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POSITION PAPER

Systemic evaluation of actions toward developing practical broadband applications for elderly and people with disabilities

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Abstract The paper reports results of a structured democratic dialogue Co-Laboratory that aimed to *explore actions* that could alleviate obstacles preventing the development of practical broadband applications for elderly people and people with disabilities. Thirty-three experts representing stakeholders from 20 European countries and one from the USA participated. The same experts had participated in an earlier Co-Laboratory that aimed to *identify obstacles*, which prevent practical broadband applications from being produced and utilized. Each participant contributed one or more actions. Contributions were subsequently clustered and prioritized using a structured process. Relationships among actions were systematically studied using Interpretative Structured Modeling. The process resulted an influence map from which it is concluded that eight actions have the greatest influence (i.e., capable of producing maximum impact), and stakeholders should therefore focus their efforts on these actions: #26: "Provide empirical rather than anecdotal evidence that evaluation/testing makes products easier to use for everyone"; #25: "Provide an agenda for industry by unifying the disability community around a clear set of expectations, requirements, and principles"; #3: "Hold workshops in each country that encourage disability representatives to agree on a common set of accessibility measures"; #1: "Help formulate specific design requirements based on user needs"; #2: "Create consensus among the handicapped community about accessibility-related products and services and their market potential"; #20: "Promote inclusive laws and standards at the European level that cannot be avoided by European countries"; #14: "Find ways to influence public attitudes and create political will for actions'; #24: "Provide examples of instances where designing inclusively has benefitted business."

Keywords Accessibility · Disability · Broadband applications · Structured democratic dialogue · Complex social systems stakeholder groups

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1 Introduction

This paper reports results of a structured democratic dialogue (SDD) workshop hereafter referred to as Co-Laboratory [1, 2] that aimed to *explore actions* that could alleviate obstacles, which prevent the development of practical broadband applications for elderly people and people with disabilities. Thirty-three experts representing stakeholders from 20 European countries and one from the USA participated in this Co-Laboratory between May and October 2007. The same experts had participated earlier in an analogous Co-Laboratory that aimed to *identify obstacles* which prevent practical broadband applications from being produced and utilized [3]. The previous Co-Laboratory served to develop what the SDD methodology refers to as the *Problématique* [4]. Virtually all experts were national representatives of the COST Action 219ter: Accessibility for all to services and terminals for next-generation mobile networks [5]. The particular COST Action, funded by the European Commission, aspired to enable disabled and elderly people to share in the benefits of new mobile communication systems.

The previous Co-Laboratory resulted to the identification of the obstacles illustrated in Fig. 1.

Obstacle #32, i.e., "The difficulty of the 'handicap' community to agree on and to define what accessible products and services really mean," "sank" invariably to the root of the influence tree therefore making it stand out as the most significant obstacle. This finding is extremely important, and it was quite unexpected among the members of the group. Furthermore, Obstacle #14: "Poor connection between statements of user needs and specific design requirements," Obstacle #60: "The weakness of broad thinking from the disability lobbies," and Obstacle #50: "Lack of understanding of the marketing potential" have also stood out as extremely influential. The term "influential" in the SDD approach is used to allude to the fact that removal of such an obstacle will have the highest impact on resolving the *Problématique*. In order to address in a most effective way the tree of obstacles, the members of the COST 219ter community agreed to organize the Co-Laboratory reported in the present paper using the following triggering question:

