Techniques For Inspection of Interaction Models

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ABSTRACT

This technical report describes two inspection techniques for different interaction models, called MoLVERIC Cards (MCards) and MoLVERIC Check (MCheck). MCards employs gamification elements to motivate professionals during the inspection. MCheck uses a checklist to guide the inspection. We also describe developed items for verification of the interaction models with the purpose of evaluating their consistency with the system user scenario. These items can be instantiated for other interaction modeling languages, as long as the elements have the same purpose in the interaction modeling. In addition, this technical report describes the material used to support the experimental studies of the two inspection techniques for different interaction models, including the participants' perceptions about techniques.

1. INTERACTION MODELS

Different techniques support user-centered design, such as the creation of personas, task modeling, and prototypes (Paula, Barbosa & Lucena, 2005). However, users often encounter problems using interactive systems (Rogers, Sharp & Preece, 2015). In this context, Beaudouin-Lafon (2004) argues that one of the ways to improve the quality of interactive systems is to shift the focus from interface design to interaction design.

Interaction modeling refers to a set of principles, rules and properties that guide interface design and can be used by designers and developers to create interactive systems (BeaudouinLafon, 2004). According to Meixner, Paternò and Vanderdonckt (2011), interaction models can include a high level of abstraction for the development of interactive systems. Several languages for interaction modeling have been proposed (Paula, Lucena & Barbosa, 2005; López-Jaquero & Montero, 2007; Kim & Yoon, 2005). The OCD (Operation and Control Diagram) provides the representation of the interaction in terms of operations that can be performed by the user in system (Kim & Yoon, 2005). CTDM (Comprehensive Task Dialog Modeling) can be used to specify tasks, dialogues, and information about the system domain (López-Jaquero & Montero, 2007). MoLIC (Modeling Language for Interaction as a Conversation) allows the representation of the user-system interaction, where the designer can correct possible breakdowns in the communication from the designer to the user (Paula, Barbosa & Lucena, 2005). objectives in modeling the interaction with OCD, CTDM, and MoLIC.

Among the OCD, CTDM and MoLIC languages, MoLIC allows detailing the actions of the user and the system with associated contents, while OCD allows only the representation of the action that is performed, without the identification of who performs it. CTMD does not allow representing details regarding the actions that occur in the user-system interaction. MoLIC allows representing other alternatives of interaction, while OCD and CTDM do not have elements with this characteristic. We also identified more reports about experimental studies of MoLIC in the design of interactive systems (Sangiorgi & Barbosa, 2009; Silva, Martins Netto & Barbosa, 2005) compared to OCD and CTDM. For this reason, we chose th MoLIC language in this work to explore the use of interaction models.

2. VERIFICATION ITEMS DEVELOPED FOR THE DIFFERENT

We developed these items with the purpose of evaluating the consistency of the interaction models with the system user scenario. We find that it is possible to support the identification of defects regarding user objectives through the elements: Scene (MoLIC), Operation (OCD) and Tasks and subtasks (CTDM).

We identify the following defects:

D1 – User objectives that are not represented (Omission);

D2 – User objectives inconsistent with the requirements (Inconsistency);

D3 – User objectives absent from the context of the requirements (Extraneous Information);

D4 – Incorrect descriptions defined in the model (Incorrect Fact);

D5 – Ambiguous User Objectives (Ambiguity); and

D5 – Different user goals cause ambiguity due to similar description (Ambiguity).

From these defects, we developed the following verification items:

• Are all user goals, described in the requirements/scenario information, represented in the interaction models? If not, report as an Omission defect - **Developed based on D1.**

• Are there user goals inconsistent with scenario requirements/information? If so, report it as an Inconsistency defect - **Developed based on D2**.

• Are there user goals that are not in the context of scenario requirements/information? If this is the case, report it as an Extraneous Information defect - **Developed based on D3**.

• User goals can be read as “At this time, you (user) can (or should) <verb + objects>?” For example: The user objective to register a student can be read as: “At this time, you (user) can (or should) Register student”. If not, report as an Incorrect Fact - **Developed based on D4**.

• Is it possible to get different interpretations in reading each user goals? If so, report as Ambiguity - **Developed based on D5**.

• Are there similar scenes? If so, also report as Ambiguity - **Developed based on D5**.

We find that it is possible to support the identification of defects regarding the user objectives that indicate how the user-system interaction occurs in the elements: Transition Utterance (MoLIC), System’s States and Responses (OCD) and Transitions (CTDM). We identify the following defects:

D6 - Direction of the arrows are incorrect (Incorrect Fact);

D7 - Incorrect arrows (Incorrect Fact);

D8 – Lack of arrows when necessary (Omission);

D9 - Arrows with content outside the context of requirements (Extraneous Information);

D10 - Arrows with content inconsistent with the context of the requirements

(Inconsistency);

D11 - Arrows with ambiguous content (Ambiguity);

D12 - Enunciator omitted (Omission);

D13 - Incorrect statement (Incorrect Fact);

D14 - Objectives of the user without the necessary arrows (Omission).

For the D13 and D14, we developed them specifically for MoLIC. From these defects, we developed the following verification items:

• Is the direction of the arrows correct in relation to the scenario requirements /information? If it is not, report it as an Incorrect Fact defect- **Developed on the basis of D6**.

• Are the correct arrows used? If it is not, report it as an Incorrect Fact defect – **Developed on the basis of D7**.

• Do the arrows represent necessary content? If not, report as an Omission defect - **Developed based on D8**.

• Is the content of the speeches in the context of the scenario requirements / information? If not, report as a Extraneous Information defect - **Developed on the basis of D9**.

• Is the content of the speech consistent with the requirements / information in the scenario? If not, report as an Inconsistency defect - **Developed based on D10**.

