

Overview of 1st AEGIS Pilot Phase Evaluation Results

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Abstract. This paper presents the most significant results, emerging from the users' evaluation of the accessible solutions developed (and/or utilised as starting point) in the AEGIS IP project (Open Accessibility Everywhere: Groundwork, Infrastructure, Standards; <http://www.aegis-project.eu>) of the 7th European Framework Programme. Users participating in the first out of the three in total evaluation rounds scheduled within the project represented all user clusters targeted by the project. The emerging results, which are considered overall positive, will constitute the basis for the optimisation to be held until the next evaluation round of the project.

Keywords: eAccessibility, Open Source Software, iterative evaluation.

1 Introduction

The AEGIS IP project (Open Accessibility Everywhere: Groundwork, Infrastructure, Standards; <http://www.aegis-project.eu>) of the 7th European Framework Programme seeks to determine whether 3rd generation access techniques will provide a more accessible, more exploitable and deeply embeddable approach in mainstream Information and Communication Technologies (ICT) 1. This approach is being developed and explored with the Open Accessibility Framework (OAF) through which aspects of the design, development and deployment of accessible mainstream ICT will be addressed. OAF will constitute a comprehensive, holistic approach to programmatic support for assistive technologies to provide embedded and built-in accessibility solutions, as well as toolkits for developers, for “engraving” accessibility in existing and emerging mass-market ICT-based products, thus making accessibility open, plug and play, personalised and configurable, realistic and applicable in various contexts.

AEGIS is targeting users with visual, hearing, motion, speech/communication and cognitive impairments, elderly persons (since, as aforementioned, functional impairment increasingly appears in old age), as well as developers of ICT infrastructures, applications and services and relevant stakeholders and groups with interest in design processes (public or private, institutional or community groups) and aims to develop open source based generalised accessibility support into the

major mainstream ICT devices/applications domains, namely the desktop applications area, the rich internet applications (RIA), and the Java-based mobile devices domain.

The accessible solutions developed in the project have and will be tested in three evaluation rounds and one final demonstration phase with all types of users (users with impairments and developers) and other stakeholders (i.e. tutors, evaluators, carers, etc.) targeted by the project, whereas they will also undergo in each case a parallel technical validation by the development teams of the project (and also by external developers in the second and third evaluation rounds). This paper aims to present the most important results of the first evaluation round conducted with users in the project. Chapter 2 gives an overview of the pilot activities held and a short description of the prototypes tested, Chapter 3 presents in short the profile of the users participating in the Pilots, and, finally, Chapter 4 presents indicative results from the Human Factor Assessment with users. All pilot activities in the project have and will be conducted on the basis of a thorough and User Centred Design based and Ethics Policy compliant evaluation framework and detailed experimental plans, which will be optimised itself, based on the results derived by each evaluation round 2.

2 Overview of 1st Phase Pilot Activities and Tested Prototypes

2.1 Prototypes/Solutions Tested in the First Evaluation Round

In the context of the first evaluation round, 10 prototypes have been tested with users and 5 of them also underwent a technical validation. During the first 12-16 months of the ÆGIS project, there have been 6 preliminary prototypes developed by the respective development teams in ÆGIS, which reached an adequate maturity level in order to be included in its first evaluation phase. These are namely the “Accessible Contact Manager and Phone Dialer”, the “Concept Coding Framework Ooo Symbols”, the “DAISY Production”, the “GnomeShell Magnifier”, the “Haptic RIA maps” and the “ÆGIS RIA Developer tool”. In addition to the above prototypes, there were 4 concepts/prototypes developed outside of ÆGIS, selected to be tested in addition which were namely the “Open Speech Access to the GNOME Desktop environment” by Sun, the “AIM Real-Time Instant Messenger” by AOL, the “Oratio for Blackberry” by RIM and, finally, a collection of some Text To Speech sample files for language evaluation. Each of them is shortly described below.

