D2.4: Exploitation Plan Iteration 4

Work Package 2 : EXPLOITATION

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Disclaimer

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APARSEN	Alliance for Permanent Access to the Records of Science Network
BAC	Business Archives Council
BBC	British Broadcasting Company
BCM	Business Continuity Management
BCP	Business Continuity Planning
BI	Business Intelligence
BIM	Building Information Modelling
CAD	Computer Aided Design
CAGR	Compound Annual Growth Rate
CEO	Chief Executive Officer
CES	Consumer Electronics Show
CIO	Chief Information Officer
CMS	Caixa Magica Software
CONSENT	Consumer Sentiment Regarding Privacy on User-Generated Content Services in the Digital Economy
CPS	Cyber Physical Systems
cRIsp	Crowd sourced Representation Information for Supporting Preservation
CRM	Customer Relationship Management
CSL	Cloud Services Lab
CUDF	Common Upgradeability Description Format
DFN	Deutsches Forschungsnetz
DOT	Development Opportunity Tool
DPC	Digital Preservation Coalition
DPES	Digital Preservation Expert Suite
DPRMA	Digital Preservation of Research Methods and Artefacts
DROID	Digital Record and Object Identification
EAB	External Advisory Board
EAS	Enterprise Archiving Solution
EIT	European Institute of Innovation & Technology Foundation's
EPS	Emergency Planning Solutions. A consultancy and training firm in Belfast
EMC	EMC Corporation (E=MC2)
ERCIS	European Research Centre for Information Systems
ERP	Enterprise Resource Planning
ESG	Enterprise Storage Group – A provider of industry analysis data
ESL	Energy and Sustainability Lab
ESM	Experience Sampling Methods
FLOSS	Free and Libre Open Source Software
FTE	Full Time Employee
GB	Gigabyte
GSMA	Global System for Mobile communications Association (Mobile Communications Operators)
GWAP	Game With A Purpose
HCM	Human Capital Management
ICMR	Irish Centre for Manufacturing Research
ICOLD	International Commission on Large Dams
IDC	International Data Corporation -– A provider of industry analysis data
iERM	Intelligent Enterprise Risk Management
IIG	Information Intelligence Group
iLE	Intel Labs Europe

ILM	Information Lifecycle Management
INESC-ID	INSTITUTO DE ENGENHARIA DE SISTEMAS E COMPUTADORES - INVESTIGACAO E DESENVOLVIMENTO
IoT	Internet-of-Things
IP	Intellectual Property
IPLS	Intel Performance Learning Solutions Limited
IQA	Intel Quality Award
IRMS	Information and Records Management Society
IT	Information Technology
IT-EC	IT Engineering Computing. An internal IT support division within Intel Corporation.
ITM	Institute for Information-, Telecommunication- and Media Law Muenster
IVI	Innovation Value Institute
JPF	Joint Path Finding
KEOD	Knowledge Engineering and Ontology Development
KPCB	Kleiner Perkins Caufield & Byers
KIT	Karlsruher Institut fuer Technologie
LAPSI	Legal Aspects of Public Sector Information
LCM	Linux Caixa Mágica
LLM	Legalities Lifecycle Management
LNEC	Laboratório Nacional de Engenharia Civil
LTDP	Long Term Digital Preservation
M&A	Mergers & Acquisitions
M2M	Machine to Machine
MD	Managing Director
MIP	Mega-Impact Project
MVC	Model-view-controller
NAS	Network Attached Storage
OAIS	Open Archival Information System
OEM	Original Equipment Manufacturer
OPF	Open Preservation Foundation
PASIG	Preservation and Archival Special Interest Group
PB	Petabyte
PCC	Project Coordination Committee
PHAIDRA	Permanent Hosting, Archiving and Indexing of Digital Resources and Assets
PoC	Proof of Concept
PREMIS	Preservation Metadata: Implementation Strategies
QKD	Quantum Key Distribution
QSD	Quark Solutions Division
R2	Risk and Resilience Ltd. An organisation based in Belfast
ROI	Return On Investment
SAN	Storage Area Network
SAP	Systems, Applications and Products in Data Processing
SBA	Secure Business Austria
SCM	Supply Chain Management
SDI	Software Defined Infrastructure
SDN	Software Defined Network
SET	Special Experience Team
SI	System Integrator
SLA	Service Level Agreement
SME	Small Medium Enterprise
SNIA	Storage Network Industry Association
SQuaRE	Systems and software Quality Requirements and Evaluation