• Does the content of the speech provide multiple interpretations? If so, report as na Ambiguity defect - **Developed based on D11.**

• In the case of MoLIC - Do the utterances use the "u:" or "d:" enunciator? If not, report as an Omission - **Developed based on D12**.

• In the case of MoLIC - Was the correct speech enunciator used? Being "u:" for user and "d:" for designer. If not, report as an Incorrect Fact defect - **Developed based on D13**.

• Are there any omissions between the scenes? If this is the case, report as an Omission defect - **Developed based on D14**.

We find that it is possible to support the identification of defects for the elements used to indicate the next goal of the user from a particular action, as System Process (MoLIC), Memory Header (OCD) and Transition Labels: Start and Error (CTDM). We identify the following defects:

D15 - Lack of use of element to interpret user action (Omission).

D16 - Improper use of interaction for the result of the system process (Incorrect Fact).

D17 - Lack of feedback to the user during the system process (Omission).

D18 - Failure to provide user rupture recovery during interaction (Omission).

From these defects, we developed the following verification items:

• Was element used to interpret a required user action in case of system feedback? If no, report as an Omission defect- **Developed based on D15**.

• After processing the system, are the appropriate responses used? If not, report it as na Incorrect Fact defect - **Developed based on D16**.

• Has feedback been used on the system's processing, in moments like downloading files? If not, report as an Omission defect - **Developed based on D17**.

• Have rupture recovery been used for the user? If not, report it as an Omission defect - **Developed based on D18**.

We find that it is possible to support the identification of defects for the elements used to indicate the beginning and end of a certain action, such as Opening Point and Closing Point (MoLIC) and Initial State and Final State (CTDM). We identify the following defects:

D19 - Lack of use of the elements to demonstrate the beginning and end of the interaction (Omission).

D20 - Inappropriate use of elements to represent other objectives (Incorrect Fact).

From these defects, we developed the following verification items:

• Have the elements been used to demonstrate the beginning and end of the user-system

interaction? If not, report as an Omission defect - **Developed based on D19**.

• Are the elements that represent the beginning and end of the user-system interaction

used correctly? If not, report it as an Incorrect Fact defect - **Developed based on D20**.

We find that it is possible to support the identification of defects for the elements used to indicate the as the interaction may occur in relation to a given user goal, such as Signs, Utterances and Dialogues (MoLIC); and State Header (OCD). We identify the following defects:

D21 - Lack of use of the elements to demonstrate how the interaction should occur in relation to the objectives that are accessed in the system and the responses of the system (Omission).

D22 - Lack of use of the elements to demonstrate how the interaction should occur in relation to the objectives that are accessed in the system and the system responses (Incorrect Fact).

From these defects, we developed the following verification items:

• The elements used to indicate how the interaction should occur in relation to the goals that are accessed in the system? If not, report as an Omission defect - Developed based on D21.

• Do the elements used to indicate how the interaction should occur in relation to the user's objectives have the appropriate answers? If not, report as an Omission defect - Developed based on D21.

• Do the elements that represent how the interaction should occur in relation to the user's objectives have been used correctly? If it is not, report as an Incorrect Fact defect - Developed based on D22.

We find that it is possible to support the identification of defects for the elements used to indicate the opportunity to change the objective in the interaction at any time, being the Ubiquid Access (MoLIC). We identified the following defects:

D23 - Inconsistent use of element in relation to requirements for user action (Inconsistency).

D24 - Incorrect use of the element to demonstrate how the user can achieve other goals at any time in the system (Incorrect Fact);

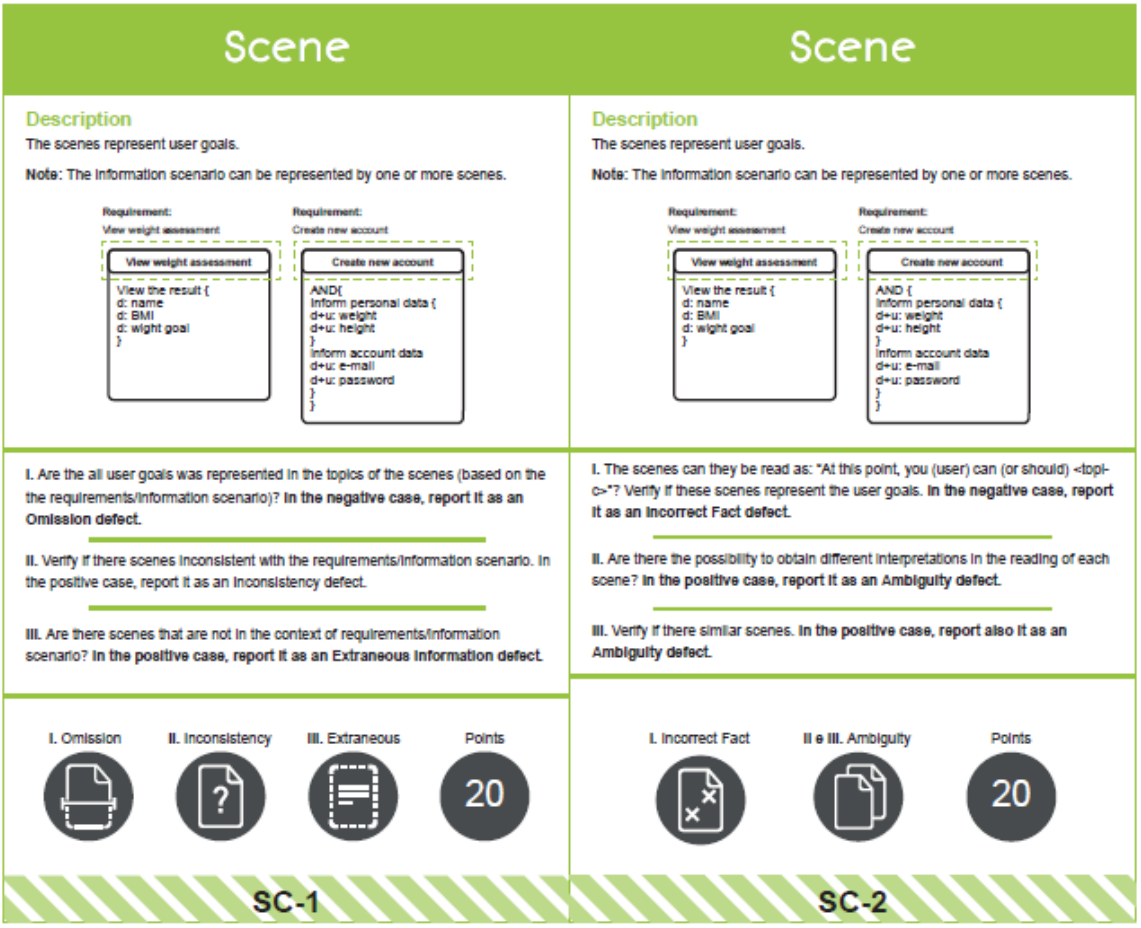
From these defects, we developed the following verification items:

• Is the element representing the opportunity for the user to change the goal in the interaction at any time used consistently with the requirements? If not, report as na Inconsistency defect - **Developed based on D23.**

• Is the element representing the opportunity for the user to change the goal in the interaction at any time used correctly? If it is not, report as an Incorrect Fact defect - **Developed based on D24.**

From these verification items, inspection techniques can be developed for OCD, CTDM and MoLIC interaction models. However, we note that these verification items can be adapted to other interaction modeling languages that have elements for the same purpose.

3. MCARDS

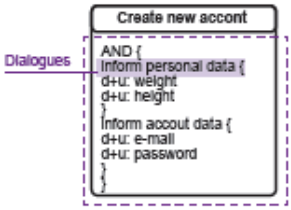

Scene
Description
The scenes represent user goals.
Note: The information scenario can be represented by one or more scenes.
Requirement:
View weight assessment
Requirement:
Create new account
View weight assessment
View the result {
d: name
d: BMI
d: wight goal
}
Create new account
AND{
Inform personal data {
d+u: weight
d+u: height
}
Inform account data
d+u: e-mail
d+u: password
}
}
I. Are the all user goals was represented in the topics of the scenes (based on the the requirements/information scenario)? In the negative case, report it as an Omission defect.
II. Verify if there scenes inconsistent with the requirements/information scenario. In the positive case, report it as an Inconsistency defect.
III. Are there scenes that are not in the context of requirements/information scenario? In the positive case, report it as an Extraneous information defect.
I. Omission
II. Inconsistency
III. Extraneous
Points
20
SC-1
Scene
Description
The scenes represent user goals.
Note: The information scenario can be represented by one or more scenes.
Requirement:
View weight assessment
Requirement:
Create new account
View weight assessment
View the result {
d: name
d: BMI
d: wight goal
}
Create new account
AND {
Inform personal data {
d+u: weight
d+u: height
}
Inform account data
d+u: e-mail
d+u: password
}
}
I. The scenes can they be read as: "At this point, you (user) can (or should) <topic>"? Verify if these scenes represent the user goals. In the negative case, report it as an Incorrect Fact defect.
II. Are there the possibility to obtain different interpretations in the reading of each scene? In the positive case, report it as an Ambiguity defect.
III. Verify if there similar scenes. In the positive case, report also it as an Ambiguity defect.
I. Incorrect Fact
II e III. Ambiguity
Points
20
SC-2

Dialogues

Description

The dialogues represent the user's actions in relation to the topic of the scene. They may be composed of other dialogues, through the following structures:

The **SEQ** structure represents the dialogues that must be exchanged in the specified sequence.
The **XOR** structure represents mutually exclusive dialogues.
The structure **OR** represents the choice of exchanging one or more dialogues.
The structure **AND** represents the use of all dialogs, but not in a predefined sequence.



I. Are the all dialogues was represented in the scenes (based on the the requirements/information scenario)? **In the negative case, report it as an Omission defect.**

II. According to the requirements /information of the scenario, there are unnecessary dialogues? **In the positive case, report it as an Extraneous information defect.**

III. Are there dialogues that offer multiple interpretations? **In the positive case, report it as an Ambiguity defect.**

D-1

Dialogues

Description

The dialogues represent the user's actions in relation to the topic of the scene. They may be composed of other dialogues, through the following structures:

The **SEQ** structure represents the dialogues that must be exchanged in the specified sequence.
The **XOR** structure represents mutually exclusive dialogues.
The structure **OR** represents the choice of exchanging one or more dialogues.
The structure **AND** represents the use of all dialogs, but not in a predefined sequence.

Are there incorrect notation in the dialogues? **In the positive case, report it as an Incorrect Fact defect.**

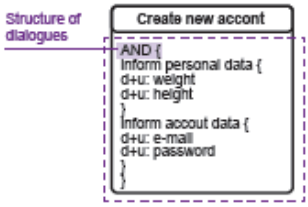
D-2

Dialogues

Description

The dialogues represent the user's actions in relation to the topic of the scene. They may be composed of other dialogues, through the following structures:

The **SEQ** structure represents the dialogues that must be exchanged in the specified sequence.
The **XOR** structure represents mutually exclusive dialogues.
The structure **OR** represents the choice of exchanging one or more dialogues.
The structure **AND** represents the use of all dialogs, but not in a predefined sequence.