The **Accessible Contact Manager and Phone Dialer** aims to show how the contact manager application will show the information and the contact details of each contact and is supported with a special support feature for cognitive impairment users to allow them recognise each contact by graphical information (picture), textual (label) and auditive (voice of the contact). The **Concept Coding Framework OooSymbols** aims to make the text based environment of a standard Office application suite – OpenOffice.org (OO.org) – accessible, as a productive tool also for users with more

profound problems in relation to text – both in terms of writing and reading. This will be achieved by – in addition to TTS reading support – providing graphical symbol support. Graphic symbols will illustrate the meaning of the words as they are entered into the text, or when text content is loaded from a file. The **DAISY Production** aims to demonstrate that it enables end users to create digital talking books in DAISY format from an (accessible) ODF document. The **GNOMEShell Magnifier** provides magnification for visually impaired users; the aim in this case was to test several features that have been implemented so far in the screen reader for the GNOME Desktop: Magnification Factor, Fullscreen feature, Moveable Lens feature, Scroll at Screen Edges feature. The **Haptic RIA maps** aim is to provide the visually impaired users with an easy way to use means of accessing conventional 2D maps. The user can interact with the produced 3D model of the map and examine its properties. The developed framework analyses the map image so as to obtain the enclosed information. While navigating, audio messages are displayed providing information about the current position of the user (e.g. street name). The **Open Speech Access to the GNOME Desktop environment** is not an actual prototype; the aim of the plan designed was to test the existing Orca screen reader with open desktop applications, the Firefox web browser, including ARIA enabled applications and also to test the screen reader customisation functionality. The **AIM Real-Time Instant Messenger** constitutes a working implementation of the commercial real-time text communication application of AOL (project beneficiary). The **Oratio for Blackberry** by RIM (project beneficiary) provides a screen reading software solution that allows people with severe visual impairments to access and operate BlackBerry smartphones. In the context of AEGIS, a proof of concept with users will take place in order to get feedback about the screen reader features, its performance, the inherent performance of the Accessibility API and of the Text-to-Speech (TTS), in order to apply or not in AEGIS relevant work. This prototype is built using an accessibility API and targets to verify the success of using this 3rd generation of accessibility with this AT. Also, **TTS sample files** have been provided for **language evaluation**, targeting at the evaluation of the TTS Engine and its further improvement in the context of the project. Finally, the **AEGIS RIA Developer tool** presents the basic idea of the accessibility support for RIA application developers.

2.2 Overview of First Evaluation Round Activities

The 10 prototypes have been evaluated in total with 185 users with impairments and 56 experts of various types (e.g. tutors, accessibility evaluators, consultants, etc.) and 7 developers (which tested of the AEGIS RIA developer tool). Tests have been conducted across 6 test sites (and 4 countries), namely in Belgium by EPR and KUL, in Spain by FONCE, in Sweden by SU-DART and in the UK by ACE and RNIB. It should be noted that users of each test site tested more than one prototype, which implies that the number of the testing sessions has been much higher than the absolute number of users participating in the assessment. The following table gives an overview of the pilot activities of the first round of AEGIS.

Table 1. ÆGIS Pilot activities overview

ÆGIS 1 st Pilot Phase prototype	Type and number of users per test site				
	SU-DART-Sweden	RNIB-UK	ACE-UK	EPR & KUL-Belgium	FONCE-Spain
Accessible Contact Manager and Phone Dialer	√ (tested by users with cognitive and speech impairments and experts in focus groups)	-	√ (users with cognitive, speech and motor impairments and experts in focus groups)	√ (users with cognitive, speech and motor impairments and experts in focus groups)	√ (users with cognitive, speech and motor impairments and experts in focus groups)
Concept Coding Framework Ooo Symbols	√ (tested by users with cognitive and speech impairments and experts in focus groups)	-	√ (tested by users with cognitive impairments and reading/language disorders and experts in focus groups)	√ (tested by users with cognitive and motor impairments and experts in focus groups)	-
DAISY Production	√ (tested with experts in focus groups)	√ (tested with experts in focus groups)	√ (tested with production centres representatives and with experts in focus groups)	√ (tested with users with speech impairments, blind and low vision users and experts in focus groups)	√ (tested with production centres representatives and with experts in focus groups)
GnomeShell Magnifier	-	√ (tested with users with visual impairments)	√ (tested with users with visual impairments and with experts in focus groups)	√ (tested with users with hearing and motor impairments, blind and low vision users and with experts in focus groups)	√ (tested with users with visual impairments and with experts in focus groups)
Haptic RIA maps	-	Not tested due to technical reasons	√ (tested with 2 evaluators taking part in performance testing and focus groups)	Not tested due to technical reasons	√ (tested with 2 evaluators taking part in performance testing and focus groups)
Open Speech Access to the GNOME Desktop environment	Not tested due to technical reasons	√ (tested with blind users)	-	√ (tested with users with motor impairments, blind and low vision users and experts in focus groups)	-
AIM Real-Time Instant Messenger	√ (tested with users with speech and motor impairments and experts in focus groups)	-	√ (tested with users with hearing and speech impairments and experts in focus groups)	-	√ (tested with users with speech and hearing impairments and experts in focus groups)
Oratio for Blackberry	√ (tested with blind users and expert users in focus groups)	√ (tested with users with visual impairments)	Not tested due to technical restrictions	√ (tested with blind users and users with visual impairments and experts in focus groups)	-
TTS sample files for language evaluation	√ (tested with users with speech and cognitive impairments and experts in focus groups)	√ (tested with blind users)	Not tested due to technical restrictions.	√ (tested with users with speech impairments, blind and low vision users and experts in focus groups)	√ (tested with users with speech and cognitive impairments and blind users and experts in focus groups)

