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ReAAL

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Independent Living Application Portfolio, version C

[Deliverable 3.1C]

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Description:

The original version of this deliverable (released on 1-Jun-2013) reported about the results of work in T3.1 by describing the candidate applications for deployment within ReAAL along with a ranking of them based on a set of criteria relevant for the purposes of the ReAAL project. The second version provided an overview of the selected and deployed application by the ReAAL pilot sites, without any ranking of them. This is the final version of D3.1, which will ranks the applications based on their interoperability level, thus ensuring their ability to sustain after the project ends.

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Versioning and contribution history

Version	Date	Author	Partner	Description
0.1	07-01-2016	R. Pasmans	SmH	Lineout of the document
0.2	12-01-2016	R. Pasmans	SmH	Adding application ranking
0.3	20-01-2016	R. Pasmans	SmH	Adding ranking method
0.5	02-02-2016	R. Pasmans	SmH	Updating ranking method
0.6	15-02-2016	R. Pasmans	SmH	Adding ranking results
0.7	19-02-2016	R. Pasmans	SmH	Adding final overall ranking + weight
0.8	25-02-2016	Pilar Sala Soriano	UPV	Deliverable review
0.9	26-02-2016	R. Pasmans	SmH	Correcting comments internal review
0.91	03-03-2016	R. Pasmans	SmH	Updating the deliverable based on second round of internal Review
1.0	03-03-2016	Helmi Ben Hmida	Fhg-IGD	Release

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Executive Summary

This final deliverable reports the ranking of the applications used within the project from all pilots, including the associated pilots. These applications were rated and ranked on a specific set of criteria – usage of ontologies, usage of middleware busses, usage of middleware features, usage of middleware managers and usage of LDDI's exporters. With this set we are able to give a good inside on the sustainability of the applications after the project. Higher score on all these criteria gives the application a higher chance of interoperability on many different levels.

In total 33 applications were ranked with 17 questions using a Mean Opinion Score (MOS) scale from 1 (low) to 5 (high) on the mentioned criteria by 4 experts on universAAL with a good knowledge on the platform and its middleware. On every criteria, a mean was calculated with the applications that scored the highest. Also an overall mean was calculated with the use of weighting each criteria to perceived importance. A top five of applications that have the highest chance of self-sustainability was generated. The applications are;

Number	Application	Pilot	Overall MOS mean
1	Home management	WQZ	4.42
2	HWO	BSA	4.22
3	CuraVista	RNT	4.22
4	Agenda	BSA	4.09
5	Task scheduling	ODE	4.09

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1. About this document

In the first months of the Make It ReAAL project, a preliminary portfolio of 47 independent living applications has been gathered, described and archived. These applications were rated and ranked in a number of qualitative and quantitative rating studies, which provided rich in-depth data about independent living applications suitable for the project and pilots. The goal of the rating studies was to provide recommendations for the ReAAL application portfolio.

About two years later, a fully updated application portfolio was released on all applications that were deployed by mid-2015.

The 3th and last portfolio is focused on the ability of an application to sustain after the project has ended by investigating the implementations of ontologies, the usage of the middleware and the rich set of managers, features and exporters that universAAL has to offer. In chapter 2.2 the document explains why this set of criteria is used to rank the applications. WP2 member, who are experts on universAAL, have ranked all applications of the pilot this set of criteria. The result is reported in this document in chapter 2.4.

1.1. Version-specific notes

The version A of deliverable D3.1 has provided an initial ranking of applications by various experts of the consortium partners. The ranking was, however, based on many assumptions and estimations of factors, such as the costs of universAALisation, interoperability and perceived usefulness, maturity and reliability.

Version 3.1B was an intermediate deliverable after having performed steps of universAALisation assisted by T3.2 and the experience gained during the lab tests in T3.4. The version B reports an overview of all applications that are deployed within the 9 pilot sites, including current status and applied showcases.

Finally this deliverable version C shows the ranking of the deployed applications on sustainability, ranking 5 different items, namely; usage of ontologies, usage of middleware busses, usage of middleware features, usage of middleware managers and usage of LDDI exporters.

2. Application Ranking

2.1. Indepentent Living application portfolio

The creation of this third version of the portfolio will gain insight in the sustainability of each universAALized application. Developers in 8 countries have adapted 33 applications to universAAL. This process was managed and monitored by T3.2. Deliverable D3.2a and D3.2b “Application adaptation and maintenance” documents the steps taken to a successful adaptation. Deliverable D3.2a guided the pilots in the different adaptation strategies and ontologies where deliverable D3.2b also included the full adaptation or universalization process itself before the pilots went into the deployment phase.

Using these deliverables WP2 experts were asked to rank the applications on all necessary area’s; implementation and usage of;

- Ontologies
- Middleware busses
- Middleware features
- Middleware managers
- LDDI features

The ranking was done by filling in a questionnaire using a spreadsheet for easy distribution and accessibility. (see appendix 1). Every application was put into a separate tab for a structured overview, named with the short reference code of the pilot (e.g. PUG for Puglia Region) and a sequence number if the pilot had more than one application (e.g. PUG (3) was the 3th application of Puglia Region.

Every tab also contained a link to an online document containing all relevant and available information on the application.

2.2. Independent living application criteria

Let´s recall that the main goal of the ReAAL project is to measure the impact of open platform and interoperable solutions from social and economic perspectives.

For that, the project has built, in the context of WP3, several “universAALized” applications with the target of having them interoperable. More the ported applications makes use of the platform component, more they have a potential for maximising their interoperability level with other a-priories non known universAAL applications.

With respect to the project goals, and after developing and deploying the different applications, this deliverable has opted to study and report about the applications not from a technical level as it has been the case in Deliverable D3.1b, but from an interoperability capabilities level, thus qualifying the applications ability to interoperate with others based on several defined criteria.

The ranking is divided in subsets of criteria allowing to focus on specific aspects of the use and implementation. Specifically; usage of ontologies, usage of middleware busses, usage of middleware features, usage of middleware managers and usage of LDDI features.

2.2.1. Use of ontologies

When an application is build or ported to universAAL one of the first choices a developer has to make is (1) re-use an existing ontology, (2) extent an ontology to fit the need of the application or (3) create a new ontology. UniversAAL provides a set of most-used ontologies, however it is possible that a new application cannot fit the existing ontologies at any level. For this a process of creating a new ontology, with the help of WP2 experts was an option that could be requested by any pilot.