I. The necessary structures were represented in the dialogues? **In the negative case, report it as an Omission defect.**

II. The structures were applied correctly in relation to the goal of each structure? **In the negative case, report it as an Inconsistency defect.**

III. The structures detailed are required for user actions in relation to the requirements/information scenario? **In the negative case, report it as an Incorrect Fact defect.**

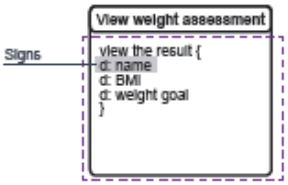
D-3

Signs

Description

The signs represent the information involved in the dialogues, for example in dialogue "register the name" is used the sign "d + u: name".

Note: A sign has only enunciators "d" (designer's deputy) and "d + u" (when the designer's deputy allows user interaction).

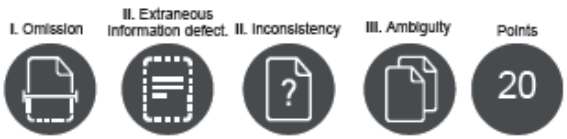


I. Are the all signs to represent the information in the user interaction was represented in the dialogues (based on the the requirements/information scenario)? **In the negative case, report it as an Omission defect.**

II. The signs are in the context of the requirements/information scenario? **In the positive case, report it as an Extraneous information defect.**

III. The signs are inconsistent with the requirements/information scenario? **In the positive case, report it as an Inconsistency defect..**

IV. Are there signs that offer multiple interpretations? **In the positive case, report it as an Ambiguity defect.**



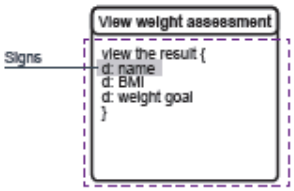
S-1

Signs

Description

The signs represent the information involved in the dialogues, for example in dialogue "register the name" is used the sign "d + u: name".

Note: A sign has only enunciators "d" (designer's deputy) and "d + u" (when the designer's deputy allows user interaction).



I. In the signs, the enunciators ("d:" and "d+u:") was used? **In the negative case, report it as an Omission defect.**

II. The signs were applied correctly? **In the negative case, report it as an Inconsistency defect.**

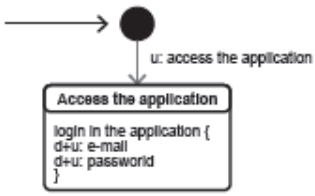
I. Omission	II. Incorrect Fact	Points
		10

S-2

Opening Point

Description

The opening point indicates the start of user interaction with the system.



I. The opening point was represented in the diagram? **In the negative case, report it as an Omission defect.**

II. The transition user utterance, related with the opening point, has consistently content with the requirements/information scenario for the start user interaction? **In the negative case, report it as an Inconsistency defect.**

III. According to the requirements/information of the scenario, the transition user utterance was directed to the scene representing the initial goal user? **In the negative case, report it as an Inconsistency defect.**

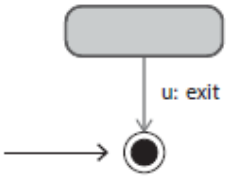
I. Omission	II e III. Inconsistency	Points
	?	20

OP-1

Closing Point

Description

The closing point indicates the end of user interaction with the system.



I. The closing point was represented in the diagram? **In the negative case, report it as an Omission defect.**

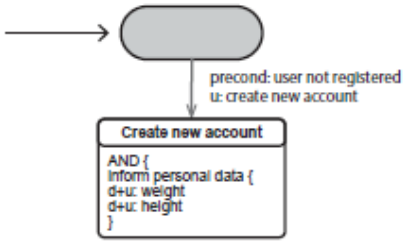
II. According to the requirements/information of the scenario, the transition user utterance to the closing point has consistent content to represent the end of the interaction? **In the negative case, report it as an Inconsistency defect.**

CP-1

Ubiquitous Access

Description

The ubiquitous access is the user's opportunity change the topic of conversation to a different goal than current.



I. The scenes associated with ubiquitous access can be accessed at any time, in the user-system interaction, consistent with the with the requirements/information scenario? **In the negative case, report it as an Inconsistency defect.**

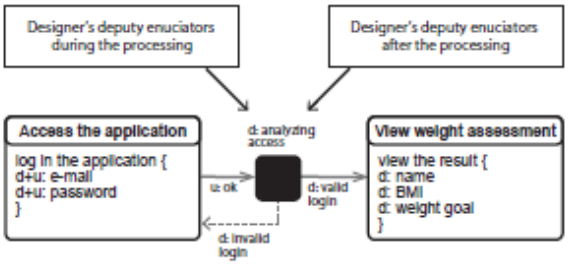
II. The ubiquitous access is being related to other elements, besides scenes and point of closure? **In the positive case, report it as an Incorrect Fact defect.**

UA-1

System Process

Description

The system process is the internal processing of a transition user utterance. This occurs only when it's necessary the system interpret the transition user utterance to provide adequate direction.



I. The element system the process was used to interpret a transition user utterance? **In the negative case, report it as an Incorrect Fact defect.**

II. After a system processing, they are used designer's deputy enunciators for the transition utterance and breakdown recovery utterance? **In the negative case, report it as an Incorrect Fact defect**

I e II. Incorrect Fact

Points

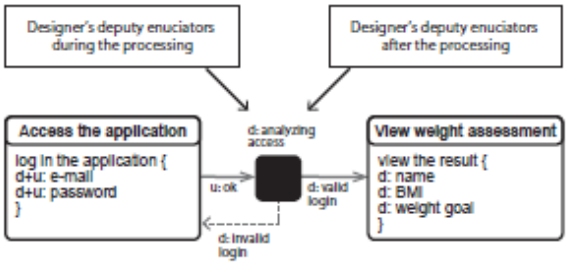
10

SP-1

System Process

Description

The system process is the internal processing of a transition user utterance. This occurs only when it's necessary the system interpret the transition user utterance to provide adequate direction.