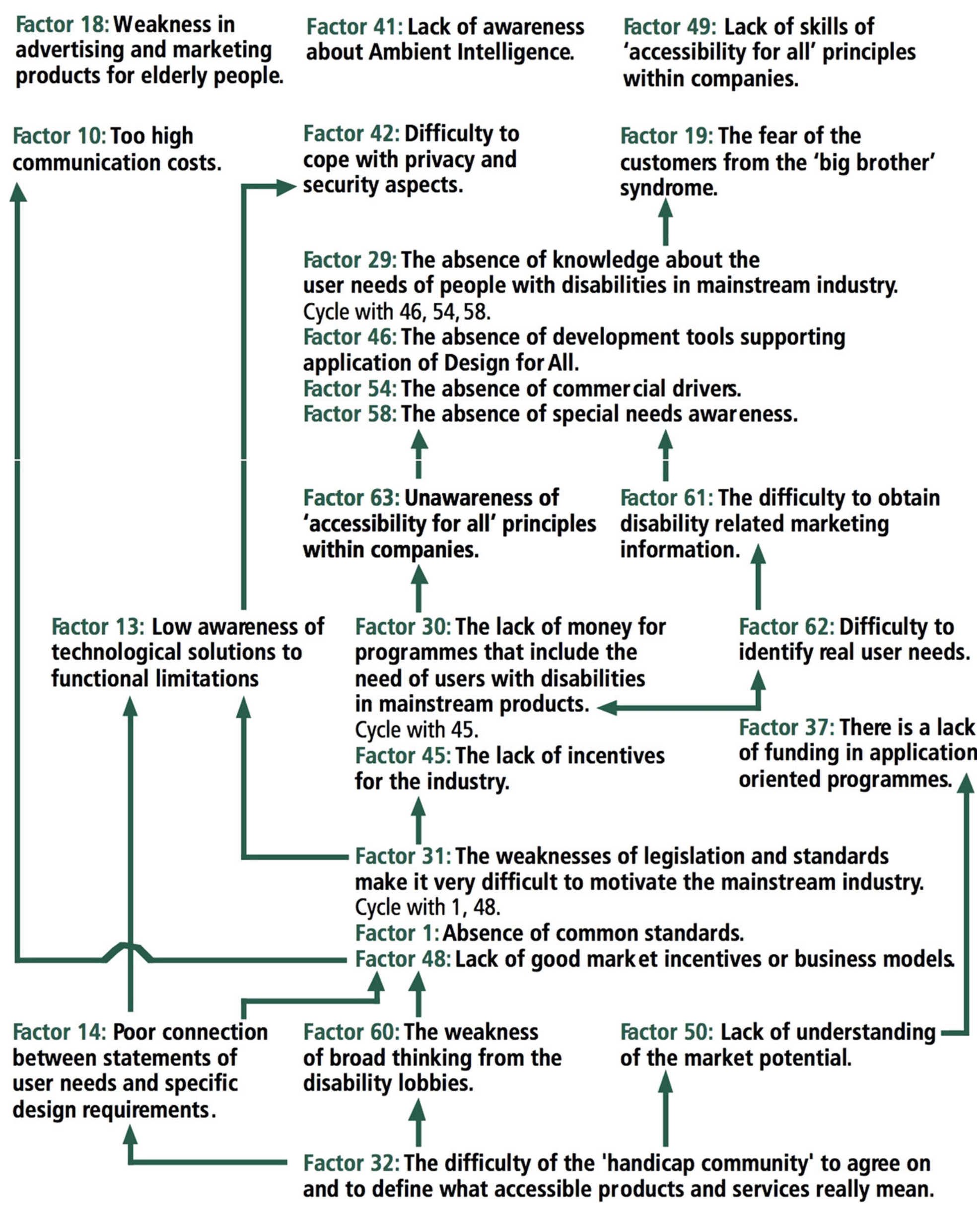

Fig. 1 Influence map of 24 obstacles that prevent practical broadband applications from being produced and utilized. Obstacle #32, at the root of the map, exerts the greatest negative influence. Reprinted with permission from (Laouris and Michaelides [3])

What actions can the COST 219ter community take to alleviate the obstacles that prevent the development of practical applications?

