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Unified theory of acceptance and use of technology (UTAUT) for market analysis of FP7 CHOReOS products

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Abstract

The European 7th Framework FP7-ICT-2009-5 project CHOReOS No. 257178 (2010-2013) "Large Scale Choreographies for the Future Internet (IP)" is aimed to elaborate on new methods and tools related to Future Internet ultra-large-scale (ULS) solution development based on the use of choreographies. The purpose of this research is to identify exploitable CHOReOS products and approaches and business market trends that may exploit them. The aim is to collect and assess early market inputs, thereby ensuring that market needs are addressed properly by the CHOReOS project. The market acceptance assessment is done using the Unified Theory of Acceptance and Use of Technology (UTAUT), but the credibility of results is assessed using Cronbach's Alpha, Split-Half Reliability and Spearman–Brown testing methods.

Keywords: CHOReOS; Dynamic development process model; Distributed service bus; IDRE; DynaRoute; IASAM; UTAUT

1. Introduction

The CHOReOS project positions itself in the context of the ULS Future Internet of software services. To address the challenges inherent of ULS as well as other key requirements of the Future Internet, such a fusion of user/developer/system roles, adaptability and QoS-awareness, to name a few, CHOReOS revisits the concept of

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choreography-based service composition in service-oriented systems. CHOReOS introduces a dynamic development process, and associated methods, tools and middleware sustaining the ever-adaptable composition of services by domain experts – being the users of business choreographies – in the Future Internet. CHOReOS concepts then encompass formally grounded abstractions and models, dynamic choreography-centric development process, governance and service-oriented middleware, thus providing an Integrated Development and Runtime Environment (IDRE) aimed at overcoming the ULS impact on software system development. Formally grounded abstractions and models enable reasoning about the properties, both functional and non-functional, of ULS choreographies. A dynamic choreography-centric development process enables the fusion of user/developer/system roles, while managing the ULS service base, and supports the synthesis of scalable and adaptable choreographies. Governance includes service integration policies and rules, as well as tools for dynamic verification and validation of choreographies. Finally, service oriented middleware enables adaptable choreographies over XSB-based middleware, Grids, Clouds, and technologies for the Internet of Things, thus overcoming scalability and heterogeneity issues of the Future Internet. Last but not least, CHOReOS assesses the industrial exploitation of this choreography-centric vision by experimenting on three demanding use cases in different domains (passenger-friendly airport, Adaptive Customer Relationship Booster (ACRB), vehicular network *DynaRoute*[1].

The purpose of current research is to identify the exploitable CHOReOS products and approaches and the market trends in the businesses that may exploit them. The aim is to collect and assess early market inputs. The market acceptance assessment is done using Unified Theory of Acceptance and Use of Technology (UTAUT), which is the first step in multi-level Integrated Acceptance and Sustainability Assessment Model (IASAM) elaborated under the framework of CHOReOS project.

2. About CHOReOS products

CHOReOS potential products could be divided between tangible (software) and intangible products (method, algorithm, methodology, model etc.), which is initial information for the market analysis.

The CHOReOS *Dynamic Development Process Model* is an abstract and simplified description of what will be the concrete development process adopted by CHOReOS. The model describes the "strategy" that CHOReOS uses for specifying, analysing, enacting, and monitoring ULS choreographies during the whole life cycle (from static to runtime to evolution). The model is made up of activities, common to (almost) every development process, but structured in a particular way (i.e., the "CHOReOS way"), hence distinguishing the CHOReOS development process from others[1].

The CHOReOS service oriented middleware consists of following major modules: eXecutable Service Composition (XSC), eXtensible Service Bus (XSB), eXtensible Service Discovery (XSD), eXtensible Service Access (XSA), and Cloud and Grid Infrastructure. These modules can be either used in isolation or as an integrated single middleware infrastructure for the enactment of large-scale choreographies.

The CHOReOS eXtensible Service Bus aims to provide a Service Oriented Architecture (SOA) backbone infrastructure for service choreography interaction and governance in the Future Internet (FI). The CHOReOS XSB comprises two main components[1]:

- The EasyESB enterprise service bus is a lightweight Enterprise Service Bus (ESB) that benefits from advanced SOA paradigms, it is built on top of a Model Driven Architecture (MDA) middleware. EasyESB enables the access to heterogeneous business services. Moreover, it allows the enactment of several services within a single choreography, thanks to the Component Coordination Delegates (CCD) ;
- The XSB abstract service bus is a set of architectural connectors and mappings among them, which aims at prescribing the high-level semantics of a novel service bus protocol. The XSB abstract service bus can be implemented on top of different service deployment and transport substrates. XSB is implemented on top of the EasyESB. XSB addresses in particular communication interoperability among services that run on top of different interaction paradigms, such as client/server and publish/subscribe, which is poorly addressed by typical ESB solutions.

The CHOReOS middleware will benefit Cloud and Grid computing. The CHOReOS Enactment Engine provides an easy and automated way to deploy large-scale choreographies on the Cloud. By using the CHOReOS software, the underlying infrastructure is kept transparent both to the choreography developer and to the end-user. Deploying tens of choreographies, each of them with hundreds of services running on hundreds of Cloud machines becomes easy when using the CHOReOS process and its Enactment Engine. The CHOReOS Cloud component does not provide the Cloud Internet as a Service (IaaS) layer itself. It relies on an existing stack such as Open Stack or Amazon EC2. Similarly, the middleware grid component must have access to a grid middleware, such as InteGrade or Hadoop, to submit the executables and run the computation[1].

The CHOReOS service-oriented middleware for the Internet of Things (IoT) aims to support applications that dynamically integrate networked sensor data in complex ways in response to user queries, where sensors may be embedded in smartphones and appear in ultra large scales, as envisaged by the IoT, which is an integral part of the Future Internet[1].

Verification and validation governance tools consists of ServicePot and rehearsal framework for testing of web service choreographies. ServicePot is a part of the reference implementation of the CHOReOS Governance Registry that will enhance standard service/choreography registries with Verification and Validation (V&V) features. The aim of the product is defining robust service/choreography registries that only link to "high-quality" entries.

