. On the other hand, within EMS, question-oriented care is its core business. Standard care fits into protocols that are important in EMS. No adaptation of this item.	In this organization, the policy is aimed at enlarging the unambiguously and predictability of care/work processes.	NA
18)In this unit, the policy is designed to improve effectiveness,	.50	<ul style="list-style-type: none"> Protocols are leading Most medical managers propagate protocols and 	This item is very abstract for ambulance workers. This item is part of goal-oriented	In this organization, the policy is designed to improve goal-oriented	.40

productivity or outcome		not the latest views until these views are generally accepted and are caught in a protocol	configuration, in which goal-oriented working is a major theme	working	
19)In this unit, the policy is designed to improve the quality of (care/work) processes	.75	<ul style="list-style-type: none"> • Continuous process • Most medical managers propagate protocols and not the latest views until these views are generally accepted and are caught in a protocol 	Three experts rated this item as very relevant, only one person as not relevant. The feedback of the expert, seems to be feedback at this item and not at the relevance of this item. The investigators think this item is very relevant. So No adaptation of this item.	In this organization, the policy is designed to improve the quality of (care/work) processes	NA
20)In this unit, the policy is designed to develop new ways of care	.50	<ul style="list-style-type: none"> • It is not a goal on itself • Add: and treatment 	Treatment is a part of the work in EMS. To add that item is absolutely relevant. It differs from the work of a nurse in for example a general hospital.	In this organization the policy is designed to develop new ways of care and treatment	.80
21)In this unit, we together find it important that rules and procedures are strictly observed	1.0	<ul style="list-style-type: none"> • In the interest of the patient organization and employees • Add protocols and guidelines? • 	For protocols and guidelines are that important in the context of EMS, they will be added. The context of this item remains.	In this organization, we together find it important that rules, guidelines, protocols and procedures are strictly observed	NA
22)In this unit, we together find it important that concrete results are being delivered	1.0	<ul style="list-style-type: none"> • Make it measurable • Good and save care 	No adaptation of this item	In this organization, we together find it important that concrete results are being delivered	NA
23)In this unit we together find it important that there is loyalty and mutual trust.	1.0	<ul style="list-style-type: none"> • Trust is, but loyalty has its limits 	Apparently has loyalty its limits. Adaption is justified	In this organization, we together find it important that there is mutual trust and a certain way of loyalty	.60

24)In this unit, we together find it important that there is involvement in innovation and development	1.0	<ul style="list-style-type: none"> Not for everyone, there may be followers as well 	No adaptation of this item	In this organization, we together find it important that there is involvement in innovation and development	NA
Original item (Innovation-attitude)	I-CVI (1 st round)	Feedback and suggestions experts	Rationale	Revised item	I-CVI (2 nd round)
25)This innovation is, according to myself, hard to use.	.50	<ul style="list-style-type: none"> If there is an agreement about an innovation, it should be applied by everyone 'Apply' instead of 'to use'. 	This item is part of the subdomain complexity. Other terminology covers this item better	I think that this innovation will be hard to apply for me	.40
26)It is hard for me to overlook how I should do my work with this innovation	.75	<ul style="list-style-type: none"> The formulation resembles item 1 very much The implementation requires more attention 	Item 1 is: This innovation will be hard to apply for me It does resemble this item. Enough items remain within the subdomain complexity, so this item could be eliminated.	eliminated	NA
27)The use of this innovation will be a huge mental effort	.75	<ul style="list-style-type: none"> This is the responsibility of the educational program One should invest time to see what is changed, but mental strain?? 	The terminology of mental does not fit in EMS-care.	The use of this innovation will be a huge effort	.80
28)The use of this innovation will be frustrating	.50	<ul style="list-style-type: none"> Agreement is agreement! Might be better to be more specific about the term frustrating. When is something frustrating? An innovation causes actually better care! 	The terminology 'frustrating' can be defined clearer. The investigators choose the term irritation, for that terminology might be clearer and more palpable.	The use of this innovation will cause irritation to me	.60
29)I think this innovation is hard to understand	.50	<ul style="list-style-type: none"> Than you should look at the justification But must be explained better 	This item seems to be very relevant as a predictor of implementation success. The feedback of the experts suggests a reaction at this item and not at the	NA	NA