SQS	Software Quality Systems
SRM	Supplier Relationship Management
STEP	Standard for the Exchange of Product Model Data
TCO	Total Cost of Ownership
TPM	Trusted Platform Modules
UC3	University Of California Curation Centre
VNI	Cisco's Visual Networking Index
VP	Vice-President
WP	Work Package
ZB	Zettabyte

1 Executive Summary

As the TIMBUS project draws to a close, it is hard not to reflect on the amazing journey which we embarked on almost four years ago. It has been a very successful and enjoyable project. Partners such as Intel and SAP were relative newcomers to the world of digital preservation and have gained vast knowledge on the subject from our interactions with partners who have a long track record in this very interesting domain. The SME and academic partners have grown their expertise, made new business relationships and have brought their unique experience to bear in the TIMBUS research agenda and in its results. The effort spent over the project duration in researching the information in this work package has been particularly informative. The structure which the work package has put in place for identifying and executing the partner plans has been effective, while also being clear, practical and efficient as it was intended to execute the work with the minimal possible overhead. This final deliverable presents the following:

A final assessment of the identified market trends from year 1, year 2 and year 3.

This focuses on the developments which are of most significance over the last 9 months. During this final review period, the purpose of the market assessment has not changed and remains aimed at ensuring that the TIMBUS research is relevant to the changing requirements of industry, to steer when appropriate, the internal direction of the TIMBUS work, and to continue to explore and establish channels for exploitation which bring the benefits of the research to as wide an audience as possible. The assessment last year picked up some interesting trends. Notable among those was the growing momentum behind the Internet-of-Things (IoT) economy which is continuing as the project comes to a close at the end of 2014. The TIMBUS consortium continues to assert its position that the rapid pace of technology change significantly adds to severity and complexity of the digital preservation challenge making it more critical than ever before to address and therefore that the wider diversity in consumer devices is both a driver for better digital preservation solutions and a core part of the root problem.

The TIMBUS consortium, following the Year 3 review, realised that it would be of the utmost interest of TIMBUS to maintain and grow its relationship with the Open Planets Foundation (OPF), as it would provide another opportunity to make some of the TIMBUS tools available once the project ends.

Partner exploitation reports

In Year 3, the exploitation effort had already adopted the approach of the *Communicating EU research and Innovation*[1] guide. This approach had been efficient and productive and since it has been welcomed by all TIMBUS partners as well as the reviewers, the consortium continued using the same approach. In Year 4, each partner has updated their exploitation plans and results to date in considerable detail to reflect the status of each of their initiatives as it stands, now that the project comes to its end. As was the case in the last review period, each partner report describes the initiatives they have undertaken, with each initiative having an identified audience, an exploitation goal, expected exploitation benefits and how these can be measured. Each initiative had previously given consideration to resources and dependencies. The structure also helped partners throughout the project to prioritise their effort spends to give the greatest chance of creating as large an impact as possible. Each planned activity has a milestone-level timeline included in the partner exploitation report section of this deliverable. During the final phase of the TIMBUS project, the partners have increased their efforts to reap the benefits of the research.

At the end of our TIMBUS journey, all the partners are in a much more informed position than before undertaking this research. Each partner has implemented and executed their plans as outlined which is tailored to their particular objectives ranging from publications to product plans and when taken on a whole present a very compelling output from this research project.