Rehearsal aims to apply Test-Driven Development (TDD) to choreographies to facilitate their development and widen their adoption. It also supports scalability testing. Using the framework, the developer can manipulate service instances in a cloud environment, execute the defined scenarios and assess their scalability. Rehearsal supports unit testing of SOAP/WSDL and RESTful services[1].

The CHOReOS Integrated Development and Runtime Environment (IDRE) relies on a modular service-oriented architecture where a number of top-level coarse-grained components/subsystems are integrated in order to support the overall *development*, from design to implementation, together with *deployment* and *execution*, of *services choreographies in the Future Internet (FI)*. The IDRE top-level components are following: CHOReOS Development Environment, eXecutable Service Composition (XSC), eXtensible Service Discovery (XSD), eXtensible Service Access (XSA), Cloud and Grid Middleware, Governance and V&V Framework and CHOReOS Monitoring[1].

To show the benefits of the CHOReOS approach three demonstrators were designed: Passenger-friendly airport, Mobile-enabled coordination: Adaptive Customer Relationship Booster and DynaRoute application[1]. Almost all the software designed in the CHOReOS project is open source software (OSS).

3. Analysis of early market inputs

To gather data for early market assessment the review of businesses that could use choreographies and competitors analysis has been performed[1]. Potential domains such as air transportation, mobile operators, as well potential users from education, health and social care, governmental and media industry sectors were reviewed and competitive software and approaches were identified.

4. Introduction to UTAUT methodology application

Different methods are used for product acceptance analysis. *Technology future analysis (TFA)* – involves technology intelligence, technology forecasting, technology road-mapping, technology assessment, technology foresight[2]. Davis[3] defined perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort" and perceived usefulness on the other hand as "the degree to which a person believes that using a particular system would enhance his or her job performance". The *Technology Acceptance Model (TAM)* is best known and is repeatedly used in studies which focus on users[4].

The most prominent of these is the Unified Theory of Acceptance and Use of Technology (UTAUT). The unified model is based on studies of eight prominent models in IS adoption research. The model has been empirically examined and found to outperform the eight individual models, including the TAM model. Venkatesh et al.'s[5]

understanding of the conceptual summary of the eight leading models that explain individual acceptance of IT namely; Theory of Reasoned Action[6], Technology Acceptance Model[4], Motivational Model[7], Theory of Planned Behaviour[8], Combined TAM and TPB[9], Model of PC Utilization[10], Innovation Diffusion Theory[11] and Social Cognitive Theory[12].

Several constructs appeared in UTAUT to be significant direct determinants of intention or usage in one or more of the individual models.

As it can be followed from the conceptual framework, the model anticipates three constructs to be direct determinants of the behavioural intention to use ICTE (with 70 percent of variance in intention; being practically at the limits of related literature[5]) and one construct to be a direct determinant of usage.

For this research four constructs will play a significant role as direct determinants of user acceptance and usage behaviour:

- *Performance expectancy* - "the degree to which an individual believes that using the system will help him or her to attain gains in job performance";
- *Effort expectancy* - "the degree of ease associated with the use of the system";
- *Social influence* - "the degree to which an individual perceives that it is important others believe that he or she should use the new system";
- *Facilitating conditions* - "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system"[5].

Three additional constructs appeared to be significant direct determinants of intention in prior models; *attitude toward using technology*: "an individual's overall affective reaction to using a system"[5]; *self-efficacy and anxiety*. However, UTAUT proposes that these three constructs have no significant effect on intention. Self-efficacy and anxiety being similar in their effects; these three construct are proposed to be captured by effort expectancy construct of the model.

On the other hand, *gender, age, occupation* and industry presented are the moderators of the model[5].

The effects of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Self-Efficacy (SE), Facilitating Conditions (FC), CHOReOS products Anxiety (ANX), and Attitude towards CHOReOS products (ATT) on Behavioural Intention (BI) and the use of CHOReOS products are examined. The impacts of moderators in the UTAUT by Venkatesh et al. [5] are included in this test.

The central constructs of the UTAUT (PE, EE, SI, SE, FC, ANX, ATT, BI), including the description of CHOReOS products were formed by using factor analysis (principal component factor analysis, varimax rotation) to identify components with similar content, which then were represented by summated scale variables.

The statements in the questionnaire used were based on some previously conducted tests of the UTAUT as well as on research relating to the adoption and use of technology[5]. The variables were measured with 7-point scales for all model components as in the original UTAUT, where 1 equalled the negative end (fully disagree) and 7 the positive end of the scale (fully agree).

The variables for intention to exploit the features of CHOReOS products (in the questionnaire the word 'technology' is used) were measured with 4-point scales, where 1 equalled Never, 2 – Rarely, 3 – Sometimes, 4 – Often. Some demographics were added – Gender, Age, Country, Industry, and Occupation.

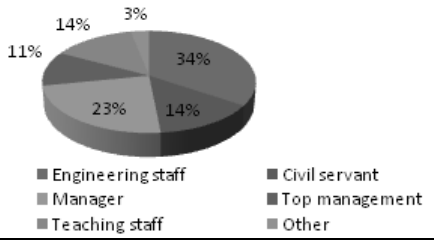
5. CHOReOS products acceptance analysis - results and findings

5.1. Respondent's profile

In this early market analysis study it has been decided to distribute the questionnaire among the associates working in the field of ICT. There are no other limitations. They are located in diverse locations, because the survey was performed on the Internet. Table 1 shows major profiles of respondents.

Table 1. Occupation fields of respondents (n=64).

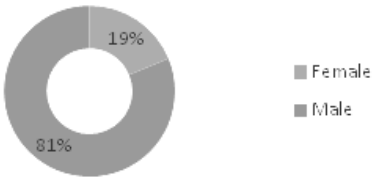
Occupation	Frequency	Share (%)
Engineering staff	22	34
Civil servants	9	14
Manager	15	23
Top management	7	11
Teaching staff	9	14
Other (Doctor, Scientific staff)	2	3



Most respondent occupations are related to engineering. More than a half are male. Table 2 shows the gender profile of the respondents.