The specific objective was to construct group knowledge and thorough understanding of the interactions between possible actions within the relevant community, agree on the most influential actions, and build commitment toward a jointly agreed action agenda for collaboratively addressing the *system of obstacles* identified previously. Furthermore, the organizers aspired that the structured democratic model could support other European networks working on analogous problems, thus forging a *chain of interactions* that could eventually embrace the variety of stakeholders to collaborate toward the development and the implementation of an agenda to overcome the system of obstacles. Indeed, these Co-Laboratories provided the background for the implementation of a series of pan-European dialogues in the context of the CARDIAC FP7 Coordinated Action that aimed to develop road maps for future research and development in the area of accessible and assistive information and communication technology systems [6]. The particular focus was on inclusive human–machine interactions, network-based applications systems, and services supporting accessibility, as well as the technology transfer process itself. The results of those three structured democratic dialogues provided significant input to the European Commission in setting the research agenda priorities for the calls within the Horizon 2020 upcoming calls.

2 Methods

The Co-Laboratory was conducted using the Structured Dialogic Design Process (SDDP), by some also referred to as Interactive Management [7]. The SDDP methodology was chosen because it supports *democratic* and *structured* dialogue among a heterogeneous group of stakeholders. It is especially effective in resolving complex conflicts of purpose and values and generating consensus on organizational and inter-organizational strategy. SDDP is scientifically grounded on seven laws of cybernetics/systems science and has been rigorously validated in hundreds of cases during the last 40 years [8, 9]. A group of participants with knowledge about the situation at hand collectively develop a common intellectual framework based on consensus and a shared understanding of the current state of affairs. The SDDP process integrates contributions of individuals with diverse views, backgrounds, and perspectives through a structured, inclusive, and collaborative process. It therefore promotes focused communication among the participants during the design process and encourages a sense of ownership and a personal investment in the outcome. In sum, an SDDP Co-Laboratory provides an excellent opportunity for experts to not only expand their shared understanding of the current complex situation within a reasonable time frame, but also to develop a road map for their future work and achieve a consensus regarding how to move forward. Furthermore, the particular methodology was chosen because of the experience of the authors who have deployed it in numerous analogous forums to facilitate organizational change and social dialogue [2, 10–13]. Specifically, the SDDP aimed to facilitate the structuring of stakeholder representatives' proposals on possible actions and determine which actions would most effectively resolve the obstacles identified in the previous *Problématique* Co-Laboratory. The process is described in detail in earlier reports [3, 14].

2.1 The COST 219ter SDDP actions Co-Laboratory

A slight variation in the SDDP methodology was applied in the particular case reported in this paper, based on experimental validation conducted in the previous studies [15] in which the authors made use of virtual communication technologies to reduce the time required to obtain reasonable results. This revised hybrid methodology involved the following steps:

1. In consultation with other experts in the COST 219ter community, the triggering question was formulated and distributed 3 weeks before the face-to-face phase of the Co-Laboratory. The triggering question was sent by email to all participants in order to stimulate their interest and encourage them to begin generating proposals for actions before the actual Co-Laboratory. This step also reduced the time required to explain the methodology at the onset of the workshop.
2. During the following weeks and until the day preceding the Co-Laboratory, the participants were allowed to send their proposals by email to the facilitators.
3. All proposals were recorded by the facilitators and entered into the Cogniscope™ software program described below, and a compilation was mailed back to all participants just before the actual Co-Laboratory.

The face-to-face phase of the Co-Laboratory took place in a spacious conference room equipped with comfortable chairs, screens, a PC, and a projector. The layout of the space and the surrounding walls (where messages could be posted) were carefully chosen to meet the standards set by the Christakis group [8, 9].

The Cogniscope™ software [16–18] facilitated the collection of proposals for actions and clarifications, the clustering and the Interpretative Structured Modeling processes strictly following the SDDP Methodology.

Moreover, it removed logistical tasks from the participants therefore allowing them to concentrate fully on their discussions. Overall, this software supports facilitators in their tasks and helps them keep process and content completely separate.

3 Results

The results presented in this paper are the product of a Co-Laboratory that took place partly on a boat meeting between Stockholm, Sweden, and Helsinki, Finland (May 9–11, 2007), and completed later in Donostia-San Sebastian, Spain (October 1–2, 2007). A total of 33 experts representing stakeholders from 20 European countries and one from the USA participated in the structured dialogue. There was no need to select the participants to ensure that they represent all diverse interests and points of view because the European COST Action networks are formed by asking National Contacts points (in most cases the respective Academies of Science) to select their delegates. Nevertheless, their expertise and backgrounds were recorded (Table 1) to ensure that the diversity of their backgrounds and of their opinions satisfied Ashby's Law of Requisite Variety as applied in the science of dialogic design [8, 15].