Table 1: shows which pilot use an existing ontology

	ODE	RNT	BSA	TEA	PGL	BRM	WQZ	ST	IBR
ont.device							X		X
ont.furniture							X		
ont.languages									
ont.lighting									
ont.phWorld			X			X	X		X
ont.profile			X	X		X	X		X
ont.health.measurement			X	X					X
ont.profile.health									X
onr.personalhealthdevice			X						

As table 1 shows, not many applications re-used existing universAAL ontologies. In this first criteria we rank the usage of an ontology, whether it is a newly created, extended or re-used ontology.

The ontology criteria ranking is on 4 different levels;

1) Is the ontology used in this application useful for any application?

By creating a more generic ontology the possibility for any (future) application to re-use this ontology increases. Ontologies should be designed in an application-agnostic way, without any application- or protocol-specific concepts.

2) Is the ontology in this application meaningful?

The ontology will be used to represent meaningful data: services provided by the application, or requested, or changes in the context. These structures built with ontologies must be understandable, that is, they must “make sense” in the way they are built.

3) Is the ontology in this application extensible?

New ontologies should be designed in the loosest way possible to represent the data required, rather than trying to cover every possible combination imaginable. There is no point in modelling the volume occupied by a sensor device if there is not going to be any application that uses that information. When someone develops that application, it will be up to him or her to extend existing ontologies with that model.

4) Is the ontology for this application as futureproof as possible?

Interaction between applications are described in terms of ontologies. Alternating existing ontologies require changes data handling at application level. It is difficult to design an ontology to be sure that it can remain unchanged in the future. It is therefore important to follow the principle: design ontologies to be generic and extensible, rather than very thorough, will leave room for future updates without having to change the existing concepts.

2.2.2. Use of middleware busses

The universAAL middleware is in charge of propagating the publications of the context events and the service request from an application to another as long as the latter is subscribing to those context event or implementing the service. The term bus is therefore used to express this propagation of information.

When an universAALized application makes use of the above-mentioned busses, it increases its separation into different modules communicating together through the platform middleware busses and not directly with each other’s. This flexibility will allow the applications modules to increase the potential chance to communicate with others modules through the middleware busses. This will increase the system interoperability capability.

This sub criteria looks at the available busses (context bus, service bus, UI bus) that the middleware has to offer and the usage of these busses. The application should at least use one of the three available. As none of the application make use of the UI bus, the focus is only on the context and service bus.

2.2.3. Use of middleware features

The platform has a rich set of features at the developers' disposal. The most important one from the pilots requirement perspective are; multi-language, Configurability API, logging-mechanism, multi-tenancy support, serialization & parsing API, AAL Space Management API. An application may or may not use one or more features, fully depending on the application's scope. Therefore the ranking focusses on how the features are used within the application rather than the quantity of used features.

2.2.4. Use of middleware managers

The two main managers that were used are the CHE and the situation reasoner.

The CHE stands for Context History Entrepot and stores all context events forwarded through the middleware into an ontological database in RDF statements format. This allows access to this data by several methods, like retrieving events stored from, to or between timestamps.

The Context History Entrepot (CHE) plays the platform data base role, where its usage allow sharing all application related knowledge (data) in a common central data base. This will allow the other applications/module running on the top of the platform and sharing the same AAL space to see, make use and profit from the shared knowledge through the usage of the SPARQL component. This will allow writing queries extracting the dedicated information without having any prior knowledge about the initial applications storing the knowledge in the universAAL CHE database.

The situation reasoner is a general-purpose reasoner that uses the database of CHE (and the possibility of ontological reasoning of its storage engine) and builds up new contextual information using the power of the RDF query language SPARQL. The basic task of the Reasoner itself is to manage Situations, Queries and Rules. This mean to provide services at the Service-Bus to add/remove/get Situations/Queries/Rules.

Introducing one or more middleware managers to an applicaiton increases the flexibility and sustainability of an application. However, application may or may not use one or more managers, fully depending on the application's scope. Therefore the ranking focusses on how the managers are used within the application rather than the quantity of used managers.

2.2.5. Use of LDDI features

Local Device Discovery and Integration (LDDI) defines an abstraction layer that is able to represent and to facilitate the integration of sensors and actuators from various protocols, e.g. KNX, Zigbee and FS20. Some of the applications make use of Zigbee, Continua (Bluetooth) and even custom build LDDI's such as integration with a Wago P.L.C. (programmable logic controller). The LDDI layer allow the system to have a clear separation between the hardware and the software parts of the system. Using the LDDI layer will allow the system to have a full independency between the hardware and software systems. In this context, the system will no more depend on a specific type of sensors, but will have the ability to "Plug" several similar hardware technology thus increasing the system ability to interoperate between different hardware protocol and type.

Only a handful of applications make use of exporters as it heavily depends if it fits within the scope of the application. Therefore the ranking focusses on how the LDDI

's are used within the application rather than the quantity of used LDDI's within an application.

2.3. Ranking method

The WP2 universAAL experts were given an questionnaire where all applications were listed with a total of 17 questions per application.

Every application has a separate tab and a link to an document containing all relevant information as described by D3.2b. Information on the application from the knowledge portal and other sources were also at the disposal of the surveyed.

The experts were asked to rate the aforementioned criteria on a Mean Opinion Score (MOS) scale from 1 (low) to 5 (high) – using the template presented in Appendix 1.

As not all needed information proved to be properly documented some of the questions could not be answered. For this the surveyed WP2 expert was asked to leave the question open to "Select your MOS score". If the application did not make use of the criteria's topic the surveyed WP2 expert was asked to fill in the additional answer "it is not used in this application".

In some cases it was possible that the answer "it is not used in this application" was already given as information of the application clearly indicated that the application did not make use of the criteria's topic.

At the end, all surveyed were asked an additional ranking of the five items (usage of ontologies, usage of middleware busses, usage of middleware features, usage of middleware managers and usage of LDDI's) to the perceived importance compared with the sustainability of an application. The average ratings are presented in figure 7.

An overall mean was calculated on the weighted items to provide a final ranking of the ReAAL applications. The overall mean for the first ratings of 33 applications is presented in table 8.

2.4. Application portfolio results

In total, WP2 experts rated 33 applications. An overview of the applications can be found in table 2 below. In the first column you will find the short pilot name and their number. In the second column you will find the applications and their names used in this deliverable. Perche pilot was not included in this deliverable as this pilot only imported applications from another pilot, in this case from BSA.