			relevance of this item. Maybe these experts are top-down oriented. No adaptation of this item		
30)The way this innovation works is hard to explain to others	.75	<ul style="list-style-type: none"> • Must be better trained • Do you mean 'to complex'? Or the lack of a clear training or education? • This will make implementation harder 	The feedback suggests that this item is not clear enough. Adding terminology about complexity, will make it probably more clear	The way this innovation works is so complex, that it is hard for me to explain it to others.	.60
31)This innovation demands a lot of coherence and collaboration	.75	<ul style="list-style-type: none"> • Collaboration with other chain partners • This might be the reason that effectiveness is suboptimal 	Chain partners are indispensable in EMS as stakeholders. Less effectiveness might be a potential problem if coherence of an innovation takes too much time and effort	This innovation demands so much coherence with others/chain partners, that it defeats the effectiveness	.60
32)I have/expect enough possibilities to try out this innovation	1.0	<ul style="list-style-type: none"> • 'Try out' sounds more like 'to experiment' • Do you mean experiment? • If there are no opportunities, there is no urge for innovation 	Try out does feel like an experiment. An innovation can only be useful if there are enough opportunities to apply an innovation. Training and education (experiment) comes back in another item	I expect to meet enough situations in which this innovation can be applied	1.0
33)I have/expect enough time to try-out this innovation	1.0	<ul style="list-style-type: none"> • First in a skills lab/education 	Education must return in this instrument. It is an important issue in EMS. In the subdomain of trialability, and in the subdomain of compatibility. It is important that an organization facilitates enough education and training.	NA	NA
34)I have/expect enough time to try out this innovation my way	.5	<ul style="list-style-type: none"> • Protocols in ambulance care do not give any space for 'my own way'. • Not anyone's own way, but uniformity 	Most of all the term 'my way' does not fit in EMS. Deviation of a protocol is possible if well justified. One should get in control of	I have/expect enough time to get in control of this innovation	.80

		<ul style="list-style-type: none"> • My way?! If a protocol says to do it in a certain way, you cannot do it another way? • This item seems to resemble another item 	an innovation, try it his own way in an educational environment. And after that the innovation can be applied in practice 'in his own way', but with a preset purpose.		
35)This innovation is compatible with our current way of healthcare	1.0	<ul style="list-style-type: none"> • Should fit • Should fit in our current way of work 	Change of terminology will make this item more relevant	This innovation fits in our current way of healthcare	1.0
36)This innovation is compatible with our current way of decision-making and communication	1.0	<ul style="list-style-type: none"> • The distance between the innovation and the current standard influences the implementation. How more far, how more difficult. • This has to be 	Clear feedback. No adaptation of this item	NA	NA
37)This innovation is compatible with our current ways of provision of information and reports	1.0	<ul style="list-style-type: none"> • This has to be! 	Clear feedback, no adaptation of this item	NA	NA
38)This innovation is compatible with our current knowledge, skills and attitudes.	1.0	<ul style="list-style-type: none"> • Innovation is often new and does not fit in to present knowledge. Education is relevant. • The lack of knowledge should be trained 	Education comes back again and again in the feedback and must be added to this item to be more relevant. The context of this item remains.	This innovation is compatible with our current knowledge, skills and attitudes, if necessary by training and education	NA
39)This innovation fits within the (policy)goals of my department	1.0	<ul style="list-style-type: none"> • It is hard to judge the policy goals per department. Organization might be better • I would substitute department for organization 	EMS are flat organizations with less departments. The next item in the list is an item about the organization. The item about department could be eliminated because of the overlap.	Eliminated	NA
40)The innovation fits within the (policy) goals of my organization	1.0	<ul style="list-style-type: none"> • Otherwise, the innovation is useless 	No adaptation of this item. It	NA	NA
41)This innovation fits into my personal values and goals	1.0	<ul style="list-style-type: none"> • It should give a good feeling 	No adaptation of this item	NA	NA