As mentioned earlier in the paper, the triggering question was: "*What actions can the COST219ter community take to alleviate the obstacles that prevent the development of practical applications?*" The participants generated 48 proposals for actions in response to the triggering question (i.e., the actions that would best alleviate the obstacles preventing the development of practical applications). Some proposals were submitted by the participants before the face-to-face event. Nevertheless, more than 2 h were dedicated to the clarification of these actions during the first face-to-face meeting, to ensure that all participants understood both individually and collectively each proposal for action the way it was proposed by the respective contributor.

3.1 Clustering of the actions

The next phase was conducted by a group of four participants during a 2-h-long break between sessions. They clustered the actions into categories based on common attributes among the actions. The particular experts were chosen based on their long experience in the field and also because they represented opposite opinions within the group, therefore ensuring that their consensus would to some extent reflect a group consensus. They generated the eight categories reported in Fig. 2a, b.

Figure 2a, b was printed and handed out to all participants. They were also reproduced in large print that covered an entire wall. The participants were provided sufficient time to study individually and also to discuss as a group the clusters of actions. Subsequently, they were asked to select quietly and individually the five actions that they considered as the most important. Once they were ready, they could stand up, place their sticker votes on the respective actions that were displayed on the walls and leave the room. The votes were counted and inserted into Cogniscope™ by the facilitation team. Table 2 documents the resulting prioritization of the actions. Action #11 received 7 votes; Actions #9 and #20 received 6 votes; Actions #47, #25, and #33 received 5 votes; Actions #25 and #33 received 4 votes.

3.2 Generation of an influence map

The voting results were used to select actions for the subsequent structuring phase, during which relationships among the generated actions were explored. The participants were encouraged to engage in a structured dialogue to develop the "map of influences." All actions with two or more votes plus a few with one vote were selected. A total of 22 actions were used to structure the influence map.

The actions were projected on the screen in pairs accompanied by the following question:

> If Action X was successfully implemented, will that SIGNIFICANTLY support implementing Action Y?

During each comparison, the participants engaged in a focused dialogue that explored the particular relationship projected on the screen. This dialogue usually presents an opportunity for participants to refine meanings, uncover relationships, and generally develop a better understanding of the complexity of the situation. The arguments presented by the participants during this phase and their deliberations also serve as an educational exercise because it helps all participants to achieve the same level of understanding and knowledge about the particular field.

The method of presenting these questions uses the Interpretative Structural Modeling algorithm developed by Warfield [19]. This method allows the relationships between statements to be examined within a reasonable time frame. It uses deductive logic, i.e., if $A \rightarrow B$ and $B \rightarrow C$, then we can safely assume that $A \rightarrow C$) to minimize the number of combinations. The symbol $\rightarrow$ denotes "influences."

As quantities rather than ideas are concerned, it is essential to fully understand the meanings of the statements; thus, creating a common knowledge base is essential.

Table 1 Matrix of expertise within members of the COST219ter community participating in the SDDP