Table 2: list of all applications used in this deliverable

11-ODE	Rehabilitation Portal
	Task Scheduling

06-BSA	HWO
	Agenda
	Nomhad chronic

13-RNT	VitAAL-app
	MindDistrict
	MedicineMan
	NetMedical
	MiBida
	CuraVista

16-TEA	Cognibox
	eHealth
	SocialByElder
	OptiSAD

12-Puglia	Safety at home
	module "safehome" (Ingel)
	module "elektrosafe" (SteelMinds)
	module "iHELP" (Virtech)
	Home Activity Monitoring
	module "Indoor monitoring system" (eresult)
	module "Enviromental monitoring system" (eresult)
	module "Omnicare health check" (eresult)
	module "iCam" (Virtech)
	Easy Home Control
	module "Newdom" (Cupersafety)

20-Iber	Lynx ReAAL service: Immediate Aid Provider
	Lynx ReAAL service: Healthy Habits & Mental wellness

01-WQZ	Home management

04-SL	Smart Living System

ASSOCIATED PILOTS

IMA	IMA Technical Solution

NCSR	HealthTracker
	RemindMe

SCUPS	Home Care
	Remote rehab. & diagnostics on demand

EIC-IL	ACTI graph

Ideally, all applications should be rated with a higher number of participants but as the expertise needed to answer the questionnaire is very specific on universAAL, only a few people within the project were able to give answers. Although the statistical power of the questionnaire is low, it does give an insight of the sustainability of the applications ranked.

2.4.1. Usage of ontologies:

A total of 32 applications could be rated on the usage of ontologies. 13 were rated higher than the MOS scale mid-point. Coloured green and orange in table 3.

For an application to score higher than the scale mid-point of 3, the mean should be higher including the lowest error value. Standard Error (SE) is an estimate of the standard deviation of the sample-mean's estimate of a population mean (+/- 2 SE resembles a 95 percent confidence interval around the mean).

Reliability can also be expressed in terms of the standard error of measurement, i.e. high error can represent low reliability and low error high reliability. To reduce the number of candidates, the scale cut-off line was additionally increased to 3.5, and then 8 scored higher than 3.5. Coloured orange in table 3.

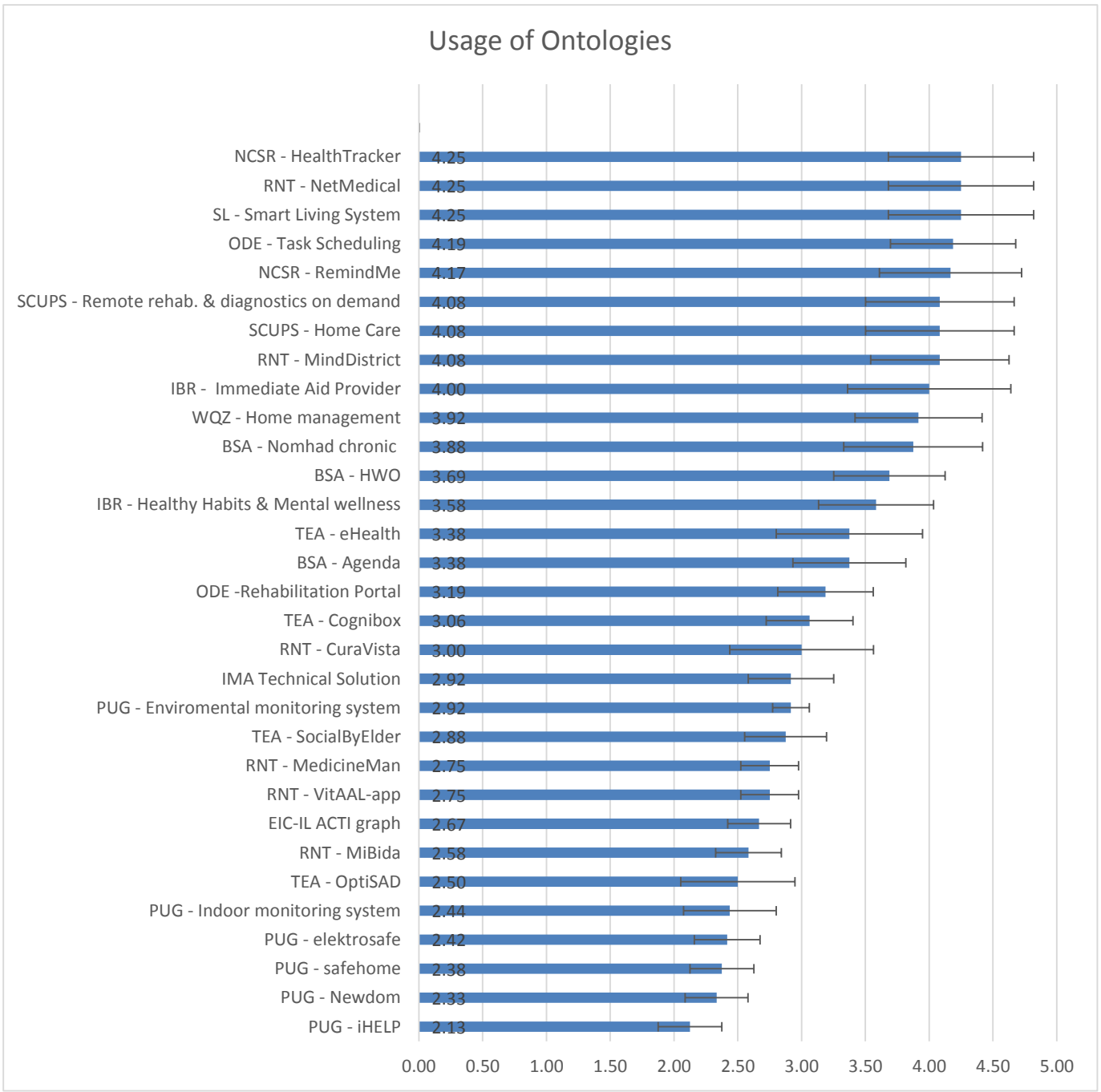

Figure 1: Ranking results of the usage of ontologies for all relevant applications

Table 3: Mean usage of ontologies by application with the number of samples (N), standard deviations (SDs), and the Standard error.