Table 2. Respondents gender distribution.

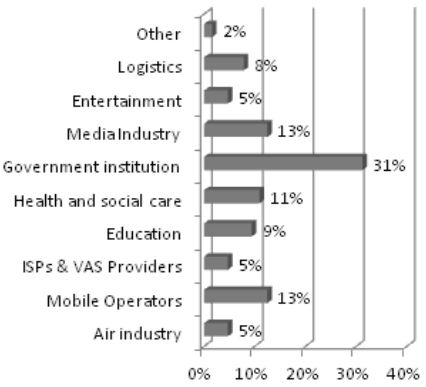
Gender	Frequency	Share (%)
Female	12	19
Male	52	81
Total	64	100



About one third of respondents work in government institutions. Other respondents represent industries important to the CHOReOS project (see Table 3).

Table 3. Respondents represented industries.

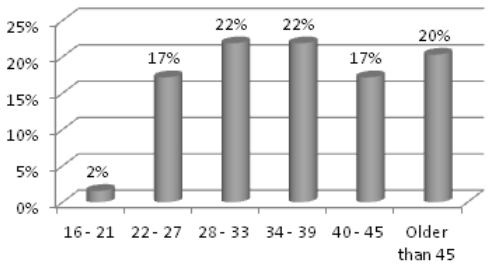
Industry	Frequency	Share (%)
Air industry	3	5
Mobile Operators	8	13
ISPs & VAS Providers	3	5
Education	6	9
Health and social care	7	11
Government institution	20	31
Media Industry	8	13
Entertainment	3	5
Logistics	5	8
Other	1	2



The survey involved respondents of ages between 28 and 39. This is also the most active part of Internet users (see Table 4).

Table 4. Respondents age distribution.

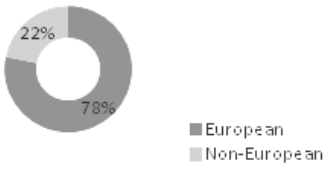
Age	Frequency	Share (%)
16 - 21	1	2
22 - 27	11	17
28 - 33	14	22
34 - 39	14	22
40 - 45	11	17
Older then 45	13	20



Most of the respondents are from European countries, although non-European countries are present (see Table 5).

Table 5. Respondent representation – European or non-European.

Location	Frequency	Share (%)
European	50	78
Non-European	14	22



5.1.1. Reliability

In this research:

- *Cronbach's Alpha* reliability test method has been applied. A higher value of Cronbach's Alpha is a better value of reliability. The Table 6 shows that each of the UTAUT scales that represent the UTAUT constructs are reliable, since Cronbach's Alpha is above 0.70[13];
- *Split-Half Reliability* - an alternative way of computing the reliability of a sum scale is to divide it in some random manner into two halves. If the sum scale is perfectly reliable, we would expect that the two halves are perfectly correlated (i.e., r = *1.0*). Less than perfect reliability will lead to less than perfect correlations. We can estimate the reliability of the sum scale via the Spearman-Brown split half coefficient[14];
- *The Spearman–Brown prediction formula*, also known as the *Spearman–Brown Prophecy* formula, is a formula relating psychometric reliability to test length and used by psychometricians to predict the reliability of a test after changing the test length[14]. Test length must grow by increasingly larger values as the desired reliability approaches 1.0.

The results of reliability tests based on 64 respondents summarised in Table 6. Calculations were done using a specially prepared format (http://www.gifted.uconn.edu/siegle/research/Instrument%20Reliability%20and%20Validity/reliabilitycalculator2.xls).

Table 6. Reliability analysis.

UTAUT parameter	Cronbach's Alpha	Split-half correlation	Spearman-Brown Prophecy	Number of Items
Performance Expectancy (PE)	0.800	0.717	0.835	4
Effort Expectancy (EE)	0.839	0.717	0.835	4
Social Influence (SI)	0.801	0.793	0.884	3
Facilitating Conditions (FC)	0.810	0.709	0.830	8

Self-Efficiency (SE)	0.788	0.614	0.761	4
Anxiety (ANX)	0.627	0.592	0.744	4
Attitude Toward Using Technology (ATT)	0.789	0.780	0.876	4
Behavioural Intention (BI)	0.805	0.716	0.834	7

Cronbach's Alpha coefficients are higher than 0,700, except for Anxiety.

Spearman-Brown Prophecy coefficient for Social Influence and for Attitude Toward Using Technology are the closest to 1.000. The same situation can be observed with Split-half correlation coefficients. It means that UTAUT parameters are the right ones in order to test future usage of CHOReOS products and the results are reliable.

5.1.2. Correlation analysis

Table 7 shows the results of Spearman's correlation analysis to test the relationship among the UTAUT parameters. Correlation analysis was done using a special calculation format (http://www.wessa.net/rankcorr.wasp).

In Table 7 each UTAUT parameter has two coefficients – not corrected and corrected.

There are some concepts that have a more significant relationship – between Performance Expectancy and Effort Expectancy and Behavioural Intention and between Attitude toward Using Technology and Facilitating Condition and Self- Efficacy.

An insignificant relationship between Age and SI, FC and SE; Industry and Attitude Toward Using Technology. The data also shows a significant relationship between Self-efficacy and Facilitating Condition (http://www.wessa.net/rankcorr.wasp).

Table 7. Spearsman's correlation table (n=64).