2 Introduction

The previous exploitation deliverables D2.1, D2.2 and D2.3 have together presented reviews of the market trends which are continuing to create business opportunities for digital preservation along with the TIMBUS partner exploitation reports for year 1, year 2 and year 3 of the TIMBUS project. This deliverable follows a similar structure to previous iterations. It first presents an updated view of background information behind the drivers of digital preservation. As always, we tie the relevance of these into the TIMBUS project, making comments and drawing our own conclusions in the process. The deliverable has fulfilled the task requirements as described in the description of work and has taken into account the inputs of the reviewers in year 1, 2 and 3, the inputs of the External Advisory Board and the many interactions that the partners have had with their respective stakeholders, be they internal to their organisation or external.

This deliverable, in its market assessment, checks the current state of play as the TIMBUS project comes to an end. Technology development, global competition and open standards have resulted in product innovation, shorter product lifespans and in higher rates of technological obsolescence. Again, there seems to be little sign of this trend slowing, in fact the opposite is the case. We have a more highly technologically integrated society than at any earlier point in history. For better or worse, a *Personal Data Economy* is now emerging which would never have been possible without the level of technology interaction currently seen in our societies. With respect to the preservation of data in an intelligible way, the rate that this change is happening is so fast that we are struggling as a global society in our ability to insulate ourselves from the risks arising from technological obsolesce.

While much has been achieved in TIMBUS, unfortunately many more obstacles remain into the future if our society is to successfully address these issues. This is further recognised by one of the TIMBUS deliverables, D5.6, reports open research challenges. The European Commission continues to recognise the digital preservation challenge and as Europe moves now toward its Horizon 2020 strategy, funding for research projects such as TIMBUS is helping to address this multifaceted and complex issue.

The TIMBUS project goals were deliberately ambitious. Our work faced many challenges in absorbing, integrating and building upon the considerable body of work already completed by previous projects and agencies in many aspects of Digital Preservation, and even beyond that in related disciplines of big-data technologies and emerging meta-data generation techniques. Nonetheless, the TIMBUS focus on business processes preservation has remained unique right to the end of our research mandate and the consortium members are not aware of any other undertaking with the same objective or approach. In particular, the mix of partners in TIMBUS brought expertise from diverse domains together including ERM expertise from SAP. SQS and ITM brought in their knowledge of the SW quality and legal domains. This provided a unique mix when organisations with a longer history in the problem domain such as the DPC and SBA were factored in with partners who had strong use cases which required solutions.

The objectives of the project can be considered in several ways, both technical and non-technical. At the technical level, the project is providing a complete integrated suite of tools which can analyse interdependent business processes, identify and prioritise risks and provide a facility to enable the mitigation of those risks. At a non-technical level, the consortium aims to disseminate its research outputs raising the awareness of a problem which in 2014 is still not receiving the focus it should from governments, legislatures or industry. While progress is being made, if we accept that at the highest level, the purpose of these research undertakings is to ensure that society avoids a digital dark age, then it is clear that there remains plenty of work to be done in the years ahead. TIMBUS will be successful because it will have strongly contributed to that growing body of work in the long term, but it will also have reaped rewards for its members and their stakeholders during the project life time which will continue to bear fruit in years to come.

2.1 Addressing the Year 3 Reviewer Feedback

This section of the deliverable details what has been done in the fourth year of the TIMBUS research to address the reviewer feedback documented following the year 3 review in Karlsruhe in June 2014.

2.1.1 Reviewer Feedback

The TIMBUS consortium has welcomed and appreciated all feedback during its existence. We recognise that the reviewers, during the Year 3 review, have spent once again their time into providing feedback which is intended to be helpful to the project, the consortium members and the objectives of the research. This deliverable spends some time explaining how we have acted on the feedback given after the year 3 review.