Application	N (min 2)	mean	standard deviation	standard error
SL - Smart Living System	12	4.25	1.14	0.57
RNT – NetMedical	12	4.25	1.14	0.57
NCSR - HealthTracker	12	4.25	1.14	0.57
ODE - Task scheduling	16	4.19	0.98	0.49
NCSR - RemindMe	12	4.17	1.11	0.56
RNT - MindDistrict	12	4.08	1.08	0.54
SCUPS - Home Care	12	4.08	1.16	0.58
SCUPS - Remote rehab. & diagnostics on demand	12	4.08	1.16	0.58
IBR - Immediate Aid Provider	12	4.00	1.28	0.64
WQZ - Home management	12	3.92	1.00	0.50
BSA - Nomhad chronic	16	3.88	1.09	0.54
BSA - HWO	16	3.69	0.87	0.44
IBR - Healthy Habits & Mental wellness	12	3.58	0.90	0.45
BSA - Agenda	16	3.38	0.89	0.44
TEA - eHealth	16	3.38	1.15	0.57
ODE -Rehabilitation Portal	16	3.19	0.75	0.38
TEA - Cognibox	16	3.06	0.68	0.34
RNT - CuraVista	12	3.00	1.13	0.56
PUG - Enviromental monitoring system	12	2.92	0.29	0.14
IMA Technical Solution	12	2.92	0.67	0.33
TEA - SocialByElder	8	2.88	0.64	0.32
RNT - VitAAL-app	12	2.75	0.45	0.23
RNT - MedicineMan	12	2.75	0.45	0.23
EIC-IL ACTI graph	12	2.67	0.49	0.25
RNT - MiBida	12	2.58	0.51	0.26
TEA - OptiSAD	16	2.50	0.89	0.45
PUG - Indoor monitoring system	16	2.44	0.73	0.36
PUG - elektrosafe	12	2.42	0.51	0.26
PUG - safehome	16	2.38	0.50	0.25
PUG - Newdom	12	2.33	0.49	0.25
PUG - iHELP	16	2.13	0.50	0.25

2.4.2. Usage of middleware busses

A total of 26 applications (both green and orange coloured, see table 4) were rated higher than the MOS scale mid-point of three and 8 scored higher than the 3.5 scale cut-off line. See orange colour in table 4.

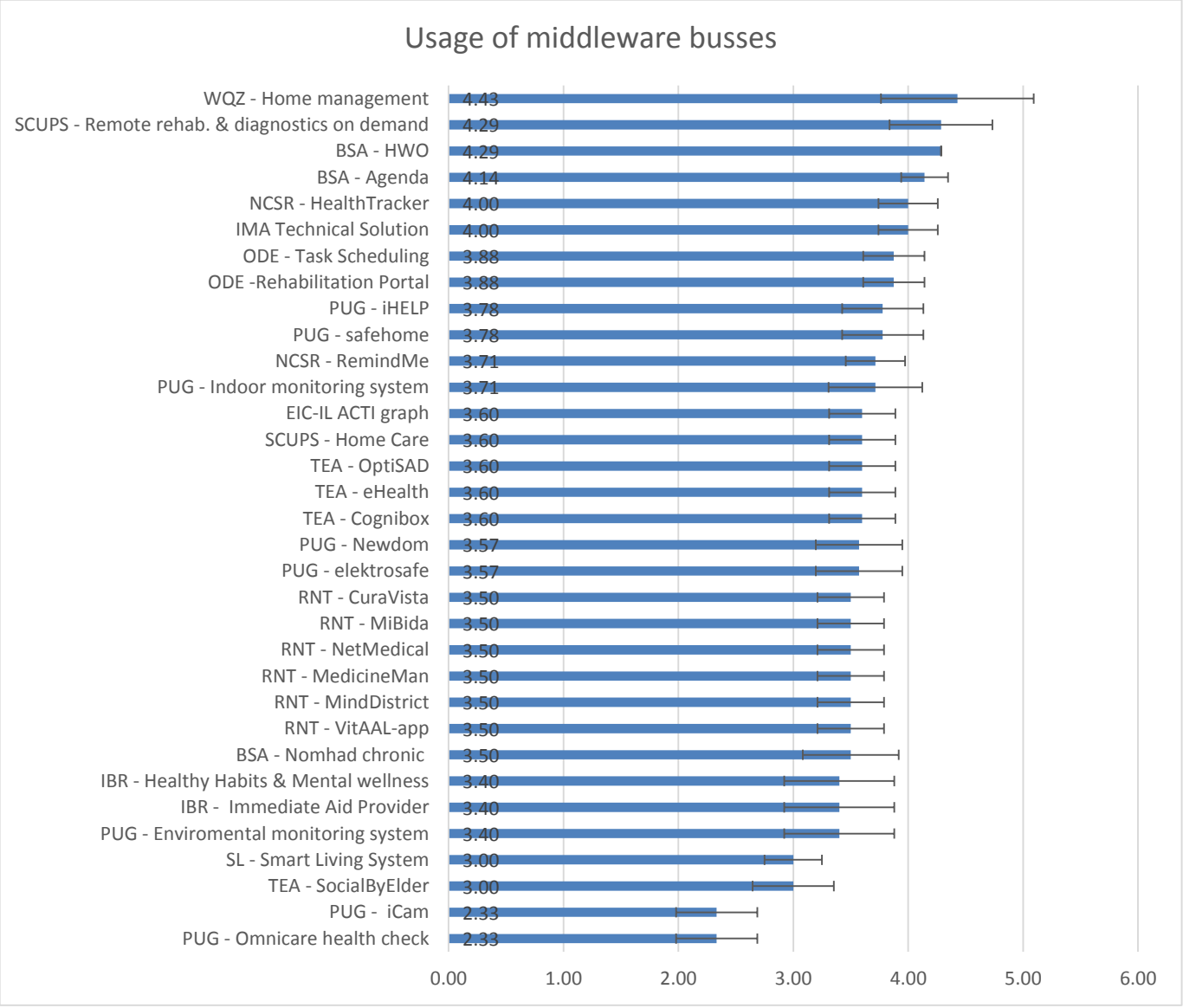

Figure 2: Ranking results of the usage of busses for all relevant applications

Table 4: Mean usage of busses by application with the number of samples (N), standard deviations (SDs), and the Standard error.

Applications	n (min 2)	mean	st. dev	st. error
WQZ - Home management	6	4.43	1.33	0.66
BSA - HWO	6	4.29	0.00	0.00
SCUPS - Remote rehab. & diagnostics on demand	6	4.29	0.89	0.45
BSA - Agenda	6	4.14	0.41	0.20
IMA Technical Solution	6	4.00	0.52	0.26
NCSR - HealthTracker	6	4.00	0.52	0.26
ODE -Rehabilitation Portal	7	3.88	0.53	0.27
ODE - Task scheduling	7	3.88	0.53	0.27
PUG - safehome	8	3.78	0.71	0.35
PUG - iHELP	8	3.78	0.71	0.35
PUG - Indoor monitoring system	6	3.71	0.82	0.41
NCSR - RemindMe	6	3.71	0.52	0.26
TEA - Cognibox	4	3.60	0.58	0.29
TEA - eHealth	4	3.60	0.58	0.29
TEA - OptiSAD	4	3.60	0.58	0.29
SCUPS - Home Care	4	3.60	0.58	0.29
EIC-IL ACTI graph	4	3.60	0.58	0.29
PUG - elektrosafe	6	3.57	0.75	0.38
PUG - Newdom	6	3.57	0.75	0.38
BSA - Nomhad chronic	5	3.50	0.84	0.42
RNT - VitAAL-app	3	3.50	0.58	0.29
RNT - MindDistrict	3	3.50	0.58	0.29
RNT - MedicineMan	3	3.50	0.58	0.29
RNT - NetMedical	3	3.50	0.58	0.29
RNT - MiBida	3	3.50	0.58	0.29
RNT - CuraVista	3	3.50	0.58	0.29
PUG - Enviromental monitoring system	4	3.40	0.96	0.48
IBR - Immediate Aid Provider	4	3.40	0.96	0.48
IBR - Healthy Habits & Mental wellness	4	3.40	0.96	0.48
TEA - SocialByElder	2	3.00	0.71	0.35
SL - Smart Living System	4	3.00	0.50	0.25
PUG - Omnicare health check	2	2.33	0.71	0.35
PUG - iCam	2	2.33	0.71	0.35