	Age	Country	Industry	Occupation	Gender	PE	EE	SI	FC	SE	ANX	ATT	BI
Age	1.000												
Country	0.292 0.041	1.000											
Industry	0.292 0.041	0.252 -0.015	1.000										
Occupation	0.407 0.376	0.337 0.092	0.078 0.031	1.000									
Gender	0.212 -0.119	0.638 0.254	0.315 0.038	0.361 0.091	1.000								
PE	0.131 0.032	0.486 0.244	0.117 0.017	0.368 0.288	0.404 0.081	1.000							
EE	0.094 -0.040	0.405 0.081	0.030 -0.113	0.213 0.086	0.404 0.038	0.679 0.603	1.000						
SI	-0.023 -0.143	0.586 0.395	0.186 0.093	0.280 0.187	0.316 -0.065	0.578 0.494	0.504 0.384	1.000					
FC	-0.023 -0.143	0.433 0.172	-0.069 -0.181	0.180 0.082	0.364 0.026	0.583 0.504	0.558 0.458	0.600 0.524	1.000				
SE	-0.075 -0.205	0.433 0.172	0.131 0.027	0.223 0.119	0.388 0.045	0.592 0.508	0.470 0.339	0.611 0.530	0.785 0.743	1.000			
ANX	0.206 0.081	0.446 0.046	0.311 0.147	0.191 -0.019	0.430 -0.031	0.395 0.185	0.232 -0.075	0.357 0.132	0.428 0.238	0.517 0.346	1.000		

ATT	-0.121	0.317	-0.030	0.048	0.430	0.392	0.478	0.341	0.756	0.641	0.262	1.000	
	-0.266	0.011	-0.126	-0.053	-0.031	0.286	0.367	0.224	0.716	0.575	0.027		
BI	0.063	0.563	0.089	0.275	0.375	0.784	0.478	0.618	0.619	0.574	0.283	0.578	1.000
	-0.053	0.353	-0.023	0.175	0.021	0.739	0.367	0.537	0.542	0.481	0.022	0.500	

5.1.3. Descriptive analysis

This section aims to provide a richer understanding of future exploitation of CHOReOS products. Almost all analysed items had 7 interval scores, in range from 1-7, except 3 – range from 1 – 4. The lowest score was 1 and the highest score was 7 (4). As can be seen in Table 8, most of the respondents gave a 6 and 7 score on Performance Expectancy.

Table 8. Performance expectancy (PE).

Questionnaire Item	Fully disagree	Disagree	Some-what disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
PE1: I would find the system useful in my job	0	0	0	12	20	**24**	8
	0%	0%	0%	18.7%	31.3%	**37.5%**	12.5%
PE2: Using the system enables me to accomplish tasks more quickly	0	0	0	8	**31**	21	4
	0%	0%	0%	12.5%	**48.5%**	32.8%	6.2%
PE3: Using the system increases my productivity	0	0	1	9	23	**29**	2
	0%	0%	1.6%	14.1%	35.9%	**45.3%**	3.1%
PE4: If I use the system I would have more chances for career	1	0	2	13	14	**27**	7
	1.6%	0%	3.1%	20.3%	21.9%	**42.2%**	10.9%

They quite agree that CHOReOS products will help to increase their productivity and will provide more chances in their career (see Fig. 1).

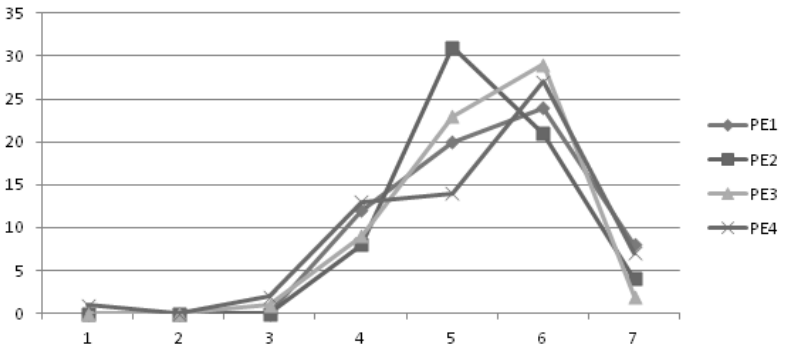


Fig. 1. Performance Expectancy scaling results.

Table 9 provides a clear understanding of respondent perception on Effort Expectancy. They agree that CHOReOS products will be easy to use, understandable and easy to master. Also they believe that learning will be easy.

Table 9. Effort Expectancy.

Questionnaire Item	Fully disagree	Disagree	Some-what disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
EE1: My interaction with the system would be clear and understandable	0	2	1	7	**29**	21	4
	0%	3.1%	1.6%	10.9%	**45.3%**	32.8%	6.3%
EE2: It would be easy for me to become skilful system exploitator	0	0	4	7	23	**29**	1
	0%	0%	6.3%	10.9%	35.9%	**45.3%**	1.6%
EE3: I would find the system easy to use	0	0	4	9	20	**28**	3
	0%	0%	6.3%	14.1%	31.3%	**43.8%**	4.7%
EE4: Learning to operate the system will be easy for me	0	2	1	3	22	**31**	5
	0%	3.1%	1.6%	4.7%	34.4%	**48.4%**	7.8%

Most of the respondents gave a score of 6 on Effort Expectancy (see Fig. 2). This confirms that CHOReOS products will be easy to use and adopted by the prospective clients.

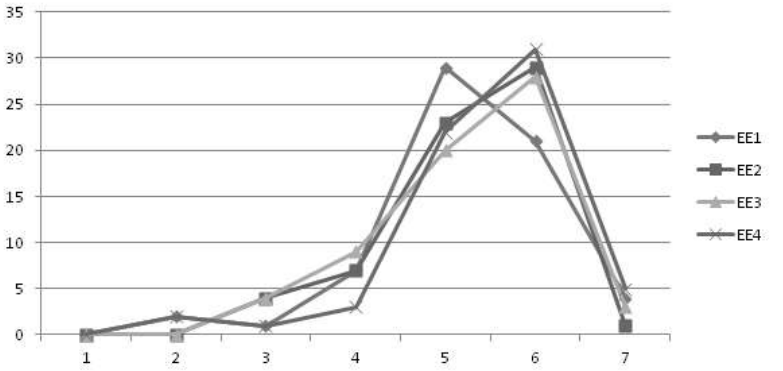


Fig. 2. Effort Expectancy scaling results.