ÆGIS 1 st Pilot Phase prototype	Type and number of users per test site				
	SU-DART-Sweden	RNIB-UK	ACE-UK	EPR & KUL-Belgium	FONCE-Spain
ÆGIS RIA developer tool	√ (tested with experts)	-	√ (tested developers and experts in focus groups)	-	√ (tested with developers)
Total number of end-users (some of them tested more than one of the above prototypes)	18 users with impairments 5 cognitive -speech-language-motor impaired 1 speech-language-motor impaired 3 speech-language impaired 2 speech-motor impaired 7 cognitive impaired	35 users with impairments 27 blind 7 low vision 1 low vision and hearing impaired	48 users with impairments 1 blind user 3 low vision 2 hearing impaired 20 cognitive impaired 20 motor impaired 2 speech impaired 2 RIA developers	34 users with impairments 1 blind 7 low vision 9 motor impaired 8 cognitive impaired 2 hearing impaired 7 speech impaired	50 users with impairments 10 cognitive impaired 11 speech impaired 10 visual impaired 10 motor impaired 9 hearing impaired 5 RIA developers
Total number of experts	10 experts (of all types) 2 tutors 2 education consultants-developers 2 tutors-education consultants 1 education consultant-expert user 1 education consultant 1 web developer 1 tutor-researcher +2 users participating as experts in focus groups	2 experts (with expertise in DAISY production)	23 experts of all types 10 with expertise in cognitive impairments 6 with expertise in motor impairments 7 with expertise in speech impairments	7 experts (of all types) 5 experts (2 of which with impairments) 2 tutors	14 experts (of all types) 2 production centre representatives 2 accessibility evaluators 3 with expertise in motor impairments 2 with expertise in cognitive impairments 2 with expertise in hearing impairments 1 with expertise in visual impairments 2 with expertise in speech impairments

3 Pilot Participants Profile

A series of selection criteria were defined and agreed upon by the whole ÆGIS Consortium (test sites and developers) to be considered in the participant recruitment for the different evaluation phases within the project. The selection criteria for the end users with impairments have been the type and severity of disability, gender, age, previous experience with using the devices analysed in the project (mobile, computer, internet), previous experience with using AT and previous experience of participation in similar activities of past or ongoing projects. The table below shows the distribution of the sample that should be recruited (where these percentages should be the minimum for each variable in order to ensure a controlled pool of participants), actual

percentages according to the recruited participants in each site and the deviation, if any, in the number of users needed to reach the minimum. Looking at the different columns of the table, one can notice that there are very slight deviations regarding the minimum acceptable percentages, which means that the sample of users recruited to carry out the evaluation test of the first phase has been correctly controlled by the Consortium in order to ensure the consistence and representativeness of the results. It also implies the statistical strength of the emerging results.

Table 2. AEGIS Pilot participants profile according originally defined recruitment criteria