2.4.3. Usage of the middleware features

A total of 7 applications (both green and orange coloured, see table 5) were rated higher than the MOS scale mid-point of three and 1 scored higher than the 3.5 scale cut-off line. See orange colour in table 5.

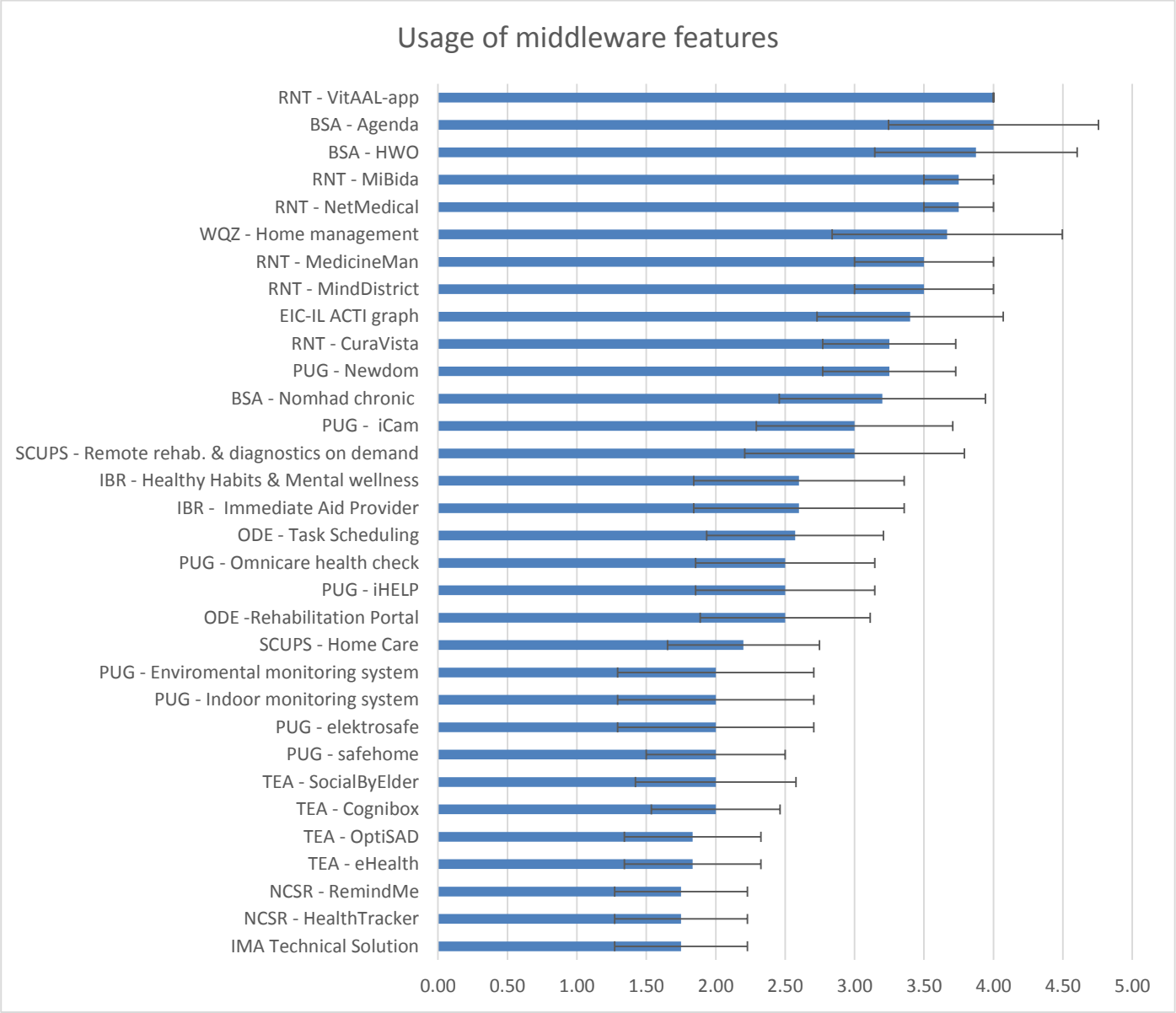

Figure 3: Ranking results of the usage of features for all relevant applications

Table 5: Mean usage of middleware features by application with the number of samples (N), standard deviations (SDs), and the Standard error.

applications	n (min 2)	mean	st.dev	st. error
BSA - Agenda	8	4.00	1.51	0.76
RNT - VitAAL-app	4	4.00	0.00	0.00
BSA - HWO	8	3.88	1.46	0.73
RNT - NetMedical	4	3.75	0.50	0.25
RNT - MiBida	4	3.75	0.50	0.25
WQZ - Home management	9	3.67	1.66	0.83
RNT - MindDistrict	4	3.50	1.00	0.50
RNT - MedicineMan	4	3.50	1.00	0.50
EIC-IL ACTI graph	5	3.40	1.34	0.67
PUG - Newdom	4	3.25	0.96	0.48
RNT - CuraVista	4	3.25	0.96	0.48
BSA - Nomhad chronic	5	3.20	1.48	0.74
SCUPS - Remote rehab. & diagnostics on demand	5	3.00	1.58	0.79
PUG - iCam	4	3.00	1.41	0.71
IBR - Immediate Aid Provider	5	2.60	1.52	0.76
IBR - Healthy Habits & Mental wellness	5	2.60	1.52	0.76
ODE - Task scheduling	7	2.57	1.27	0.64
ODE -Rehabilitation Portal	6	2.50	1.22	0.61
PUG - iHELP	4	2.50	1.29	0.65
PUG - Omnicare health check	4	2.50	1.29	0.65
SCUPS - Home Care	5	2.20	1.10	0.55
TEA - Cognibox	8	2.00	0.93	0.46
TEA - SocialByElder	4	2.00	1.15	0.58
PUG - safehome	3	2.00	1.00	0.50
PUG - elektrosafe	2	2.00	1.41	0.71
PUG - Indoor monitoring system	2	2.00	1.41	0.71
PUG - Enviromental monitoring system	2	2.00	1.41	0.71
TEA - eHealth	6	1.83	0.98	0.49
TEA - OptiSAD	6	1.83	0.98	0.49
IMA - Technical Solution	4	1.75	0.96	0.48
NCSR - HealthTracker	4	1.75	0.96	0.48
NCSR - RemindMe	4	1.75	0.96	0.48

2.4.4. Usage of middleware managers

A total of 7 applications (both green and orange coloured, see table 6) were rated higher than the MOS scale mid-point of three and all scored higher than the 3.5 scale cut-off line. See orange colour in table 6.