We ask that the reviewers, during this final round of review, continue their good work and give inputs on all aspects of the project because even as the TIMBUS project ends, the partner interests do not and as researchers, each individual and partner will continue work in this domain, and continue to apply what they have learned into the future. In the case of the work package 2 exploitation reports, the TIMBUS consortium invites feedback, comment and discussion on:

- The market assessment
    - is it informative, interesting, topical and relevant
    - does it reflect trends that you have noticed in the industry or did it uncover new ones you had not considered
- The partner exploitation reports
    - We welcome both individual and consortium wide comments on exploitation reports but bear in mind that, as pointed out in our previous report, each project beneficiary had differing goals in its sight because the consortium has a mix of industry, academic and SME partners. These partners have placed different priorities on different types of exploitation. The assessment of the reports should consider if each partner has worked hard on interesting and exciting exploitation objectives which will have tangible and measurable benefits. Please comment if there are individual efforts that you would like to see more detail.
    - In this final Exploitation Plan, the partner exploitation reports all follow the same structure, as in the Year 3 Plan. They are made up of initiatives which are tracked individually.
    - Each initiative has an identified audience, it has objectives, it has detailed how to measure the benefit, it has considered the resources and dependencies required for the initiative to be successful, it has detailed what actions have been carried out to date and it has a roadmap of remaining planned milestones with their dates.

2.1.2 Feedback relating to Work Package 2 Exploitation

The consortium was pleased to hear, after the Year 3 review, that the reviewers had noted that there had been outstanding achievements in the last year in terms of WP2 activities and outputs, as well as WP6 and WP8. This acts as a positive reinforcement of the trajectory that the consortiums work was on and we have continued that direction at pace in the final phase of the project. The consortium appreciates receiving additional comments from the reviewers and has aimed to address these. The review feedback shared specifically for the WP2 – Exploitation, can be found below:

"In Y3 this work package had one deliverable: D2.3 - Exploitation Plan Iteration 3. The reports presents a good network of stakeholders including major industry players as potential adopters and users of TIMBUS results. Individual exploitation plans are very detailed and convincing, in particularly the ones from SAP, CMS and SQS."

In year 4, the same structured approach as in year 3 was maintained, as it appeared to be clearer and well received by the reviewers. This enabled each partners to list all their initiatives, and highlight the following for each one of them: an identified target audience, goals and objectives, how the anticipated benefit can be measured, what technical and non-technical resources are required to meet the goal so that success can be assessed, details of the steps taken to date and a timeline of planned milestones going forward.

In the same spirit as in Year 3, the consortium resumed their work on their respective initiatives, increasing their network of stakeholders whenever possible and updated their individual plans to reflect the progress made and latest status.

"The consortium continued its efforts in the market assessment where new actors and complementary tools were identified. The reported analysis included all additional areas that have been proposed by the review team at Y2."

In this final Exploitation Plan, the consortium has monitored the changes taking place in the market and updated the market assessment accordingly; highlighting the changes in the market overall, market trends, new products and services that are influencing or relevant to the TIMBUS project. These have included, at a high level, drivers for the growth in data generation, drivers for digital preservation of business processes, reviews of commercial and open source products and services in this area, product innovations which are accelerating the need for digital preservation solutions and advances in storage media technologies.

"It is worth mentioning the results from the face-to-face meeting with the External Advisory Board (EAB) which provided valuable feedback in crucial issues for the project."

Since its establishment, the EAB has been very valuable to the TIMBUS project, providing additional opinions, input and feedback on the modelling and technical work carried out in the project, as well as an additional dissemination channel. Now the TIMBUS project is coming to an end, the consortium provided an update to the EAB to get some further feedback and input.

"It is of high importance the relationship with the Open Planets Foundation to ensure that some of the TIMBUS prototypes are explored after project ends."

Following the Year 3 review, the TIMBUS consortium engaged more actively with the Open Planets Foundation (OPF), now the Open Preservation Foundation, to ensure, as advised by the reviewers, that some of the TIMBUS prototypes are explored after project ends. This engagement was became a cross-work package initiative, involving WP2, WP3 and WP6 and lead in a new and strong relationship with OPF… with the consortium meeting with OPF many occasions, not only via phone and WebEx, but also face-to-face, for instance at the PASIG event in Karlsruhe in September 2014 and at the 4C Conference in London in November 2014. A new section, providing more details has been added to the Exploitation plan detailing how partners from WP2, WP3 and WP6 engaged actively with OPF, meeting on many occasions to agree on the best approach for this collaboration.