Table 10 provides a look at general respondent perception of social influence on using CHOReOS products in the future.

Table 10. Social Influence.

Questionnaire Item	Fully disagree	Disagree	Some-what disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
SI1: People who influence my behaviour think that for me would be easy	0	1	3	8	**27**	23	2
	0%	1.6%	4.7%	12.5%	**42.2%**	35.9%	3.1%

to use the system							
SI2: People who are important to me, believe that I should use the system	0	0	2	12	20	**26**	4
	0%	0%	3.1%	18.8%	31.3%	**40.6%**	6.3%
SI3: Management would motivate me to use the system	0	0	3	13	17	**23**	8
	0%	0%	4.7%	20.3%	26.6%	**35.9%**	12.5%

The most important thing is that the items indicate respondents tend to agree that people around them will support the use of CHOReOS products (see Fig. 3).

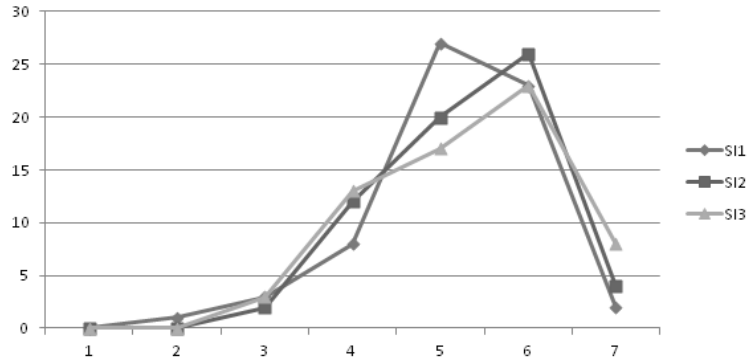


Fig. 3. Social Influence scaling results.

Table 11 shows respondent perception on compatibility of CHOReOS products with other ICT resources and respondent knowledge.

Table 11. Facilitating conditions.

Questionnaire Item	Fully disagree	Disagree	Some-what disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
FC1: I have the reasons and resources necessary to use the system	0	0	2	7	**31**	23	1
	0%	0%	3.1%	10.9%	**48.4%**	35.9%	1.6%
FC2: I have the knowledge necessary to use the system	0	0	2	11	**26**	22	3
	0%	0%	3.1%	17.2%	**40.6%**	34.4%	4.7%
FC3: The system is not compatible with other systems I use	0	2	0	17	20	**23**	2
	0%	3.1%	0%	26.6%	31.3%	**35.9%**	3.1%
FC4: A specific person (or group) is available for assistance with system difficulties	0	0	3	14	16	**26**	5
	0%	0%	4.7%	21.9%	25.0%	**40.6%**	7.8%
FC5: It would be	0	1	1	9	**23**	15	15

good to use the system in work, even if it is not compulsory	0%	1.6%	1.6%	14.1%	**35.9%**	23.4%	23.4%
FC6: Management does not require exploit the system during work time	0	0	0	8	**28**	19	9
	0%	0%	0%	12.5%	**43.8%**	29.7%	14.1%
FC7: It is compulsory to use the system in work	0	0	2	11	11	**32**	8
	0%	0%	3.1%	17.2%	17.2%	**50.0%**	11.5%
FC8: I would be using voluntary the system	2	2	5	9	13	**20**	13
	3.1%	3.1%	7.8%	14.1%	20.3%	**31.3%**	20.3%

Most respondents believe that CHOReOS products can be compatible with their daily ICT resources. They also believe that they have sufficient knowledge to use CHOReOS products. Respondent perception on the ease of use of CHOReOS products relates to effort expectancy (see Fig. 4).

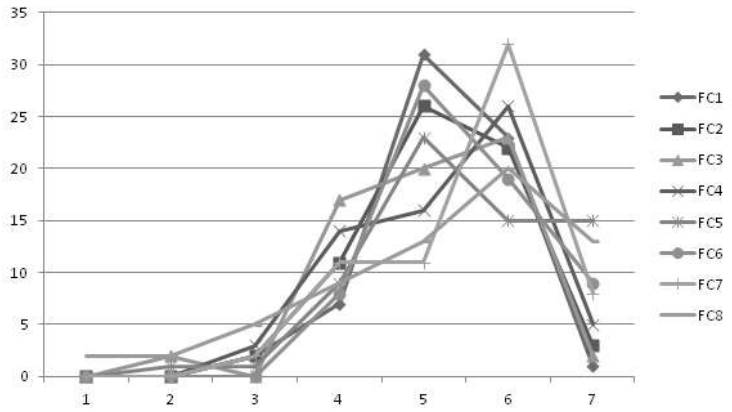


Fig. 4. Facilitating Conditions scaling results.

Although respondents acknowledge that their management will not be very demanding about using CHOReOS products, if they would not be directly related to the work they do. More than half of respondents are ready to try CHOReOS products on a voluntary basis.

Table 12 shows respondent perception on attitude toward using technology. The most important thing is most of the respondents think that using CHOReOS products would be fun.

Table 12. Attitude toward Using Technology.

Statement	Fully disagree	Disagree	Some-what disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
ATT1: Using the system is a good idea	0	0	0	13	18	**25**	8
	0%	0%	0%	20.3%	28.1%	**39.1%**	12.5%
ATT2: Exploitation of the system makes job	0	0	0	7	**25**	19	13

more interesting	0%	0%	0%	10.9%	**39.1%**	29.7%	20.3%
ATT3: Exploiting of the system is fun	0	1	0	11	11	**36**	5
	0%	1.6%	0%	17.2%	17.2%	**56.3%**	7.8%
ATT4: I will use system with pleasure	0	0	2	8	**21**	19	14
	0%	0%	3.1%	12.5%	**32.8%**	29.7%	21.9%

Respondents also believe that a combination of CHOReOS products and routine work can make the job more interesting (see Fig. 5).