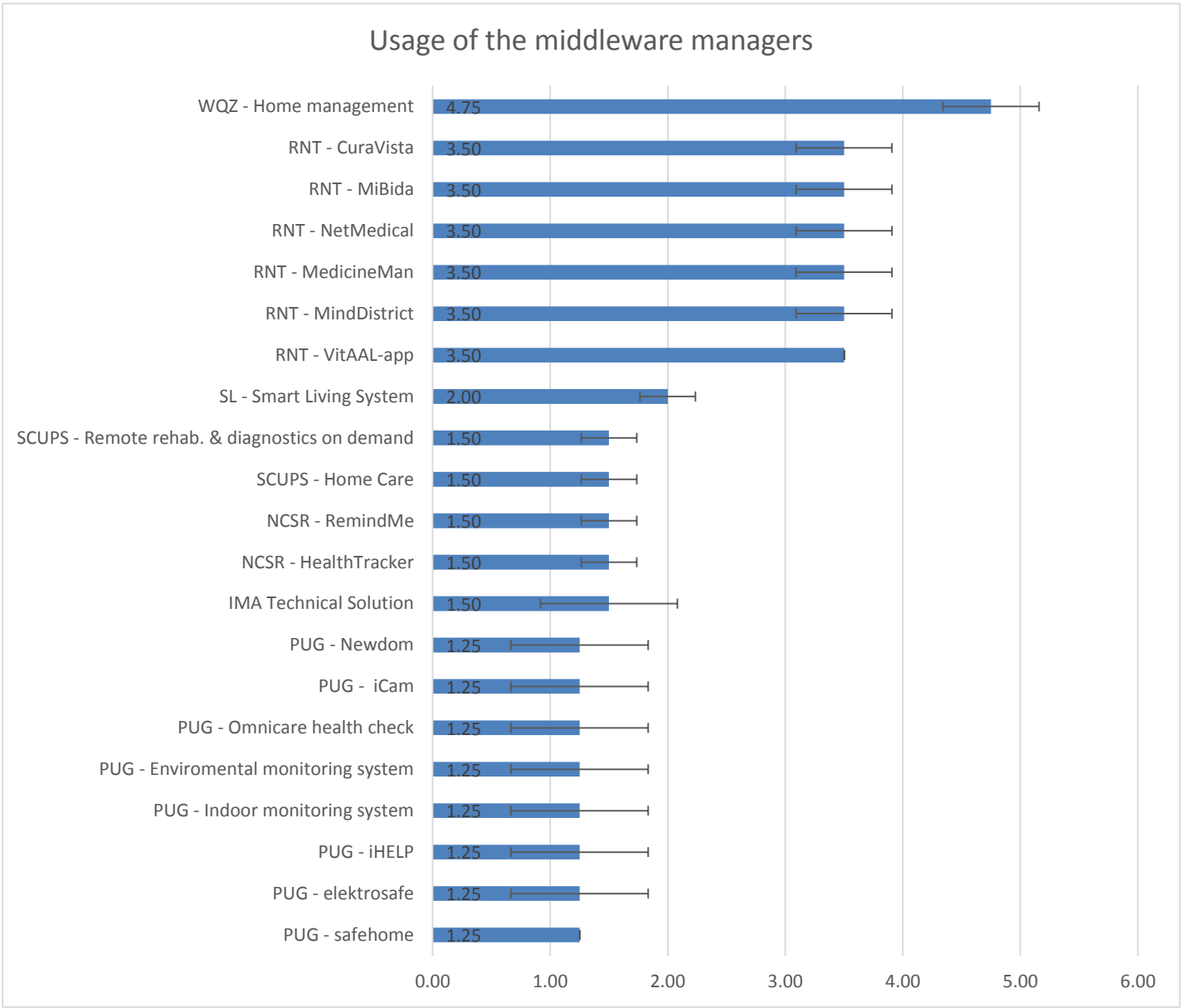

Figure 5: Ranking results of the usage of managers for all relevant applications

Table 6: Mean usage of managers by application with the number of samples (N), standard deviations (SDs), and the Standard error.

applications	n (min 2)	mean	st. dev	st. error
WQZ - Home management	4	4.75	0.49	0.24
RNT - VitAAL-app	2	3.5	0.82	0.41
RNT - MindDistrict	2	3.5	0.82	0.41
RNT - MedicineMan	2	3.5	0.82	0.41
RNT - NetMedical	2	3.5	0.82	0.41
RNT - MiBida	2	3.5	0.82	0.41
RNT - CuraVista	2	3.5	0.82	0.41
SL - Smart Living System	2	2	0.00	0.00
IMA Technical Solution	2	1.5	0.47	0.24
NCSR - HealthTracker	2	1.5	0.47	0.24
NCSR - RemindMe	2	1.5	0.47	0.24
SCUPS - Home Care	2	1.5	0.47	0.24
SCUPS - Remote rehab. & diagnostics on demand	2	1.5	0.47	0.24
PUG - safehome	4	1.25	1.17	0.58
PUG - elektrosafe	4	1.25	1.17	0.58
PUG - iHELP	4	1.25	1.17	0.58
PUG - Indoor monitoring system	4	1.25	1.17	0.58
PUG - Enviromental monitoring system	4	1.25	1.17	0.58
PUG - Omnicare health check	4	1.25	1.17	0.58
PUG - iCam	4	1.25	1.17	0.58
PUG - Newdom	4	1.25	1.17	0.58

2.4.5. **Usage of LDDI**

A total of 4 applications (both green and orange coloured, see table 7) were rated higher than the MOS scale mid-point of three and 1 scored higher than the 3.5 scale cut-off line. See orange colour in table 7.