The system process was used in necessary moments for the interpretation of a transition user utterance? **In the negative case, report it as an Omission defect.**

Omission

Points

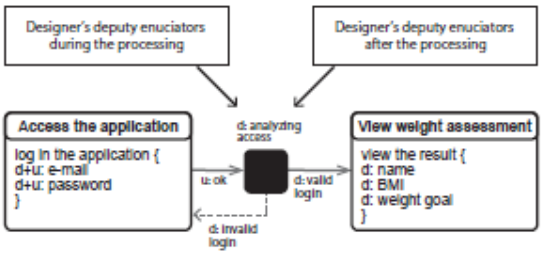
20

SP-2

System Process

Description

The system process is the internal processing of a transition user utterance. This occurs only when it's necessary the system interpret the transition user utterance to provide adequate direction.



The feedback system processing was used in necessary moments, as the download files? **In the negative case, report it as an Omission defect.**

Omission

Points

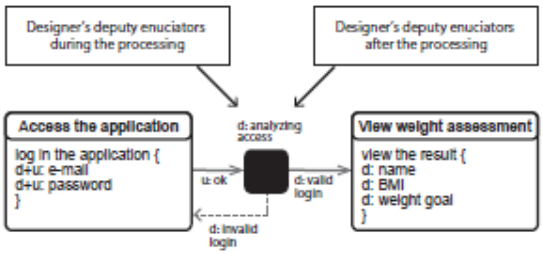
10

SP-3

System Process

Description

The system process is the internal processing of a transition user utterance. This occurs only when it's necessary the system interpret the transition user utterance to provide adequate direction.



As outputs of process system, a transition utterance and other (s) transition utterance were used? **In the negative case, report it as an Incorrect Fact defect.**

Incorrect Fact

Points

10

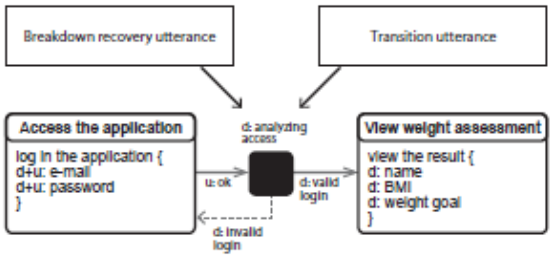
SP-4

Transition Utterance and Breakdown Recovery Utterance

Description

Transition utterance represents the user goals change from the current scene.
Breakdown recovery utterance is a type of designer utterance for a recovery situation of communication disruption.

Note: The transition utterance and breakdown recovery utterance have only enunciators "u" and "d".



I. The direction of the utterances (arrow) is correct in relation to the requirements/information scenario? **In the negative case, report it as an Incorrect Fact defect.**

II. The utterances use the right arrow? That is, the transition utterance with normal arrow and breakdown recovery utterance with the dashed arrow. **In the negative case, report it as an Incorrect Fact defect.**

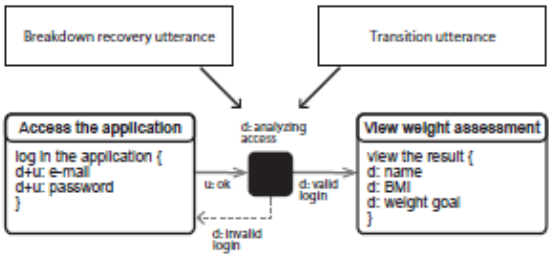
TR-1

Transition Utterance and Breakdown Recovery Utterance

Description

Transition utterance represents the user goals change from the current scene.
Breakdown recovery utterance is a type of designer utterance for a recovery situation of communication disruption.

Note: The transition utterance and breakdown recovery utterance have only enunciators "u" and "d".



I. The utterances have content? **In the negative case, report it as an Omission defect.**

II. The content of the utterances is in the context of the requirements/information scenario? **In the negative case, report it as an Extraneous information defect.**

III. The content is consistent with the requirements/information scenario? **In the negative case, report it as an Inconsistency defect.**

IV. The content of the utterances offer multiple interpretations? **In the positive case, report it as an Ambiguity defect.**

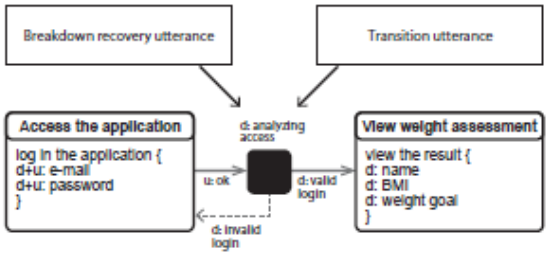
TR-2

Transition Utterance and Breakdown Recovery Utterance

Description

Transition utterance represents the user goals change from the current scene.
Breakdown recovery utterance is a type of designer utterance for a recovery situation of communication disruption.

Note: The transition utterance and breakdown recovery utterance have only enunciators "u" and "d".



I. The utterances use the enunciator "u" or "d"? **In the negative case, report it as an Omission defect.**

II. The enunciator utterances is correct? Being considered "u" to the user and "d" to the designer's deputy. **In the negative case, report it as an Incorrect Fact defect.**

I. Omission | II. Incorrect Fact | Points | 20

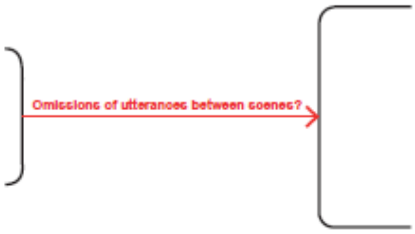
TR-3

Transition Utterance and Breakdown Recovery Utterance

Description

Transition utterance represents the user goals change from the current scene.
Breakdown recovery utterance is a type of designer utterance for a recovery situation of communication disruption.