	Name	Organization	Country	User(s)	Human Factors	Researcher(s)	ICT Developer	Education/Trainin	Standardization	Regulation	Government	Service Delivery	Healthcare	Requirements	EU collaboration	Procurement	Authority
1	J. Engelen	Kath. Un. Leuven	BE	■		■	■		■		■	■	■	■			
2	Y. Laouris	CNTI	CY				■	■						■	■		
3	B. Rasch	TeleDenmark	DK							■	■					■	■
4	E. Winterberg	Zealand Care A/S	DK	■								■	■	■			
5	E. Kemppainen	STAKES	FI						■	■	■					■	■
6	A.L. Salminen	Social Insur. Inst.	FI			■						■					
7	C. Bühler	Univ. Dortmund	DE	■	■	■	■						■	■			
8	B. Allen	CRC	IE	■				■	■	■	■	■	■				
9	N. Bitterman	Technion Haifa	IL	■	■	■		■						■			
10	P.L. Emiliani	Nat. Res Council	IT	■	■	■			■	■		■		■	■		
11	T. Soede	IRV	NL			■		■						■			
12	H. Knops	Next Gen. 4All	NL									■	■				
13	K.A. Bringsrud	Univ. of Oslo	NO			■	■	■									
14	L.M. Pereira	FMH-Lisbon	PT			■	■	■							■	■	■
15	D. Freitas	Porto University	PT	■	■	■	■	■						■	■	■	■
16	J. Abascal	Univ. Basque Country	ES	■	■		■		■	■			■	■			
17	A. Richter	Användningsforum	SE		■					■	■					■	■
18	P. Roe	LEMA-EPFL-ITOP	CH			■		■		■	■				■	■	
19	J. Gill	RNIB/Consultant	UK		■				■								
20	R. Hecht	Post/Telecom-SE	SE	■	■				■	■						■	■
21	F. Miller	BT	UK	■		■	■					■		■			
22	T. Shipley	Phoeneability	UK	■		■	■					■					
23	N. Young	Design for Diversity	UK						■					■			
24	S. Tyler	EDF/RNIB	Expert							■	■	■	■	■	■	■	■
25	E. Chandler	RNIB	Expert	■								■	■				
26	C. Giovannini	ANEC	Expert						■	■	■					■	■

After considering all the necessary pair comparisons, a schematic presentation of the "actions map" was created using CogniScope™ software and projected on the wall.

The influence diagram of relationships is provided in Fig. 3. The tree has seven levels. The items shown at the top of the chart have the weakest influence, whereas the items with the strongest influence, or the so-called *deep drivers*, are gathered at the bottom of the tree. This method of presenting the results provides a visual interpretation of the participants' observations.

The 22 actions were divided into seven levels and were placed according to their relative influence. The actions at the lower parts of the influence map, positioned at the root of the tree (i.e., levels VII and VI), are more influential than those at higher levels. The most influential driver (i.e., the one at the root of the influence tree) turned out to be Action #26: "*Provide empirical rather than anecdotal evidence that evaluation/testing makes products easier to use for everyone.*" If this action were to be addressed first, the stakeholders would achieve the maximum impact for their efforts; its implementation would significantly help in implementing all the actions that lie above it. Action #25 in Level VI is almost equally important: "*Provide an agenda for industry by unifying the disability community around a clear set of expectations, requirements, and principles.*" It is worth noting