3 The Digital Universe – Final update

Over the previous 3 years, we have presented figures for the growth in internet usage. Such data has been and remains important to TIMBUS as it shows how our life habits and behaviours have change as a result to the progress made in technology. A KPCB report on Internet Trends in 2014 highlights a 10% growth year-on-year in internet usage. The fastest growth is seen in developing markets like India, Indonesia and Nigeria. The continued growth in internet usage remains one of the factors driving the requirement for long-term preservation. In fact, as a result of spending more time online, we produce more data and more complex forms of data; in turn, we have increasing need to preserve the tools which are needed to process, render and interpret this data into the future.

3.1 Internet Users

The TIMBUS market assessment in previous years has quoted figures about the growing numbers of internet users globally. We pointed out already that many sources, such as the World Internet Statistics[1] group, had stated figures such as "it is estimated that there will be 2.2 billion Internet users in the world" by 2013. Last year, the TIMBUS market assessment found that 2.7 billion was a generally accepted figure in 2013. As shown below in Figure 1, according to the ITU Telecommunications Development Bureau[2], there are now 2.9 billion, or just over 40% of the world's population online in 2014. When TIMBUS began in 2011, the figure was only 29% as shown in Figure 2.

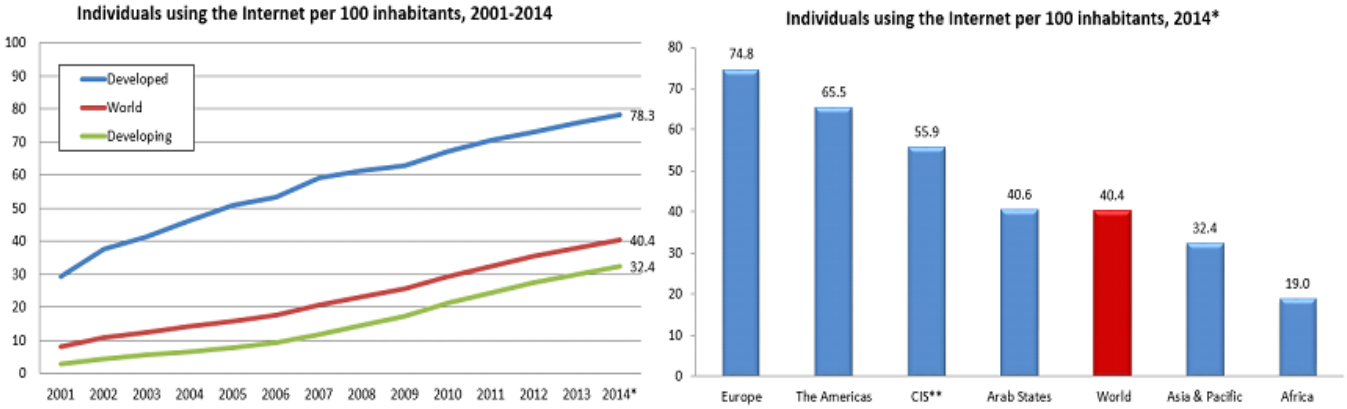

Figure 1: World Internet Usage 2003-2014[2]

(Source: ITU World Telecommunication /ICT Indicators database)