Note: The transition utterance and breakdown recovery utterance have only enunciators "u" and "d".



Are there omissions of utterances between scenes? **In the positive case, report it as an Omission defect.**

Omission | Points | 20

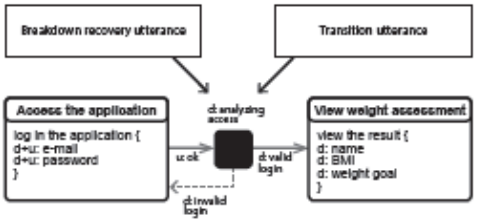
TR-4

Transition Utterance and Breakdown Recovery Utterance

Descrição

A fala de transição representa a mudança de objetivo do usuário a partir da cena corrente (seta normal). A fala de recuperação da ruptura representa um tipo de fala para uma situação de recuperação de ruptura da conversa (seta tracejada).

Observação: As falas de transição e recuperação da ruptura da conversa possuem somente os enunciadores de "u:" (representa a fala do usuário) e "d:" (representa a fala do designer).



I. Are there utterances where necessary any precondition? If not, disregard the next verification items. **In the positive case, if the precond expression was not used to represent a necessary precondition in the utterances, report it as an Omission**

II. The precond expression has inconsistent content with a precondition necessary for the requirements/information scenario? **In the positive case, report it as an Inconsistency defect.**

III. The precond expression has unnecessary content with the requirements/information scenario? **In the positive case, report it as an Extraneous Information defect.**

IV. The precond expression has ambiguous contente? **In the positive case, report it as an Ambiguity defect.**

I. Omission	II. Inconsistency	II. Extraneous Information	III. Ambiguity	Points
				20

TR-5


MoLVERIC
CARDS

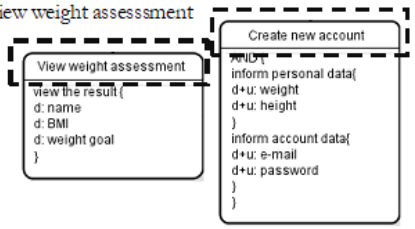

MoLVERIC
CARDS

4. MCHECK

<table>
<tr><th colspan="2">SCENE</th></tr>
<tr><th colspan="2">TOPIC OF THE SCENE (FIRST COMPARTMENT OF THE SCENE)</th></tr>
<tr><th>Description</th><th>Example</th></tr>
<tr><td>The scenes represent user goals.

<u>Note:</u> The information scenario can be represented by one or more scenes.</td><td>Requirement:
View weight assessment

Requirement:
Create new account

 
</td></tr>
<tr><td colspan="2">Verification items:

CN1: <u>Are the all user goals</u> was <u>represented in the topics of the scenes (</u>based on the the requirements/information scenario)? In the negative case, report it as an Omission defect.

CN2: Verify if <u>there scenes inconsistent</u> with the requirements/information scenario. In the <u>positive case</u>, report it as an Inconsistency defect.

CN3: Are there <u>scenes that are not in the context</u> of requirements/information scenario? In the <u>positive case</u>, report it as an Extraneous Information defect.

CN4: The <u>scenes can they be read as</u>: “At this point, you (user) can (or should) <topic>”? <u>Verify if these scenes represent the user goals</u>. In the <u>negative case</u>, report it as an Incorrect Fact defect.

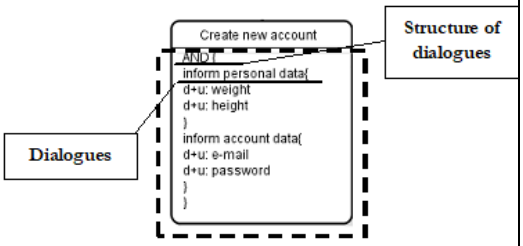
CN5: Are there the possibility to obtain different interpretations in the reading of each scene? In the positive case, report it as an Ambiguity defect.

CN6: Verify if <u>there similar scenes.</u> In the <u>positive case</u>, report also it as an Ambiguity defect.</td></tr>
<tr><th colspan="2">DETAILS OF THE SCENE</th></tr>
<tr><th colspan="2">DIALOGUES (SECOND COMPARTMENT OF THE SCENE)</th></tr>
<tr><th>Description</th><th>Example</th></tr>
<tr><td>The dialogues represent the user's actions in relation to the topic of the scene. They may be composed of other dialogues, through the following structures:

The SEQ structure represents the dialogues that must be exchanged in the specified sequence.

The XOR structure represents mutually exclusive dialogues.

The structure OR represents the choice of exchanging one or more dialogues.

The structure AND represents the use of all dialogs, but not in a predefined sequence.</td><td> 
</td></tr>
<tr><td colspan="2">Verification items:

D1: <u>Are the all dialogues</u> was <u>represented in the scenes (</u>based on the the requirements/information scenario)? In the <u>negative case</u>, report it as an Omission defect.

D2: According to the requirements /information of the scenario, there are unnecessary dialogues? In the positive case, report it as an Extraneous Information defect.

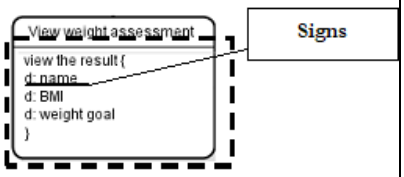
D3: Are there <u>incorrect notation in the dialogues</u>? In the <u>positive case</u>, report it as an Incorrect Fact defect.