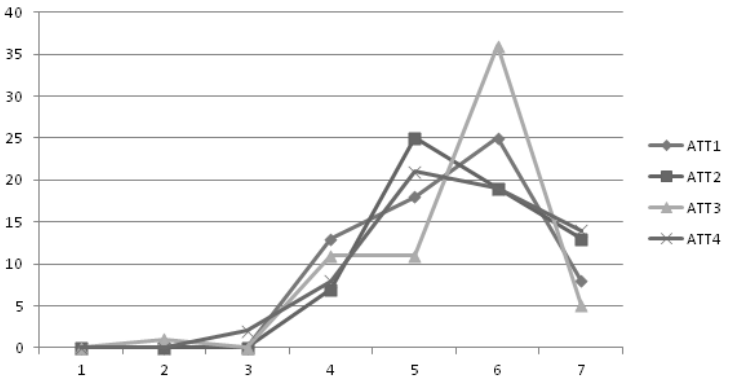


Fig. 5. Attitude toward Using Technology scaling results.

Table 13 shows respondents perception on self-efficacy. Most of the respondents gave a score of 6. It could be acknowledged that most of them feel they are capable enough to use CHOReOS products.

Table 13. Self-efficacy.

Statement	Fully disagree	Disagree	Somewhat disagree	Nor agree, nor disagree	Somewhat agree	Agree	Fully agree
	1	2	3	4	5	6	7
SE1: If there was no one around to tell me what to do as I go	0	1	6	13	20	**21**	3
	0%	1.6%	9.4%	20.3%	31.3%	**32.8%**	4.7%
SE2: If I could call someone for help if I got stuck	0	0	1	7	24	**28**	4
	0%	0%	1.6%	10.9%	37.5%	**43.8%**	6.3%
SE3: If I had a lot of time to complete the job for which the software was provided	0	0	2	10	14	**34**	4
	0%	0%	3.1%	15.6%	21.9%	**53.1%**	6.3%
SE4: If I had just the built-in help facility for assistance	0	1	1	10	17	**20**	15
	0%	1.6%	1.6%	15.6%	26.6%	**31.3%**	23.4%

Most of respondents are ready to learn new technology on their own if they would have enough time (see Fig. 6).

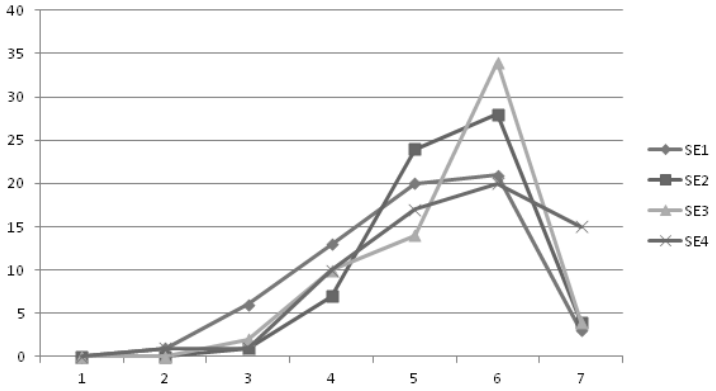


Fig. 6. Self-efficacy scaling results.

The respondents do not have a high score on Anxiety, probably because almost all of them are familiar with ICT's (see Table 14).

Table 14. Anxiety.

Statement	Fully disagree	Disagree	Somewhat disagree	Nor agree, nor disagree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
ANX1: I feel apprehensive about using the system	0	4	11	**34**	12	3	0
	0%	6.3%	17.2%	**53.1%**	18.8%	4.7%	0%
ANX2: Inappropriate exploitation of system could lead to huge information loss	0	5	18	**35**	2	3	1
	0%	7.8%	28.1%	**54.7%**	3.1%	4.7%	1.6%
ANX3: I hesitate to use the system for fear of making mistakes I cannot correct	0	8	14	**25**	14	3	0
	0%	12.5%	21.9%	**39.1%**	21.9%	4.7%	0%
ANX4: The system is somewhat intimidating to me	1	6	11	**38**	7	1	0
	1.6%	9.4%	17.2%	**59.4%**	10.9%	1.6%	0%

Score 4 – Nor agree, nor disagree could also mean that respondents need more information and knowledge about new products before they start to worry about their abilities (see Fig. 7).

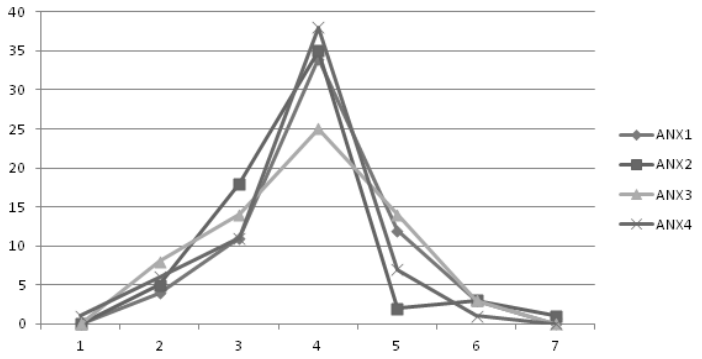


Fig. 7. Anxiety scaling results.

Table 15 shows important information on behavioural intention to use CHOReOS products.

Table 15. Behavioural Intention.

Statement	Fully disagree	Disagree	Some-what dis-agree	Nor agree, nor dis-agree	Some-what agree	Agree	Fully agree
	1	2	3	4	5	6	7
I intend to use the system in the next 12 months.	3	2	1	5	16	**27**	10
	4.7%	3.1%	1.6%	7.8%	25.0%	**42.2%**	15.6%
I predict I would use the system in the next 12 months	1	1	3	5	18	**27**	9
	1.6%	1.6%	4.7%	7.8%	28.1%	**42.2%**	14.1%
I know that I will use the system in the next 12 months	1	1	2	7	12	**31**	10
	1.6%	1.6%	3.1%	10.9%	18.8%	**48.4%**	15.6%
I always try new advanced technologies	0	0	3	12	**23**	18	8
	0%	0%	4.7%	18.8%	**35.9%**	28.1%	12.5%
I have to buy and own devices of instant generation	1	2	2	13	**27**	17	2
	1.6%	3.1%	3.1%	20.3%	**42.2%**	26.6%	3.1%
I will not regret money for new technology	0	0	1	12	21	**29**	1
	0%	0%	1.6%	18.8%	32.8%	**45.3%**	1.6%
I want to have the most advanced means of communication	0	0	3	12	13	**18**	**18**
	0%	0%	4.7%	18.8%	20.3%	**28.1%**	**28.1%**

Most of the respondents have a score of 6 for the behavioural intentions items. This means that they are certain to use CHOReOS products in the next 12 months (see Fig. 8).