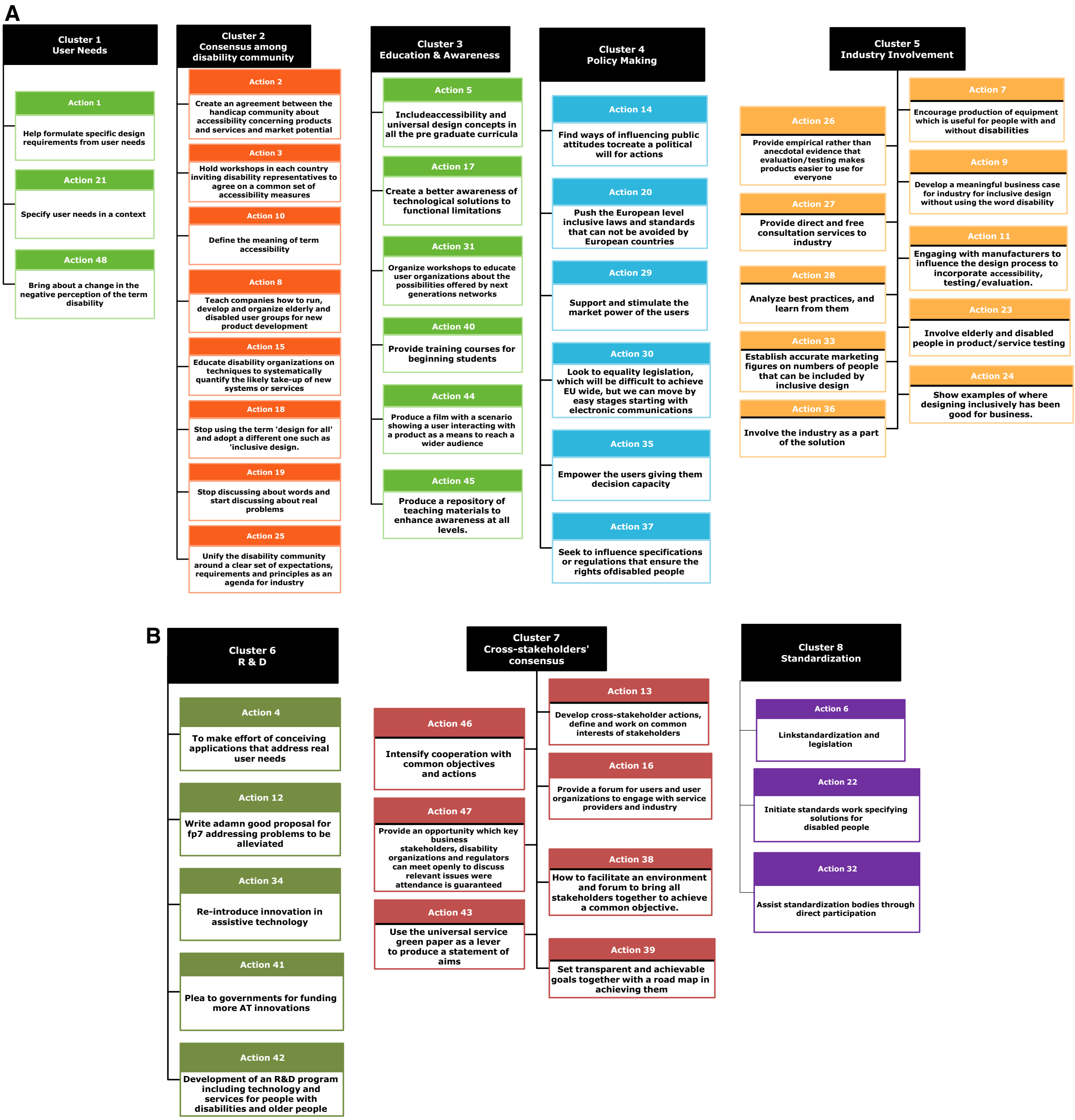

Fig. 2 **a** COST219ter corrective actions—clusters 1–5. **b** COST219ter corrective actions—clusters 6–8

that this action addresses directly the root obstacle discovered during the obstacles-definition Co-Laboratory (see root of Fig. 1).

Layer V features two actions:

Action #3: Hold workshops in each country that encourage disability representatives to agree on a common set of accessibility measures;
Action #1: Help formulate specific design requirements based on user needs;

Layer IV has four actions:

Action #2: Create consensus among the handicapped community about accessibility-related products and services and their market potential;
Action #20: Push for inclusive laws and standards at the European level that cannot be avoided by European countries;
Action #14: Find ways to influence public attitudes to create a political will for actions, and