42)This innovation will increase the quality of care	1.0	<ul style="list-style-type: none"> • This is the main goal • And safety! • Otherwise the innovation has no benefit 	Safety is a major theme in EMS. Safety for the patient as well as safety for the workers. Safety should return in another item, within the subdomain of relative advantage. No adaptation of this item	NA	NA
43)By this innovation, working pleasure will increase	.75	<ul style="list-style-type: none"> • Working pleasure is not a goal itself • Working conditions? • It might cost time to get this feeling 	Working pleasure sounds a bit old-fashioned. It might be better to broaden this item.	By this innovation, the working conditions will improve	.60
44)By this innovation, productivity will increase	.5	<ul style="list-style-type: none"> • Productivity? One can treat only one patient at a time. We cannot treat two patients instead of one • Productivity is not a purpose! 	Productivity is no issue for ambulance-workers. It is for the management. Efficient might be a better term and covers not only productivity but also for example: competent, cost-effective, effective, timesaving, considerate and simplified .	By this innovation I can help a patient more efficient	1.0
45)Because of this innovation, men will be able to work faster	.75	<ul style="list-style-type: none"> • Faster? More efficient! • That is not the main goal <p>Effectively or expediency instead of faster</p>	The previous item was about an increase of productivity. Working faster and an increase of productivity has been replaced by 'more efficient'. This item can be eliminated.	Eliminated	NA
Added Items	I-CVI (1st round)	Feedback and suggestions experts	rationale	Added item	I-CVI
46)	NA	<ul style="list-style-type: none"> • Safety should return in an item 	Safety is a main issue in EMS. Due to many unsafe incidents it has become a national item. Therefor it is relevant to add this item to subdomain 'relative advantage'	By this innovation, the feeling of safety will increase	.40

				in the innovation-attitude list		
47)	NA	<ul style="list-style-type: none"> The execution of an innovation must be educated in theory and practice. 	Training is indispensable in EMS. Every EMS-worker has to assess again and again to keep their competences. The success of an innovation may depend on the education. Added to the WIK.	The way of using this innovation must be educated in theory and/or in practice	1.0	
48)	NA	<ul style="list-style-type: none"> The innovation contributes to the ergonomics of the work on an ambulance 	Physical exertion is standard in EMS-care. To avoid physical burnout, attention to ergonomics is important. Innovations might improve ergonomics and might therefore be relevant. Added to the WIK.	This innovation is meant to improve the ergonomics of my work.	.80	
49)	NA	<ul style="list-style-type: none"> The innovation contributes to the safety of the patient and the EMS-workers. 	Safety as a main issue for patients and EMS-workers. This item is added to the WIK.	This innovation gives me an idea of safety.	.80	

NA=Not Applicable; I-CVI=Item Content Validity Index; EMS=Emergency Medical Service; WIK=perceived features of the innovation;
WAK=perceived features of the organization