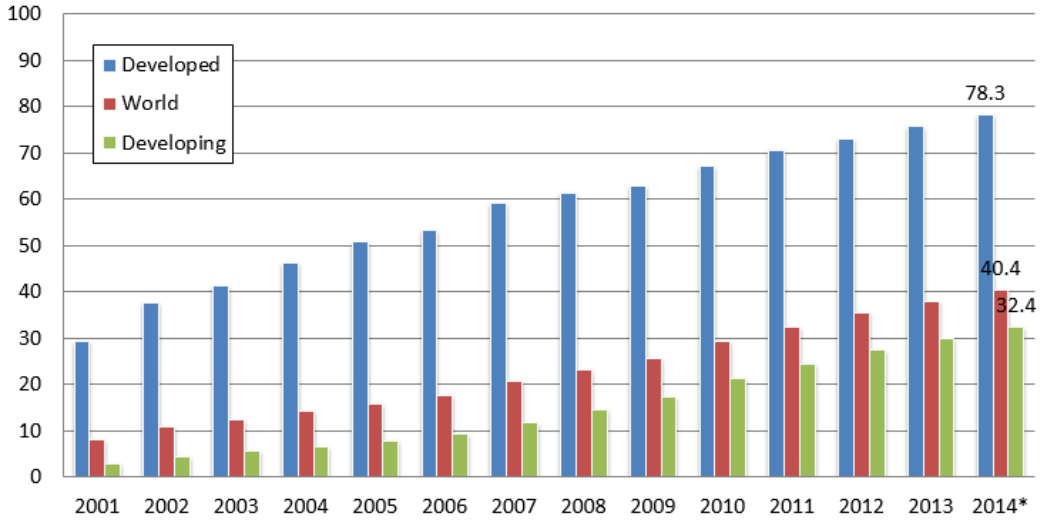

Figure 2: Percentage of Population using the internet 2005-2014

(Source: http://www.itu.int/en/ITU-D/Statistics)

Asia and Africa continue to be the largest growth areas as internet penetration in those regions lags behind the world average at 32% and 19% respectively. But, as shown in Figure 3, these regions are well represented globally if viewed in terms of raw numbers of internet users instead of percentages of the population online.

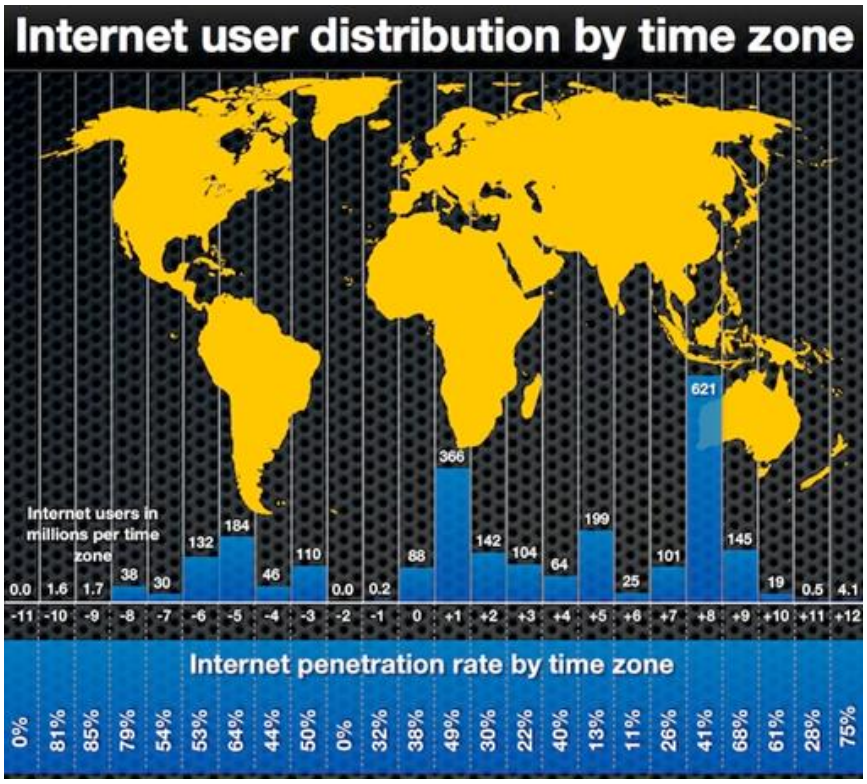

Figure 3: Internet User Distribution by time zone[3]

With the increase in users comes a direct increase in network traffic as shown below in Figure 4. The KPCB report on Internet Trends in 2014 highlights a considerable increase in the number of smartphone subscribers, with a 20% strong growth, though slowing, with a fastest growth in under-penetrated markets such as China, India, Brazil and Indonesia. They also point out an 81% accelerating growth in mobile data traffic, with the video content being a strong driver for this growth.