Table 2 Results of the voting process

Action	Votes	Action
11	7	Engaging with manufacturers to influence the design process to incorporate accessibility, testing/evaluation
9	6	Develop a meaningful business case for industry for inclusive design without using the word disability
20	6	Push the European-level inclusive laws and standards that cannot be avoided by European countries
47	5	Provide an opportunity which key business stakeholders, disability organizations, and regulators can meet openly to discuss relevant issues were attendance is guaranteed
25	4	Unify the disability community around a clear set of expectations, requirements, and principles as an agenda for industry
33	4	Establish accurate marketing figures on numbers of people that can be included by inclusive design
14	3	Find ways of influencing public attitudes to create a political will for actions
22	3	Initiate standards work specifying solutions for disabled people
34	3	Re-introduce innovation in assistive technology
2	2	Create an agreement between the handicap community about accessibility concerning products and services and market potential
3	2	Hold workshops in each country inviting disability representatives to agree on a common set of accessibility measures
6	2	Link standardization and legislation
8	2	Teach companies how to run, develop, and organize elderly and disabled user groups for new product development
15	2	Educate disability organizations on techniques to systematically quantify the likely take-up of new systems or services
24	2	Show examples of where designing inclusively has been good for business
26	2	Provide empirical rather than anecdotal evidence that evaluation/testing makes products easier to use for every one
28	2	Analyze best practices, and learn from them
37	2	Seek to influence specifications or regulations that ensure the rights of disabled people
42	2	Development of an R&D program including technology and services for people with disabilities and older people
43	2	Use the universal service green paper as a lever to produce a statement of aims
7	1	Encourage production of equipment, which is useful for people with and without disabilities
10	1	Define the meaning of term accessibility
12	1	Write a damn good proposal for fp7 addressing problems to be alleviated
16	1	Provide a forum for users and user organizations to engage with service providers and industry
18	1	Stop using the term "design for all" and adopt a different one such as "inclusive design"
19	1	Stop discussing about words and start discussing about real problems
21	1	Specify user needs in a context
29	1	Support and stimulate the market power of the users
32	1	Assist standardization bodies through direct participation
36	1	Involve the industry as a part of the solution
45	1	Produce a repository of teaching materials to enhance awareness at all levels

Action #24: Provide examples of instances where designing inclusively has been good for business;

4 Discussion

According to the collective wisdom of the members of the COST219ter community, the actions that the community should take to overcome the obstacles preventing the development of practical applications are those that appear at the root of the influence tree. The community should focus its activities and commit resources mainly in two directions. First, they should approach and work more closely with the designers and researchers of new technologies. This action could apparently provide empirical rather than anecdotal evidence that evaluation/testing could make products easier to use for everyone. Second, the community should focus on providing an agenda for industry by unifying the disability communities around a clear set of expectations, requirements, and principles. Interestingly, this latter action is also the exact opposite of the root problem that emerged as the same group of experts met to explore obstacles in a previous Co-Laboratory [3].

The influence map should not be treated as a static road map for action. The map reflects the collective consensus that resulted when the participating stakeholders were allowed to discuss and plan their actions democratically and collectively. *It reflects their collective wisdom at the time it was created*. The participants have ownership over