VARIABLES		Minimum acceptable %	TOTAL		SPAIN (FONCE)		BELGIUM (EPR & KUL)		UK (ACE)		UK (RNIB)		SWEDEN (SU-DART)	
			Actual users (n=185)	Deviation No. of users	Actual users (n=50)	Deviation No. of users	Actual users (n=34)	Deviation No. of users	Actual users (n=48)	Deviation No. of users	Actual users (n=35)	Deviation No. of users	Actual users (n=18)	Deviation No. of users
Gender	Male	40% Min	61,6%	--	58,0%	--	47,1%	--	70,8%	--	68,6%	--	61,1%	--
	Female	40% Min	38,4%	3	42,0%	--	52,9%	--	29,2%	6	31,4%	3	38,9%	1
Age	18-34	25% Min	53,0%	--	44,0%	--	61,8%	--	89,6%	--	20,0%	2	27,8%	--
	35-54	25% Min	30,3%	--	36,0%	--	14,7%	4	10,4%	7	51,4%	--	55,6%	--
	55 or more	15% Min	16,8%	--	20,0%	--	23,5%	--	0,0%	7	28,6%	--	16,7%	--
Previous experience in using mobile	Yes	60% Min	67,0%	--	98,0%	--	91,2%	--	39,6%	10	28,6%	11	83,3%	--
Previous experience in using computers	Yes	70% Min	96,8%	--	100,0%	--	85,3%	--	97,9%	--	100,0%	--	100,0%	--
Previous experience in using internet	Yes	40% Min	78,9%	--	100,0%	--	85,3%	--	54,2%	--	71,4%	--	88,9%	--
Previous experience with AT's	Yes	50% Min	69,2%	--	48,0%	1	100,0%	--	45,8%	2	100,0%	--	72,2%	--
Previous participation in similar activities	Yes	30% Min	27,3%	4	46,0%	--	0,0%	10	18,8%	5	--	--	50,0%	--
	No	30% Min	72,7%	--	54,0%	--	100,0%	--	81,3%	--	--	--	50,0%	--

The selection criterion for experts and tutors is the type of disability in which each one has experience, which is directly linked to the beneficiaries of each prototypes. In the case of developers, the criterion is the type of area (mobile, desktop, RIA), and is also related to the environment of the prototype. This means that the selection for recruitment of experts, tutors and developers is not as specific and exhaustive as that one followed for the users with disabilities.

4 Human Factors Assessment Results

4.1 Human Factor Assessment Techniques

The evaluation approach followed in AEGIS needed to encompass all types of users that are interfering directly or indirectly with its solutions. Therefore, as shown in the table below, besides performance testing with end-users, deploying naturalistic observation methods, focus groups have been planned in order to involve tutors, experts and other relevant stakeholders. It is important to note that AEGIS has tried to gather both subjective and objective measurements; not aiming to evaluate the users' performance; on the contrary for evaluating the systems' performance through users' interaction with them. As such, a combination of contextual inquiry and performance testing took place, where the users were asked to perform designed tasks (assigned to their type of impairment) with the AEGIS prototype/proposed solution. Performance

stepwise testing scenarios were developed per prototype, and, when applicable, recommended execution times were defined for each step, to serve as thresholds for later analysis. On the basis of the scenarios, service diaries were developed to allow the testing supervisors to keep track of the users' performance testing while applying at the same time the Think Aloud or Co-discovery protocols.

Table 3. First evaluation phase techniques and tools applied in Human Factor assessment

1st Evaluation Phase Techniques and Tools	
<i>Evaluation technique</i>	<i>Tools to be used</i>
Training workshops and consent forms signed by end-users	Consent forms and training manuals
Questionnaires/Interviews addressing end-users	Subjective: Pre-test form
Performance testing combined with Naturalistic Observations and Contextual Inquiry addressing end-users	Objective: Service diaries and video/sound/screen recordings, in combination with: Subjective: Think Aloud/Co-Discovery Protocol/open questions
Questionnaires/Interviews addressing end-users	Subjective: Post-test forms, including standard scales and prototype-specific questions
Focus Groups involving all types of experts	Subjective: Open questions and free discussion and questionnaire

4.2 Indicative Human Factor Assessment Results

The most important results, of qualitative nature, as emerging from the questionnaires, interviews and the Think Aloud/Co-discovery Protocol open questions, during the testing with users and also during the focus groups sessions with experts are summarised below per prototype/mock-up/solution tested in the first evaluation round. It should be highlighted that the results provided below are only indicative (the length of this paper prohibits more extended discussion) and also refer only to those prototypes/solutions that have been developed within the context of the project.

Accessible Contact Manager: Overall, this prototype received positive feedback by users and unanimous overall appreciation by Focus Groups experts despite the series of technical problems noticed, some of which relating to controlling the phone. Users were specifically interested to know if this will finally work also in Symbian and Android (prototype tested was developed in J2ME). Interoperability with communication aids was considered essential. Room for optimisation was identified in a number of functions. For example, the scroll function should have a border on the side and be improved in general, an alphabet list should be added, it should be possible to adjust and customise settings, the most frequently used contacts should appear on top of the list, a better touch screen response is required, improvement of the small, unclear and hard to manage screen buttons is needed and also of icons and texts on some displays, better synchronisation of feedback messages is required, etc. The prototype was considered useful especially for people with mobility impairments (e.g. MS, degenerative muscle disease) because the pictures are easy to touch, and for elderly people, because

it works with pictures instead of small characters (they do not need an “elderly phone”), and, finally for persons with mild cognitive disabilities. However, there are still some navigation problems making it hard for people with manual dexterity problems.