Last year, the graph below on the left was available and showed no slow-down in this trend with traffic in 2011 just under 30 Exabyte's and growing to over 107 by 2016. The latest figures available from Cisco in 2014 show the trend continuing with the largest data types being video and video communications with web traffic and file sharing also being significant contributors. The data being produced shows that in just five short years, from 2012 through to 2017, internet traffic will have increased 3-fold. This rapid pace of growth is even affecting the ability of Telco's to provision capacity to meet this demand.

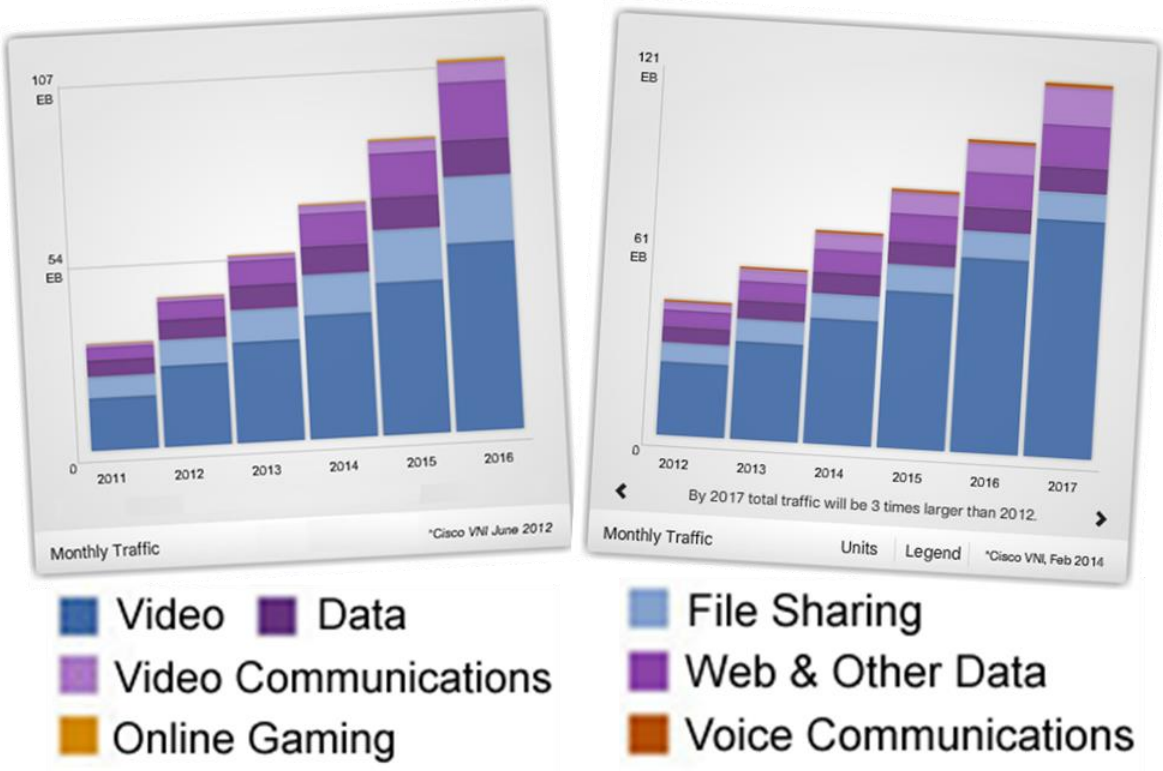

Figure 4: Global IP Traffic 2011- 2016[4]

Figure 4 below shows that the digital universe data has been growing rapidly over the last few years, with 50% growth in 2013, reaching over 4 Zettabytes (ZB). It is expected this growth will remain robust over the next 3 years, reaching 6ZB by the end of 2014 and 13ZB by 2016, representing a 40% year-on-year growth.