Figures and figure legends

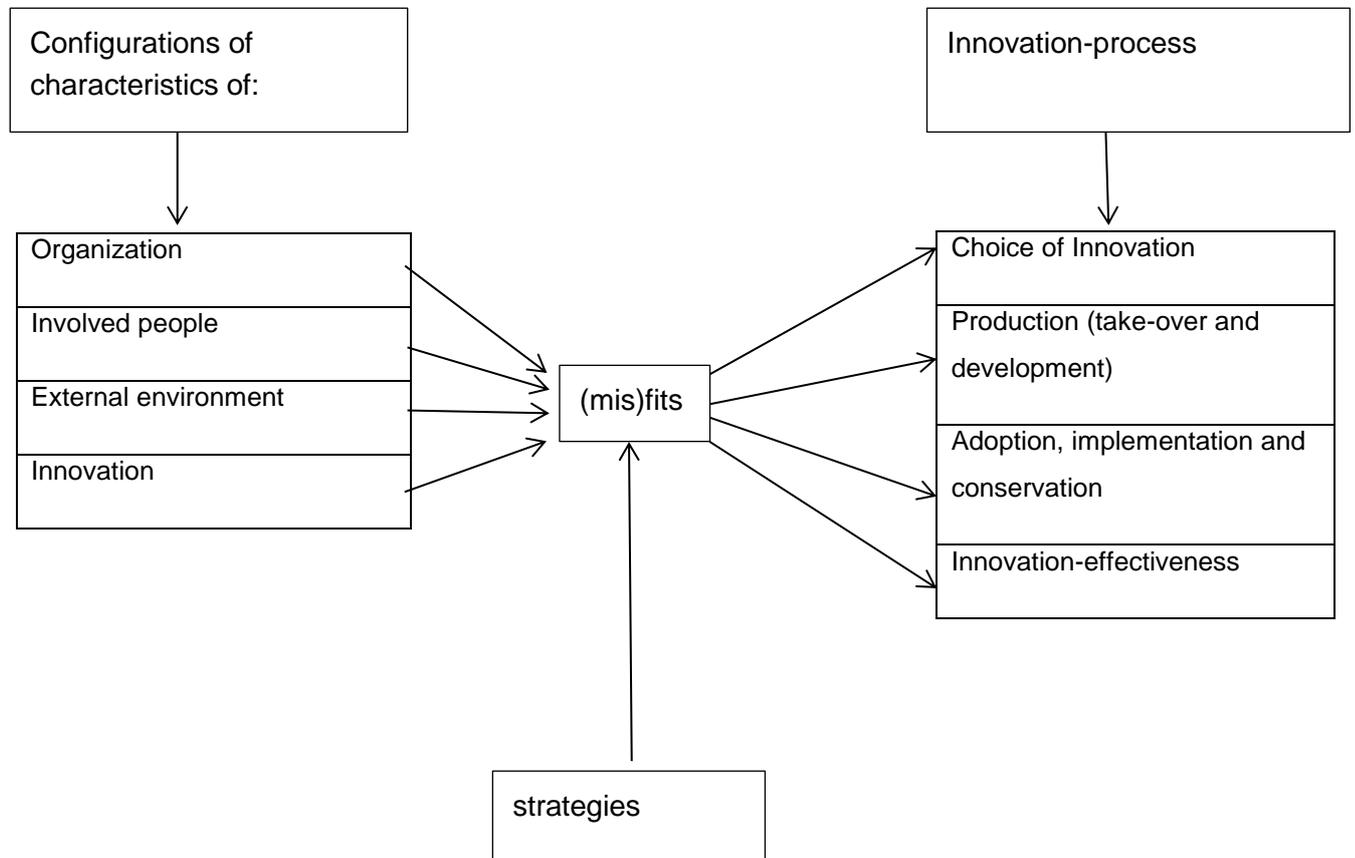


Figure 1: Innovation Contingency Model (Van Linge, 2006)