Concept Coding Framework Ooo Symbols: Bliss-users seemed to have the greatest benefit. The modifications proposed encompass placement of text under symbols, possibility to show symbols only without text, to choose among multiple alternative symbols, to add own sets of symbols, to store in a smart way preferences, etc. Other languages availability than English (i.e. Dutch) seems essential, whereas it would be interesting to be able to deal with phrases in some way. Focus Groups experts expressed interest and requested for smooth interaction with TTS synthesis reading support.

DAISY Production: It has been considered a good, free way to generate DAISY material through OpenOffice. But it was made evident that the quality of the DAISY output is totally dependent on the quality, structure and tagging of the input document. Users were unable to find options in the prototype to select different audio compression settings. Lexicon files incorporated into the prototype would allow the user to correct errors in the audio such as pronunciation. Proposals for improvement encompass improvement of set of “voices”, easier installation on networks, more graded example documents in ODT and Daisy forms, improvement of choosing and finding location of output Daisy files, provision of continuous feedback about the current stage in the execution of tasks, possibility to choose pitch and speed. Focus Groups experts commented in addition that support for document structure would be appreciated. Also, that Odt2Daisy should enable the user to choose the voice so as not to consume resources if the user already has a TTS installed and does not want to install a different one.

GnomeShell Magnifier: The “movable lens” feature was considered the most intuitive and useful. The screen edges feature is very helpful when surfing the web. Proposed improvements encompass additional keyboard commands for scrolling the screen and changing the magnification level, improvement of the screen movement (more stable and avoid flickering), making it resizable so that it is customizable, have a small window to let the user get an overview of the full screen, improve color and contrast and visibility options for mouse and cursor, language availability, combination of the features with speech and improvement of quality of the characters in large magnifications (scale was also discussion point).

Haptic RIA maps: Some test sites (RNIB & EPR) did not manage to test this, due to compatibility issues with hardware and installation problems. However, high interest in the overall has been expressed. Recommendations for improvement encompassed language support, support to the user in order to know to which cardinal points s/he is heading to, improvement of the performance of the device to further refine the pointer and convey more sensations, improvement of the user’s feedback (vibration for street intersections and additional “push” info about directions or near places).

ÆGIS RIA Developer tool: According to the developers, the position of the different elements and application areas is simple and intuitive. However the description of the

controls is not fully clear, at least for developers unfamiliar with these development environments. Focus Groups highlighted the risk with throwing too much warnings and information at the user. Recommendations for improvement included direct editing of the styles of the components and language availability (other than English).

The aggregated results on the User Acceptance (measured on qualitative basis through the system acceptance scale 3) are shown in the following figure as a further reflection of the results presented above. As it is shown below, all prototypes have been positively rated against both indices of the scale (“Usefulness” and “Satisfaction”), besides the *RIA Developer tool*, the *Open Speech Access to the GNOME Desktop environment* and the *Haptic Ria Maps* prototypes.

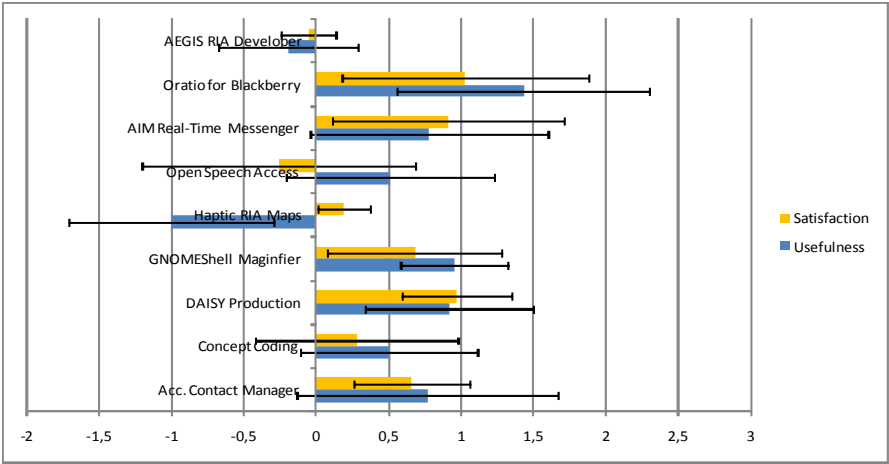


Fig. 1. 1st Evaluation Phase-User Acceptance results [Scale: “+2”- “-2”]