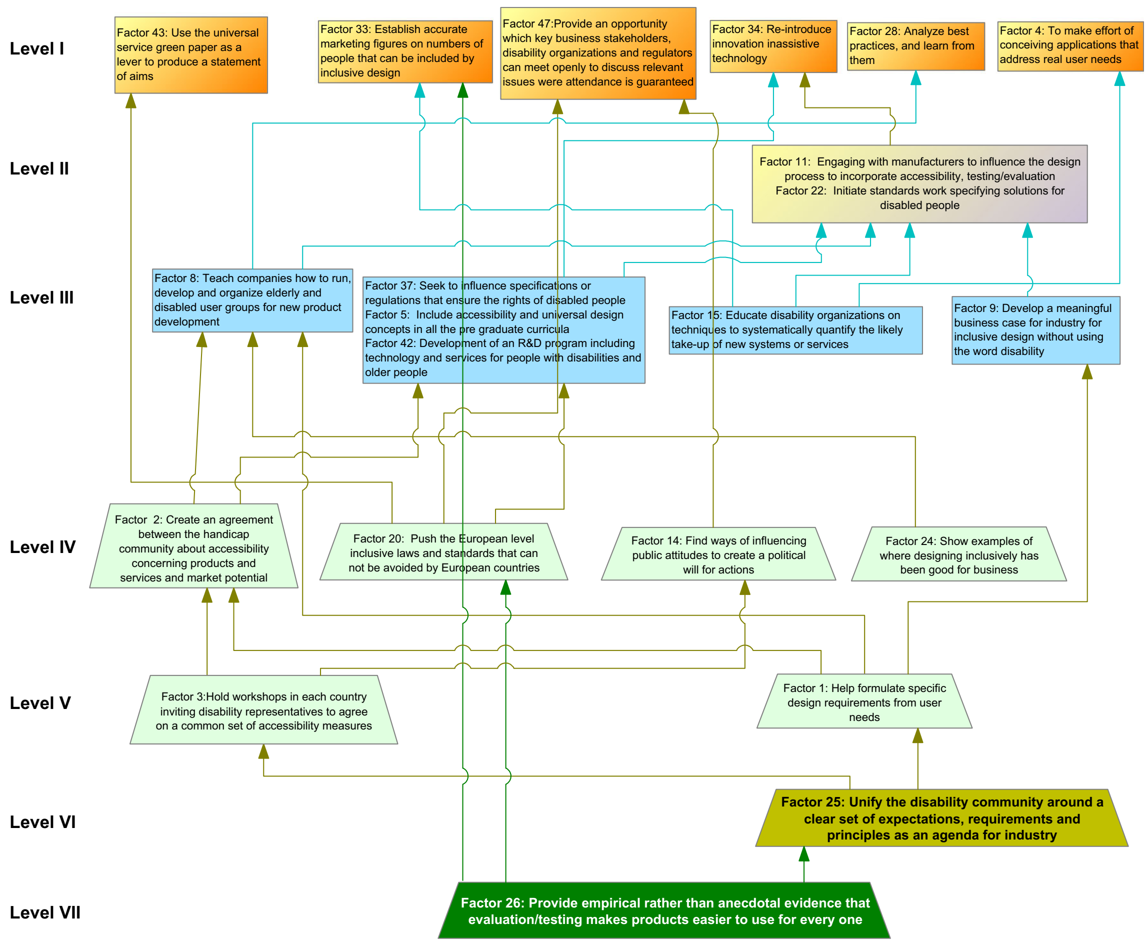

Fig. 3 COST219ter corrective actions—influence map. Factor 26: "Provide empirical rather than anecdotal evidence that evaluation/testing makes products easier to use for every one," and Factor 25: "Unify the disability community around a clear set of expectations, requirements and principles as an agenda for industry" exert the greatest influence

these results and therefore also the right and the capability to review issues, restructure the map, and reconsider the elements that compose it. For example, they have faced the case that cluster 3 was not originally represented in the map because none of its elements received any vote. The group felt that elements from this cluster could represent important actions they might wish to explore. They have therefore added Action #5 to the system and restructured the map.

4.1 Placement of actions with highest votes in the influence map

The experts in the COST219ter community perceived Actions #11 (7 votes), #9 (6 votes), #20 (6 votes), and #47 (5 votes) as the most *important* or most *significant* actions when they were asked to vote democratically. It is interesting to examine where these actions were placed in the influence tree after using the Interpretative Structural Modeling process. One would instinctively expect that these actions would turn out to be very influential and be the first to be addressed and implemented. This was clearly not the case. Of the four actions that received the most votes, one ended up in Layer II (Action #11), one in Layer III (Action #9), one in Layer IV (Action #20), and one in Layer I (Action #47). This placement indicates that, during the structuring phase of the SDDP, the "collective wisdom" of the experts gave higher priority to other actions. This lack of correspondence reveals a particular strength and value of this methodology. The contradiction between the democratically derived top-voted factors and the factors emerging out of the SDDP process as the most influential (i.e., those at the root of the influence map) is referred to as the Erroneous Priority Effect [20]. The structuring phase determined that the Actions #26, #25, #3, and #1 were the most *influential*. During the voting process, however, these actions received 2, 4, 2, and 0 votes, respectively. In summary, the actions that are most influential and would have the greatest impact if implemented were not obvious before the structured dialogue. Thus, one of the greatest values of the SDDP methodology lies in its power to identify the root causes of a problematic situation and highlight the actions that can most effectively achieve progress. In this study, the SDDP yielded a *structured road map* that none of the individual experts could have foreseen, let alone drawn up, showing the order in which the actions should be tackled in order to most effectively address the triggering question.

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