D4: Are there <u>dialogues that offer multiple interpretations?</u> In the <u>positive case</u>, report it as an Ambiguity defect.

D5: <u>The necessary structures were represented in the dialogues</u>? In the <u>negative case</u>, report it as an Omission defect.

D6: The <u>structures</u> were <u>applied correctly</u> in relation to the goal of each structure? In the <u>negative case</u>, report it as an Inconsistency defect.

D7: The <u>structures detailed are required</u> for user actions in relation to the requirements/information scenario? In the <u>negative case</u>, report it as an Incorrect Fact defect.</td></tr>
</table>

DETAILS OF THE SCENE	
SIGNS (SECOND COMPARTMENT OF THE SCENE)	
Description	**Example**
The signs represent the information involved in the dialogues, for example in dialogue "register the name" is used the sign "d + u: name". *Note: A sign has only enunciators "d" (designer's deputy) and "d + u" (when the designer's deputy allows user interaction).*	

Verification items:

S1: Are the all signs to represent the information in the user interaction was represented in the dialogues (based on the the requirements/information scenario)? In the negative case, report it as an **Omission defect**.

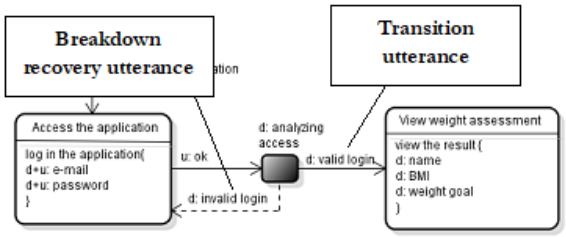
S2: The signs are in the context of the requirements/information scenario? In the positive case, report it as an **Extraneous Information defect**.

S3: The signs are inconsistent with the requirements/information scenario? In the positive case, report it as an **Inconsistency defect**.

S4: Are there signs that offer multiple interpretations? In the positive case, report it as an **Ambiguity defect**.

S5: In the signs, the enunciators ("d:" and "d+u:") was used? In the negative case, report it as an **Omission defect**.

S6: The signs were applied correctly? In the negative case, report it as an **Inconsistency defect**.

TRANSITION UTTERANCE AND BREAKDOWN RECOVERY UTTERANCE	
Description	**Example**
Transition utterance represents the user goals change from the current scene. *Breakdown recovery utterance is a type of designer utterance for a recovery situation of communication disruption.* *Note: The transition utterance and breakdown recovery utterance have only enunciators "u" and "d".*	

Verification items:

FTR1: The direction of the utterances (arrow) is correct in relation to the requirements/information scenario? In the negative case, report it as an **Incorrect Fact defect**.

FTR2: The utterances use the right arrow? That is, the transition utterance with normal arrow and breakdown recovery utterance with the dashed arrow. In the negative case, report it as an **Incorrect Fact defect**.

FTR3: The utterances have content? In the negative case, report it as an **Omission defect**.

FTR4: The content of the utterances is in the context of the requirements/information scenario? In the negative case, report it as an **Extraneous Information defect**.

FTR5: The content is consistente with the requirements/information scenario? In the negative case, report it as an **Inconsistency defect**.

FTR6: The content of the utterances offer multiple interpretations? In the positive case, report it as an **Ambiguity defect**.

FTR7: The utterances use the enunciator "u" or "d"? In the negative case, report it as an **Omission defect**.

FTR8: The enunciator utterances is correct? Being considered "u" to the user and "d" to the designer's deputy. In the negative case, report it as an **Incorrect Fact defect**.

FTR9: Are there omissions of utterances between scenes? In the positive case, report it as an **Omission defect**.

FTR10: Are there utterances where necessary any precondition? If not, disregard the next verification items. In the positive case, if the precond expression was not used to represent a necessary precondition in the utterances, report it as an **Omission defect**.

FTR11: The *precond* expression has inconsistent content with a precondition necessary for the requirements/information scenario? In the positive case, report it as an **Inconsistency defect**.

FTR12: The *precond* expression has unnecessary content with the requirements/information scenario? In the positive case, report it as an **Extraneous Information defect**.

FTR13: The *precond* expression has ambiguous contente? In the positive case, report it as an **Ambiguity defect**.

OPENING POINT

Description	Example
The opening point indicates the start of user interaction with the system.	

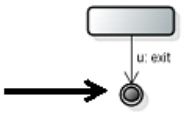
Verification items:

PA1: The opening point was represented in the diagram? In the negative case, report it as an **Omission defect**.

PA2: The transition user utterance, related with the opening point, has consistently content with the requirements/information scenario for the start user interaction? In the negative case, report it as an **Inconsistency defect**.

PA3: According to the requirements/information of the scenario, the transition user utterance was directed to the scene representing the initial goal user? In the negative case, report it as an **Inconsistency defect**.

CLOSING POINT

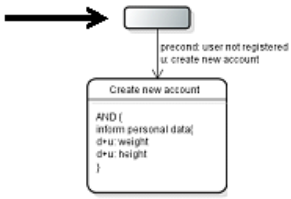
Description	Example
The closing point indicates the end of user interaction with the system	

Verification items:

PE1: The closing point was represented in the diagram? In the negative case, report it as an **Omission defect**.

PE2: According to the requirements/information of the scenario, the transition user utterance to the closing point has consistent content to represent the end of the interaction? In the negative case, report it as an **Inconsistency defect**.