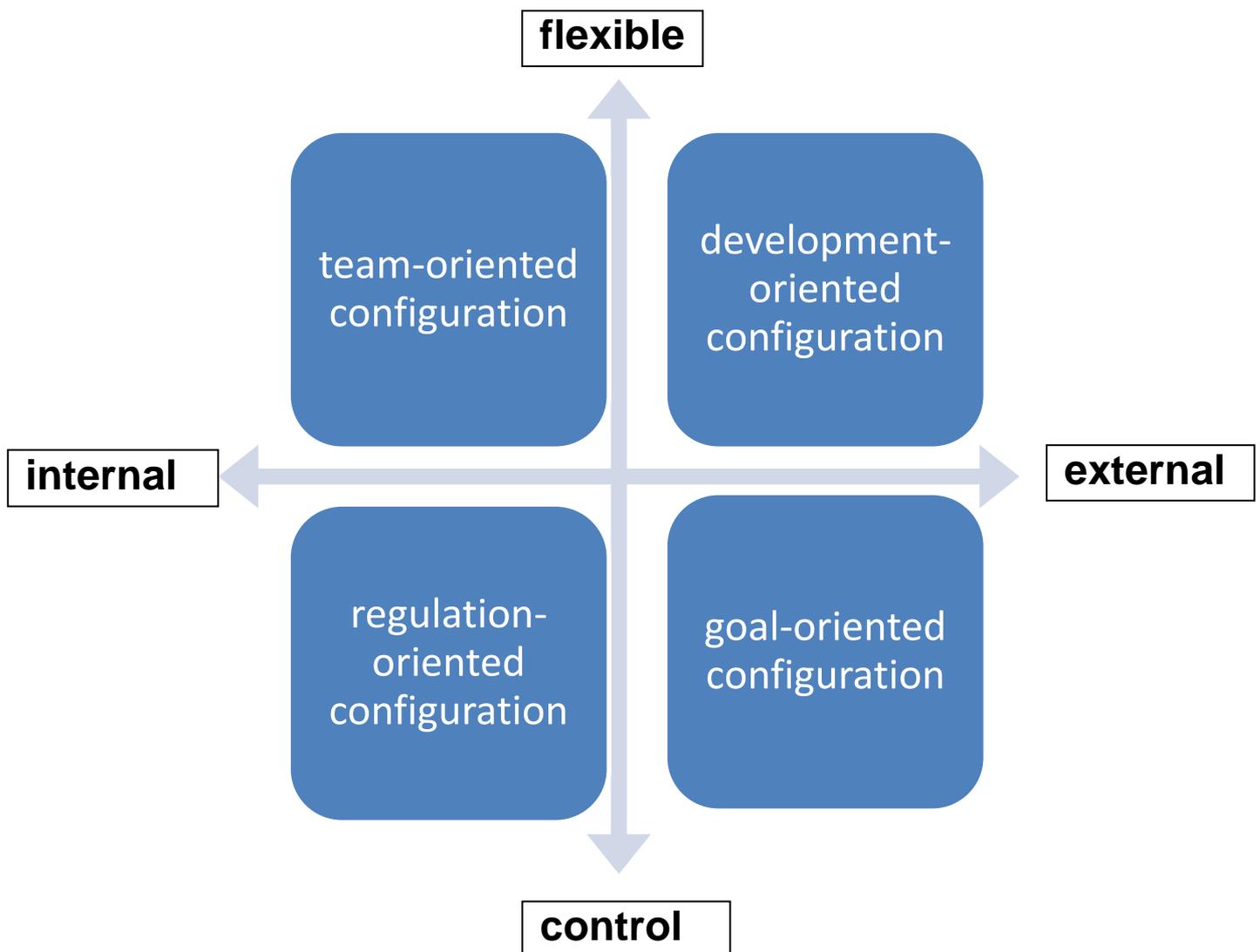


Figure 2: Four configurations and two dimensions of the IC-model (van Linge, 2006)