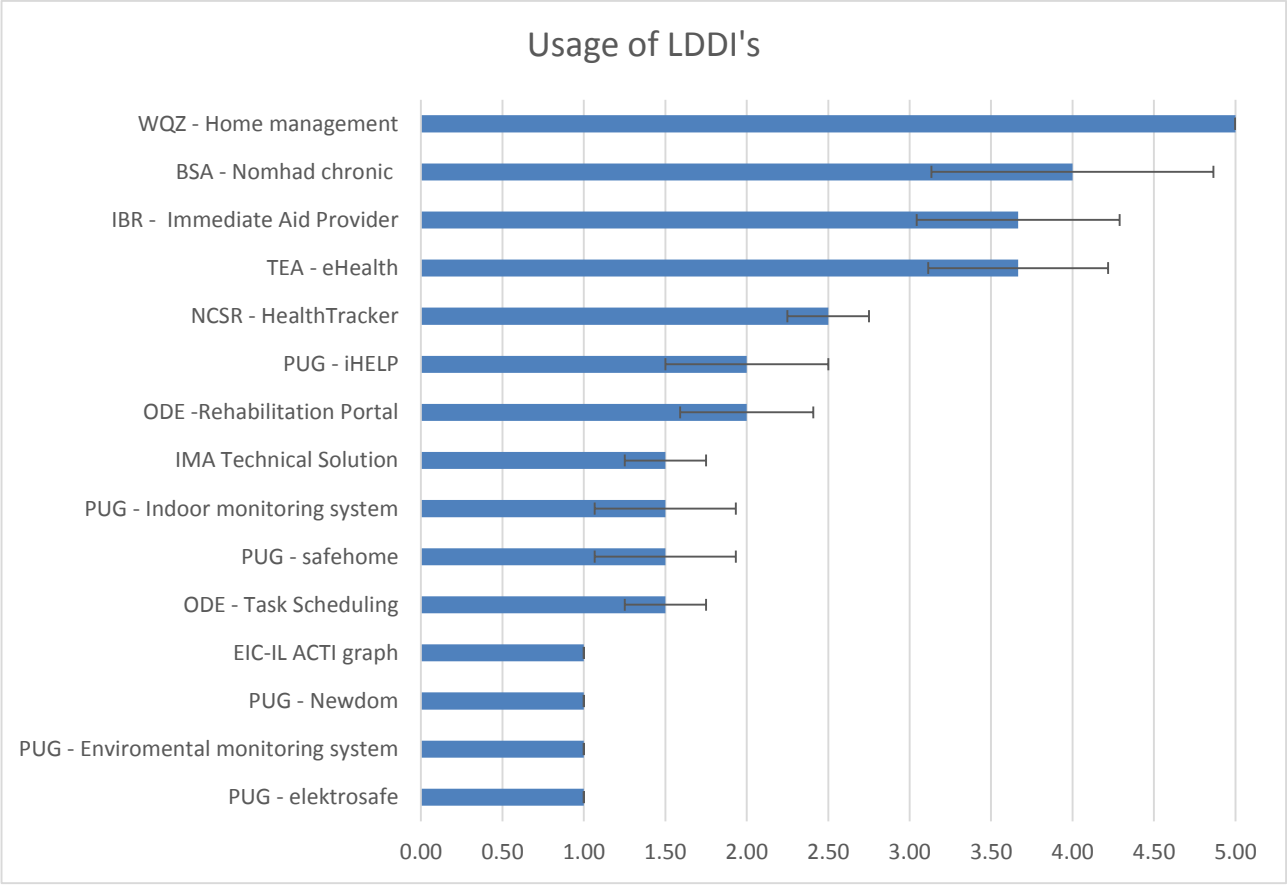

Figure 66: Ranking results of the usage of LDDI's for all relevant applications

Table 7: Mean usage of LDDI's by application with the number of samples (N), standard deviations (SDs), and the Standard error.

Applications	n (min 2)	mean	st.dev	st. error
WQZ - Home management	2	5.00	0.00	0.00
BSA - Nomhad chronic	4	4.00	1.73	0.87
TEA - eHealth	6	3.67	1.11	0.55
IBR - Immediate Aid Provider	3	3.67	1.25	0.62
NCSR - HealthTracker	2	2.50	0.50	0.25
ODE -Rehabilitation Portal	3	2.00	0.82	0.41
PUG - iHELP	2	2.00	1.00	0.50
ODE - Task scheduling	2	1.50	0.50	0.25
PUG - safehome	4	1.50	0.87	0.43
PUG - Indoor monitoring system	4	1.50	0.87	0.43
IMA Technical Solution	2	1.50	0.50	0.25
PUG - elektrosafe	3	1.00	0.00	0.00
PUG - Enviromental monitoring system	3	1.00	0.00	0.00
PUG - Newdom	3	1.00	0.00	0.00
EIC-IL ACTI graph	2	1.00	0.00	0.00

2.5. Weighting of Items

In order to create an overall rating of the applications, we combined the results from the figure 1, 2, 3, 5, 6. This was done by an additional rating with regard to the perceived importance of the selected criteria to ensure interoperability and sustainability of the applications. All experts rated the five items (Usage of ontologies, usage of busses, usage of features, usage of managers and usage LDDI's) on a scale from 1 (low importance) to 5 (high importance[1]) . The average ratings/scores are presented in Figure 7.

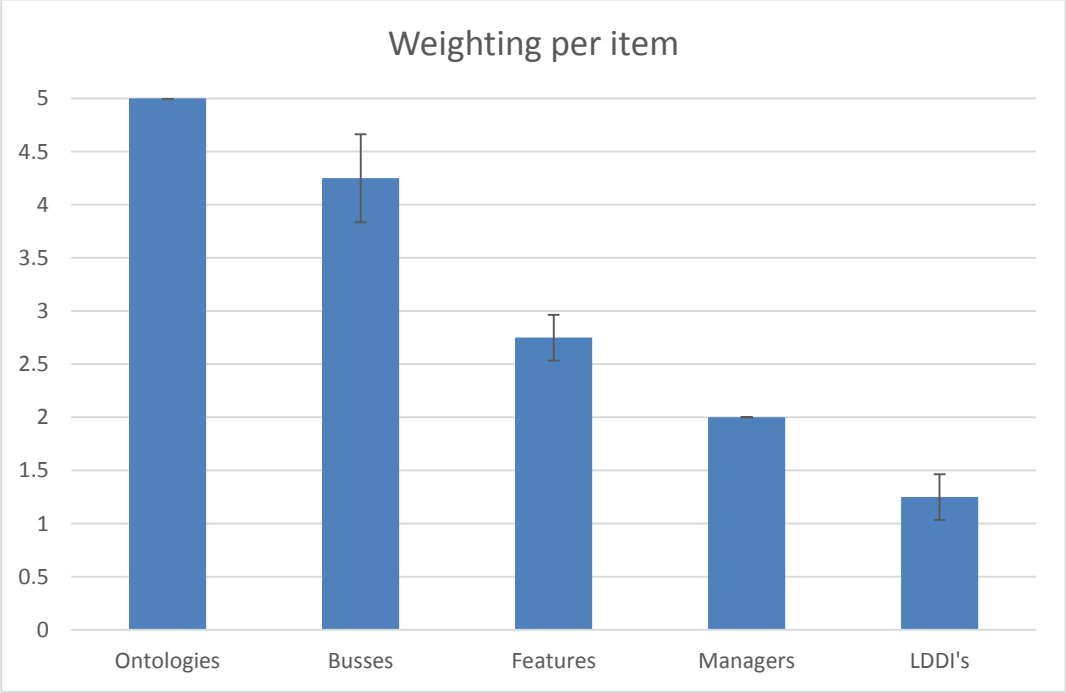

Figure 7: Results of the additional ranking on perceived importance.