It can be assumed that a big part of the respondents are also ready to spend money to have the most advanced means of communication, which is very important for the successful introduction and exploitation of CHOReOS products.

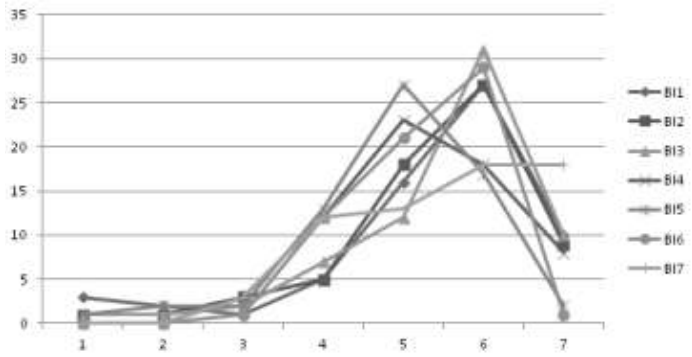


Fig. 8. Behavioural Intention scaling results.

Finally, data in Table 16 shows that:

- More than **70%** of respondents are ready to use the IDRE approach;
- More than **90%** are ready to use Choreographies;
- And more than **87%** are sometimes and often ready to use ULS features.

Table 16. Intention to exploit the following features of CHOReOS products.

Feature	Never	Rarely	Sometimes	Often
	1	2	3	4
IDRE approach	4	15	21	24
	6.3%	23.4%	32.8%	37.5%
Choreographies use	1	5	40	18
	1.6%	7.8%	62.5%	28.1%
ULS (Ultra Large Scalability) possibilities	3	5	32	24
	4.7%	7.8%	50.0%	37.5%

The questionnaire included questions about using technology with CHOReOS products. Respondent opinion was interesting and challenging, it clearly shows a trend to exploit CHOReOS products (see Fig. 9).

Several methods can be further used to forecast market response:

- Additional surveys to other target market groups using the same questionnaire;
- Focus groups – invited industry and research experts for CHOReOS products. A moderator will lead a group discussion in order to find the most important features;
- Bass model - one type of forecasting method primarily used in new product forecasting. In general, there will be no historical demand for new products. Then, Bass model (1) tries to capture the shape of demand of an existing

product and apply it to the new product (Bass diffusion model, http://en.wikipedia.org/wiki/Bass_diffusion_model).

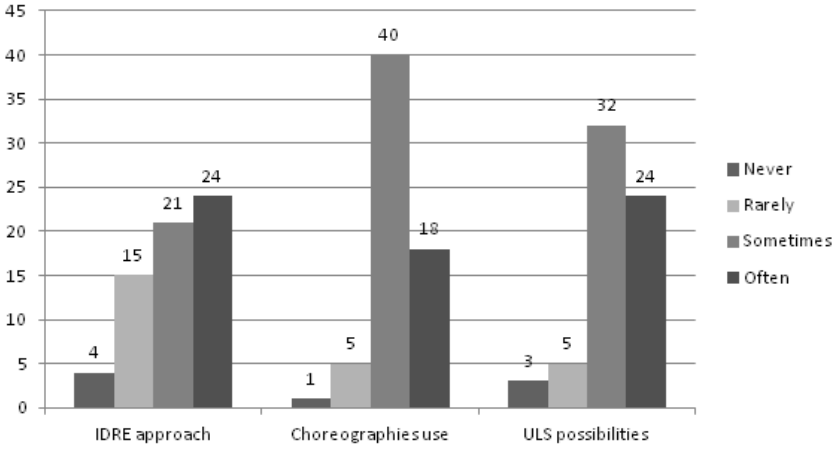


Fig. 9. Intention to exploit CHOReOS products.

$$(f(t)/(1-F(t)) = p + q/m\, N(t) \quad (1)$$

where,

- F(t) is the probability of adoption at time t;
- f(t) is the rate at which adoption is changing with respect to t;
- N(t) is the number of adopters at time t;
- m is the total number of consumers who will eventually adopt;
- p is the coefficient of innovation;
- q is the coefficient of imitation.

Multivariate techniques such as regression can be used to determine the values of p, q and N if at least some historical sales data are available.

6. Conclusions

The CHOReOS project positions itself in the context of the Ultra-Large-Scale (ULS) Future Internet of software services. To address the challenges CHOReOS revisits the concept of choreography-based service composition in service-oriented systems. CHOReOS introduces a dynamic development process, and associated methods, tools and middleware sustaining the ever-adaptable composition of services by domain experts – being the users of business choreographies – in the Future Internet.

Market analysis is aimed to identify and assess acceptance of early market inputs. The Unified Theory of Acceptance and Use of Technology (UTAUT) is selected as the most useable for CHOReOS product acceptance assessment. The effects of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Self-Efficacy (SE), Facilitating Conditions (FC), CHOReOS products Anxiety (ANX), and Attitude towards CHOReOS products (ATT) on Behavioural Intention (BI) and the use of CHOReOS products are examined.

64 respondents filled out the questionnaire on the Internet. 34% of the respondents were Engineers, 23% Managers and some 14% civil servants and teachers. 81% respondents were male. Most of respondents represented governmental institutions. 44% respondents were at ages 28 – 39. Also 78% represented European countries.