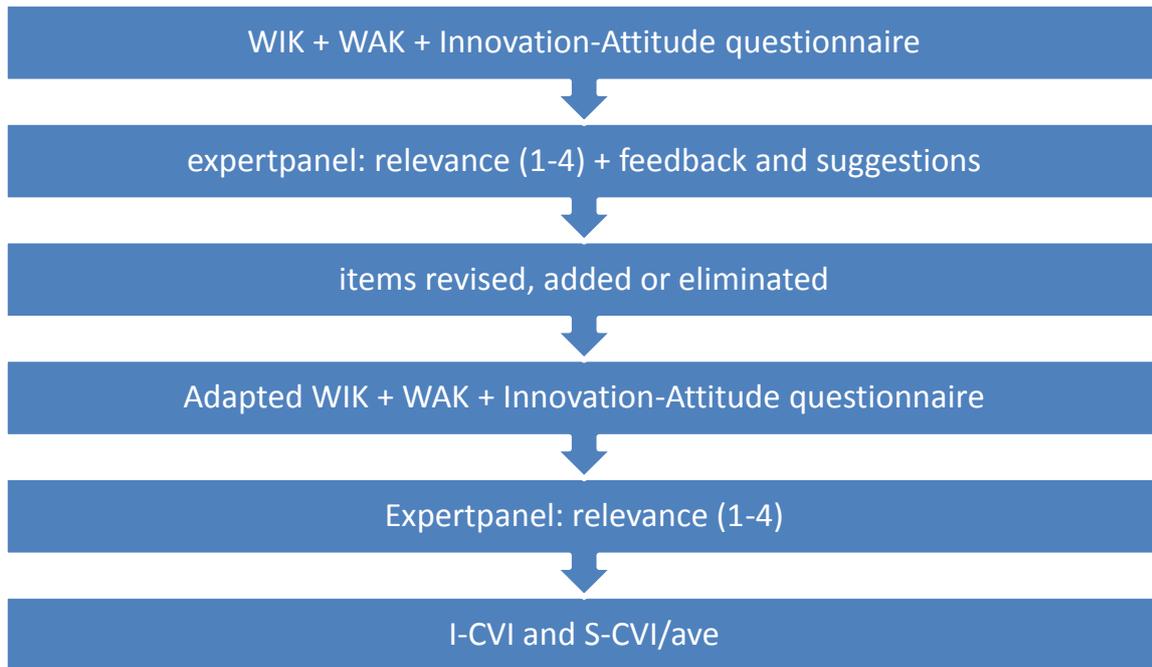


Figure 3: design

WIK=perceived features of the innovation; WAK=perceived features of the organization; I-CVI=Item Content Validity Index; S-CVI/ave=Scale Content Validity Index/averaging approach

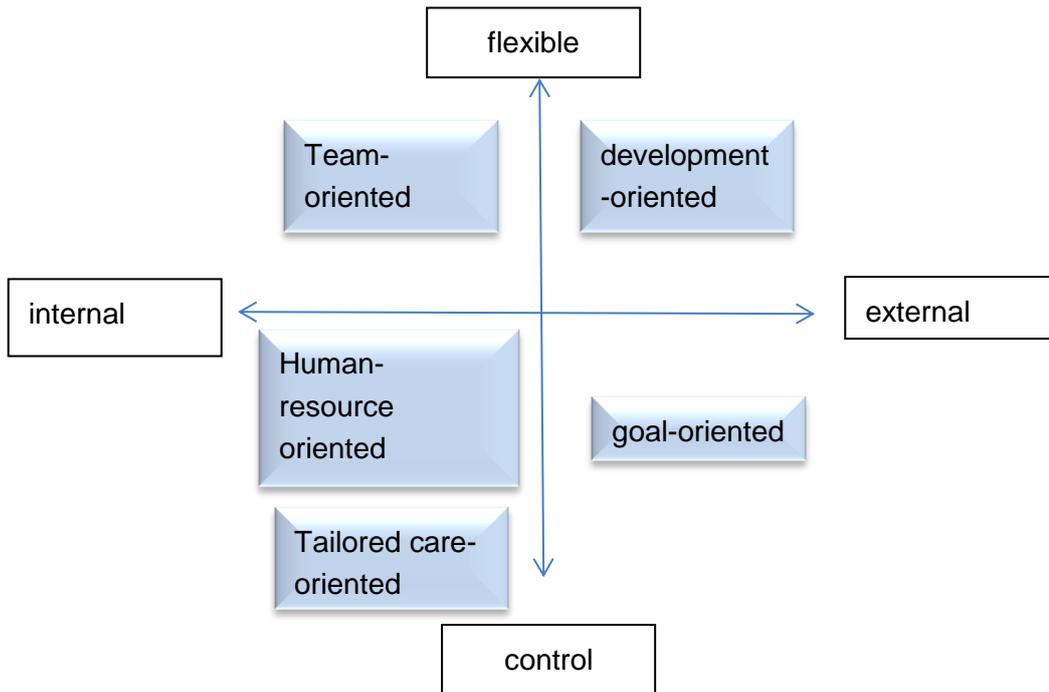


Figure 4: Revised IC-model. Five configurations and two dimensions