The perceived mean importance indicates that use of Ontologies and busses are higher than usage of features, usage of managers and LDDI's. The usage of LDDI's is at the lowest level. The weighting range is set between the highest weight (1.1* the item) and the lowest weight (0.9 * the item). The usage of ontologies and usage of busses is above the 3.5 scale cut-off line and will be weighted with 1.1. The usage of features and usage of managers are +/- 1 around the MOS scale mid-point of three and will be weighted with 1. The usage of LDDI is below +/- 1 of the MOS scale mid-point of three and will be weighted with 0.9.

The summary of the weighted items result is:

- The usage of ontologies * 1.
- The usage of busses * 1.1
- The usage of features * 1.0

- The usage of managers * 1.0
- The usage of LDDI's * 0.9

2.6. Final Application Ranking

An overall mean was calculated on the weighted items to provide a final ranking of the ReAAL applications. The overall mean for the first ratings of 33 applications is presented in table 9. The top score applications are the 5 with the highest overall mean score. The top 5 scored is listed in table 8, below.

Table 8

Number	Application	Pilot	Overall mean
1	Home management	WQZ	4.42
2	HWO	BSA	4.22
3	CuraVista	RNT	4.22
4	Agenda	BSA	4.09
5	Task scheduling	ODE	4.09

Table 9; calculated overall means with weighting per criteria applied, orange coloured are the top 5 applications. Green coloured are scored above the 3.5 mid-scale point.

Application	**overall means**
WQZ - Home management	4.42
BSA - HWO	4.22
RNT - CuraVista	4.22
BSA - Agenda	4.09
ODE - Task scheduling	4.09
RNT - NetMedical	3.94
RNT - MindDistrict	3.84
BSA - Nomhad chronic	3.73
TEA - eHealth	3.73
RNT - VitAAL-app	3.59
IBR - Immediate Aid Provider	3.51
RNT - MiBida	3.49
RNT - MedicineMan	3.47
SCUPS - Remote rehab. & diagnostics on demand	3.43
IBR - Healthy Habits & Mental wellness	3.43
SL - Smart Living System	3.33
ODE -Rehabilitation Portal	3.02
TEA - Cognibox	3.11
SCUPS - Home Care	3.04
NCSR - HealthTracker	2.92
NCSR - RemindMe	2.98

EIC-IL ACTI graph	2.80
TEA - OptiSAD	2.85
TEA - SocialByElder	2.82
IMA Technical Solution	2.44
PUG - iHELP	2.41
PUG - Newdom	2.38
PUG - iCam	2.27
PUG - safehome	2.27
PUG - Indoor monitoring system	2.27
PUG - Enviromental monitoring system	2.22
PUG - elektrosafe	2.15
PUG - Omnicare health check	2.11

3. Conclusion

Developers in eight different countries have adapted 33 applications to universAAL. These applications have passed the lab-tests and are currently in the deployment phase. During this phase, no more alterations of the applications, which could severely change the features of the application or the underlying use of universAAL are expected. In consequence, a ranking of in total 33 applications was done based on a set of defined criteria that gained insights about the sustainability of an application outside the project. From the ranking scores a top 5 of applications was selected based on weights of perceived importance of the different criteria. We can conclude that these top 5 applications also scored very high on the individual ranking criteria. WQZ Home management scored number one for “usage of middleware busses”, number one for “usage of middleware” and number one on “usage of LDDI”. Help when outdoor and Agenda (both from BSA pilot) scored in the top 5 applications of “usage of busses” and “usage of features”. Overall RijnmondNet pilot scored very high with all the applications for “usage of middleware managers” although if we add up all scores only RNT”s applications Curavista entered the overall top 5 ranked applications.
As the “usage of ontologies” was perceived as the highest and received a weight factor of 1.1, the application from Odense pilot called task scheduling (4th scoring on ontologies criteria) was also listed in the overall top 5 scoring applications.
By having high scores in one or more of the criteria the chances increase that the application is interoperable and it can be easily implemented elsewhere.

Possible limitation of the rating is the small sample size, which also resulted in a relatively large standard error. Furthermore, the surveyed did not answer all the questions. They reported that not all information could be rated due to the lack of information available. This could be due to restrictions of in-depth information on an application. Nevertheless, the outcome does give insight in the pre-set goal of the deliverable, namely to rank applications on their sustainability from an interoperability perspective

Appendix 1 - Questionnaire template

< name of pilot >	
< name of applicaiton >	
<link to online documentation>	
Useage of ontologies:	
1) Is the ontology used in this application is useful for any application?	*Select your MOS score*
2) Is the ontology in this application meaningful?	*Select your MOS score*
3) Is the ontology in this application extensible?	*Select your MOS score*
4) Is the ontology for this application as futureproof as possible?	*Select your MOS score*
Usage of the middleware buses:	*Select your MOS score*
5) To which degree is the context bus used by this application	*3*
6) To which degree is the service bus used by this application	*Select your MOS score*
Usage of middleware features;	
7) To which degree is the multi-language support used in this application	*Select your MOS score*
8) To which degree is the Configurability API used in this application	*Select your MOS score*
9) To which degree is the logging-mechanism used in this application	*Select your MOS score*
10) To which degree is the multi-tenancy suppot used in this application	*Select your MOS score*
11) To which degree is the serialization & parsing API used in this application	*Select your MOS score*
12) The AAL Space Management API	*Select your MOS score*
Usages of middleware managers;	
13) To which degree is the CHé used in this application	*Select your MOS score*
14) To which degree is the Situation Reasoner services used in this application	*Select your MOS score*
Useage of LDDI features	
15) To which degree is the LDDI zigbee used in this application	*Select your MOS score*
16) To which degree is the LDDI Bluetooth Continua used in this application	*Select your MOS score*
17) To which degree is a Custom LDDI used in this application	*Select your MOS score*