More than 70% of respondents are ready to use IDRE approach, more than 90% are ready to use Choreographies, and more than 87% are ready sometimes and often to use ULS possibilities.

The study shows respondents agree – CHOReOS products will help increase their own productivity and will provide more opportunities for their careers. They agree that CHOReOS products will be easy to use, understandable and easy to master. They also acknowledge that learning to use CHOReOS products will be easy. The respondents agree that there could be some problems with the right resources and system compatibility, but they are willing to introduce it anyway.

The preliminary study also shows that CHOReOS products can be implemented even on a voluntary basis if it can make every day job tasks more interesting. However, it is suggested to design interventions, instructions and other explanatory materials and tools to boost CHOReOS product adoption. The good news is that most of respondents are ready to learn new technologies on their own if they would have enough time. They are also certain they will use CHOReOS products within the next 12 months.

The most important thing - the items indicate that respondents tend to agree that people around them will support the use of CHOReOS products.

The research has been done with a limited sample size. The sample size is only preliminary and it is recommended to continue and implement the research on a larger scale if necessary. Although statistical assessment showed that the results obtained are reliable.

Correlation analysis is used to test the relationship between UTAUT parameters. Two coefficients are calculated – not corrected and corrected. Some concepts have a more significant relationship – the relationship between Performance Expectancy and Effort Expectancy and Behavioural Intention. It is also significant between Attitude toward Using Technology and Facilitating Condition and Self-efficacy. An insignificant relationship between Age and SI, FC and SE, and Industry and Attitude toward Using Technology is revealed. The data also shows a significant relationship between Self-efficacy and Facilitating Condition.

The credibility of assessment results was verified using three coefficients – Cronbach's Alpha, Split-Half Reliability and Spearman-Brown Prophecy. Reliability calculation results allow to assume that the CHOReOS product assessment results are credible.

The results reported in this article correspond to findings of FP7 SEQUIOA project[15] related to CHOReOS project socio-economical assessment (see Fig. 10).

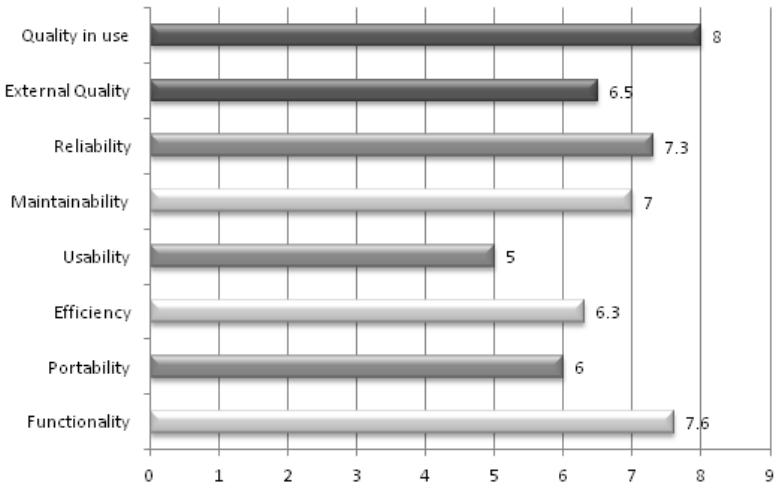


Fig. 10. SEQUIOIA assessment of CHOReOS project.

The research can be continued with a more detailed research of existing data, analysing the influence of moderators on UTAUT parameters.

Acknowledgement

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References

1. Ginters, E. and Lescevica, M. CHOReOS Market Analysis. Del. D10.2. The CHOReOS Consortium; 2012.
2. Porter, A.L. et al. Technology Futures Analysis: Toward Integration of the Field and New Methods. *Technological Forecasting & Social Change*. 71(3); 2005. p. 287-303.
3. Davis, F. D. Perceived Usefulness, Perceived Ease of Use, and Acceptance of Information Technology. *MIS Quarterly*, 13(3); 1989. p. 319-340.
4. Davis, F. D., Bagozzi, R. P., Warshaw, P. R. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35 (8); 1989. p. 982-1003.
5. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. User acceptance of information technology: Toward a unified view. *MIS Quarterly*. 27(3); 2003. p. 425-478.
6. Fishbein, M. and Ajzen, I. Attitudes and Opinions. *Annual Review of Psychology*, 23; 1972. p. 487-544.
7. Vallerand, R. J. Toward a hierarchical model of intrinsic and extrinsic motivation. In: Zanna, M.P., editor. *Advances in experimental social psychology*. New York: Academic Press; 1997. p. 271-360.
8. Ajzen, I. Behavioral Interventions Based on the Theory of Planned Behaviour. Brief Description of the Theory of Planned Behaviour. Retrieved: 13.10. 2007, URL: http://www-unix.oit.umass.edu/aizen/pdf/tpb.intervention.pdf.
9. Taylor, S. and Todd, P. Assessing IT Usage: The Role of Prior Experience. *MIS Quarterly*. 19 (4); 1995. p. 561-570.
10. Thompson, K. E. and Panayiotopoulos, P. Predicting behavioural intention in a small business context. *Journal of Marketing Practice: Applied Marketing Science*. 5 (3); 1999. p. 89-96.
11. Rogers, E. M. Diffusion of preventive innovations. *Addictive Behaviors*, 27; 2002. p. 989–993.
12. Bandura, A. Social cognitive theory. In: Vasta, R., editor. *Annals of child development*, Vol. 6. Six theories of child development. (1-60). Greenwich, CT: JAI Press; 1989.
13. Nunnally, J.C. *Psycometric Theory*. 2nd ed. New Delhi. 1981: Tata McGraw-Hill Publishing Company Limited.
14. Allen, M. and Yen W. *Introduction to Measurement Theory*. Monterey, CA: Brooks/Cole. ISBN 0-8185-0283-5; 1997.
15. SEQUIOA FP7. Deliverable 2.1b - Results from Call5 projects documentation inventory. Retrieved: 01.11.2012, URL: http://www.sequoiaproject.eu/index.php/documents/cat_view/43-released-deliverables.