When defining the tasks upon which each prototype would be tested, in some cases and whenever applicable, the test sites experts had recommended average “acceptable” performance time for each task (and actually each step of the task) from each type of users. The performance of the users was recorded by the test conductors through in advance formulated service diaries together with the average % of task completion and average number of prompts by each user in order to complete the task. Table 4 provides these aggregated results (on task level), whereas the original recommended time is also indicated, whenever applicable. As it is shown in the table, the most considerable deviation is noticed in the *Haptic RIA Maps* prototype, whereas the most “difficult” prototypes for the users in general, if we judge from the average completion % seemed to be the *Accessible Contact Manager*, and the *RIA Developer tool*. However, especially in the *Accessible Contact Manager* case, the blame, as reported by the tests conductors, should be put on the task complexity and not the prototype itself. The number of prompts for every prototype was never more than 2, which is acceptable for the level of technical maturity reached at this first phase.

Table 4. 1st Evaluation Phase-Performance testing results

Prototype's Name	Average time (min.)	Average % of completion	Average number of prompts
Accessible Contact Manager and Phone Dialer	02:35 [Recommended: 1:23]	77,00%	1
Concept Coding Framework Ooo Symbols	Non applicable	85,00%	2
DAISY Production	00:20 [Recommended: 0:20]	100,00%	1
GNOMEShell Magnifier	Non applicable	100,00%	1
Haptic RIA Maps	06:06 [Recommended: 0:37]	100,00%	0
Open Speech Access to the GNOME Desktop environment	Non applicable	94,00%	2
AIM Real-Time Messenger	03:11 [Recommended: 01:34]	97,00%	1
Oratio for Blackberry	1:09 [Recommended: 01:15]	100,00%	1
AEGIS RIA Developer Tool	NA	80,00%	NA

Finally, regarding the **demonstration of the TTS engine** has not been that convincing. It is interesting to note that most people hadn't heard eSpeak before. Overall, prosody and punctuation got good ratings, whereas lowest pitch and slowest rate were preferred. According to Focus Groups experts it is good that exists as a free and last resort alternative, but it is applicable only for users who read to support themselves, e.g. blind users, and again, if no better alternatives are available. Also, it is not applicable for communication to other people, and certainly not for users with cognitive and/or perceptual problems. The voices are artificial and sound quite robotic and unnatural: the pronunciation, intonation, pauses and rhythm of the voice need improvements to make the speech more natural and closer to the human voice. Intelligibility must be improved because currently many users do not understand correctly the content. It would be appropriate to provide more speed options for the audio. The above certify that a lot of work needs to be done by ÆGIS and the whole research community in this area (to be reminded that this part of evaluation served as one of the starting points for the optimization and development work that needs to be held in the context of the project and not as a validation of work that has already been done).

5 Conclusions, Lessons Learned and Next Steps

This paper presents indicative results, emerging from the users' evaluation of the accessible solutions developed (and/or utilised as starting point) in the ÆGIS IP project. Users participating in the first out of the three in total evaluation rounds scheduled within the project represented all user clusters targeted by the project. 10 prototypes have been evaluated with 185 users with impairments and 56 experts of various types (e.g. tutors, accessibility evaluators, consultants, etc.) and 7 developers (as end-users of the RIA developer tool) in total across 6 test sites (and 4 countries).

Overall, a high interest was expressed from users in all prototypes tested. Users especially appreciated the availability of alternatives to commercial products and expressed their interest to participate in the next evaluation rounds of the project. The partial lack of local language adaptation of prototypes has been challenging in many cases, but, as reported by the test conductors, the users did make a big effort to

provide useful feedback to ÆGIS. Some of the prototypes were still in an early stage of development with reduced functionalities that resulted in a limited evaluation of all the features expected. Despite the above, a great deal of valuable input has been gathered to enable optimisation of the prototypes but also of the procedure to be followed in the next evaluation rounds.

The evaluation results of this phase (but also of the upcoming phases) will be provided in the form of short guidelines to the developer teams of the project, to allow optimization of their prototypes for the next round. In addition, the outcomes of the evaluation will enable finally the Consortium to come up with recommendations and feedback for standards in the relevant areas of research.

Last but not least, for the evaluation process itself, the Consortium has received feedback on how to optimise the process to be followed and the supporting tools in the next phases across all aspects.

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