UBIQUITOUS ACCESS

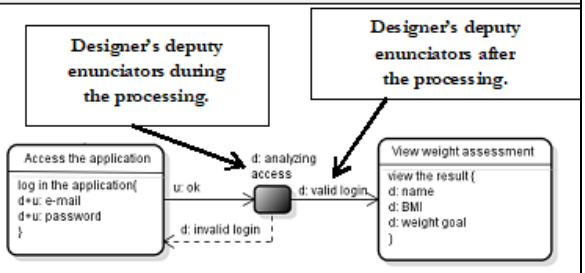
Description	Example
The ubiquitous access is the user's opportunity change the topic of conversation to a different goal than current.	

Verification items:

AU1: The scenes associated with ubiquitous access can be accessed at any time, in the user-system interaction, consistent with the with the requirements/information scenario? In the negative case, report it as an **Inconsistency defect**.

AU2: The ubiquitous access is being related to other elements, besides scenes and point of closure? In the positive case, report it as an **Incorrect Fact defect**.

SYSTEM PROCESS

Description	Example
The system process is the internal processing of a transition user utterance. This occurs only when it's necessary the system interpret the transition user utterance to provide adequate direction.	

Verification items:

PS1: The element system the process was used to interpret a transition user utterance? In the negative case, report it as an **Incorrect Fact defect**.

PS2: After a system processing, they are used designer's deputy enunciators for the transition utterance and breakdown recovery utterance? In the negative case, report it as an **Incorrect Fact defect**

PS3: The system process was used in necessary moments for the interpretation of a transition user utterance? In the negative case, report it as an **Omission defect**.

5. MATERIAL USED IN THE EMPIRICAL STUDIES

5.1 Inspection Form Used in the Studies

Inspection Form for Interaction Models

Name: _____ Initial Time_____ End Time: _____

Number Defect	Verification Item	Defect Type	Defect Description

5.2 Questionnaire used in the Feasibility Study with MCards

Post-Study Questionnaire

Name: _____

Can you help us out by describing the positive and negative aspects of MoLVERIC Cards?

5.3 Questionnaire used in the Feasibility Study with MCheck

Post-Study Questionnaire

Name: _____

Can you help us out by describing positive and negative aspects of MoLVERIC Check for inspection of interaction models?

5.4 Questionnaire used in the Observational Study

Post-Study Questionnaire

Name: _____

Which technique (MoLVERIC Cards or MoLVERIC Check) would you choose to inspect another MoLIC diagram? Please justify your choice.

6. PARTICIPANTS'S PERCEPTIONS ABOUT THE MACARDS AND MCHEK TECHNIQUES

In the observational study, to analyze the participants' perceptions regarding MCards and MCheck, we used the following open question in the post-study questionnaire: "*Which technique (MoLVERIC Cards or MoLVERIC Check) would you choose to inspect another MoLIC diagram? Please justify your choice*". All participants' responses were:

"*MoLVERIC Cards are more interesting and I could see more defects*" (P1)

"*MCards could be used with several people debating defects, since possible mistakes can be avoided*" (P2)

"With MCards it is possible interestingly identify defects" (P3)

"I prefer MCheck because I don't like games" (P4)

"*The defects were well explained and easier to locate with the MCards"* (P5)

"*MoLVERIC Cards are useful and understandable, especially fun*" (P6)

"*MCards are more fun and the cards explain each defect better*" (P7)

"I would use MCheck because it is more direct" (P8)

"*The gamification element makes the experience so much more enjoyable*" (P9)

"*Mcheck for being so simple*." (P10)

"I think the card proposal is better compared to check. So I prefer MCards" (P11)

"MCards's cards are cool to do the inspection. This dynamic is fun" (P12)

"MoLVERIC Check is more organized and easier to identify defects" (P13)

"The techniques are almost the same, but the one with gamification is preferable" (P14)

"I prefer MoLVERIC Check because it's simpler" (P15)

"MCheck seems to be simpler to use" (P16)

"*I think it fun to inspect with the MCards, and the cards colors highlight the examples of defects*" (P17)

"I choose MoLVERIC Check because of its simplicity. The problem with Cards compared to Check is necessary to look at multiple cards and it can waste time searching" (P18)

"MoLVERIC Check is more direct and guides the inspector" (P19)

"With MoLVERIC Check you can find defects more simply, but I would choose MoLVERIC Cards if I had to apply it in a group" (P20)

"I prefer MCards for promoting a fun activity" (P21)

"*MoLVERIC Cards for being more playful, the inspection is somewhat more pleasant and less monotonous and tiring*" (P22)

"MCheck is easier to use because it is more specific for inspection." (P23)

"*Although both techniques are similar, MCards are much more fun and less tiring*" (P24)

"*My impression of the version of the cards was better because the information about the items to be inspected was fragmented, in the other technique I had difficulty classifying defects compared to the cards*" (P25).

"*I found it easier to understand defects with MoLVERIC Cards*" (P26)

"*MoLVERIC Check is more adult and objective*" (P27)

"M*Cards got more attention, but in practice, I prefer MCheck*" (P28)

"*MCheck has a more organized sequential and objective form*" (P29)

"*MoLVERIC Check is better because I would look for defects checklist than having to flip several different cards*" (P30)

"I prefer MCards because this technique highlights the defect we should look for" (P31)

"*MCards are apparently less tiring (MCheck presents all specifications on one sheet and tires the mind)*" (P32)

"*MoLVERIC Check is much simpler*" (P33)

"MCards is better because it makes inspection defiant" (P34)

"*MoLVERIC Cards are much simpler and more dynamic, not producing wear like the other more formal technique*" (P35)

"Although MCheck is simpler, I prefer to use MCards cards. I also think it's cool to have my colleagues competing in the inspection" (P36)

"*I believe with MoLVERIC Check I felt less confused and did a more effective inspection*" (P37)

"I choose MCards because I think the card inspection fun." (P38)

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