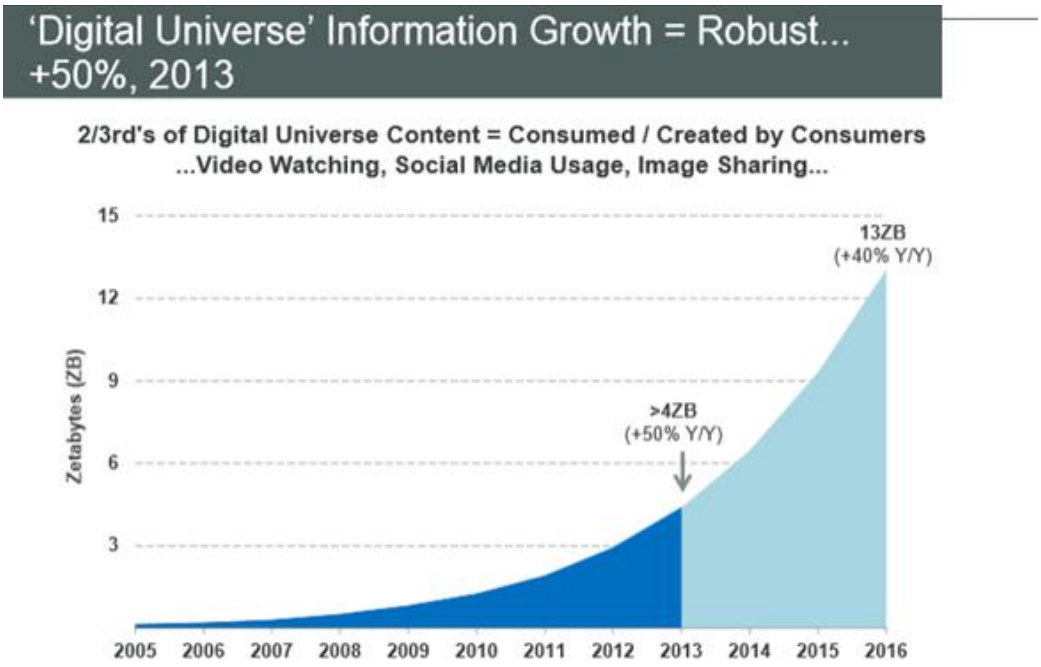

Figure 5: Digital Universe Information Growth

(Source: http://www.kpcb.com/internet-trends)

In this digital universe, it appears 34% of the data, quite a large portion, is classified as useful. This data comes from embedded systems, social media, photos, etc. However, only a small portion of it is actually tag, with a growing portion of the valuable data coming from Internet-of-Things (IoT).

Finally, to put the continuing growth in internet usage into perspective, the world internet penetration at the end of 2013 was still only about 39%. This shows that there is still huge potential for growth in terms of internet users which in turn will drive new usage models. As the TIMBUS project comes to its end, one can still come to the conclusion that there will be increasing difficulties in identifying the subset of personal and business data that needs to be preserved and carrying out that preservation in a cost effective and efficient manner. The TIMBUS consortium does not propose preserving all the software environments needed to access this data. Our focus has been and remains firstly on business processes and within that context, there is an analysis based on iERM to identify only the business processes which have risks associated with them which could be mitigated through the long-term preservation of that data. The next sections of the deliverable will examine what has changed in 2014, in how we are interacting with the internet to give us an understanding of why the need to preserve data for the long term may be increasing.

3.2 New Devices

We already established in our TIMBUS exploitation deliverable D2.2 that new devices presented a particular challenge for digital preservation, as they create a moving target of increasingly diverse, more mobile hardware platforms whose life spans are shorter than traditional IT infrastructure and whose operational profiles are extremely difficult to predict in the medium term and almost impossible if projected out over a number of years.

Figure 7 from a KPCB report on Internet Trends in 2014, below, shows that the market share of smartphone operating systems have grown from a mere 5% in 2005 to reach 97% in 2013.

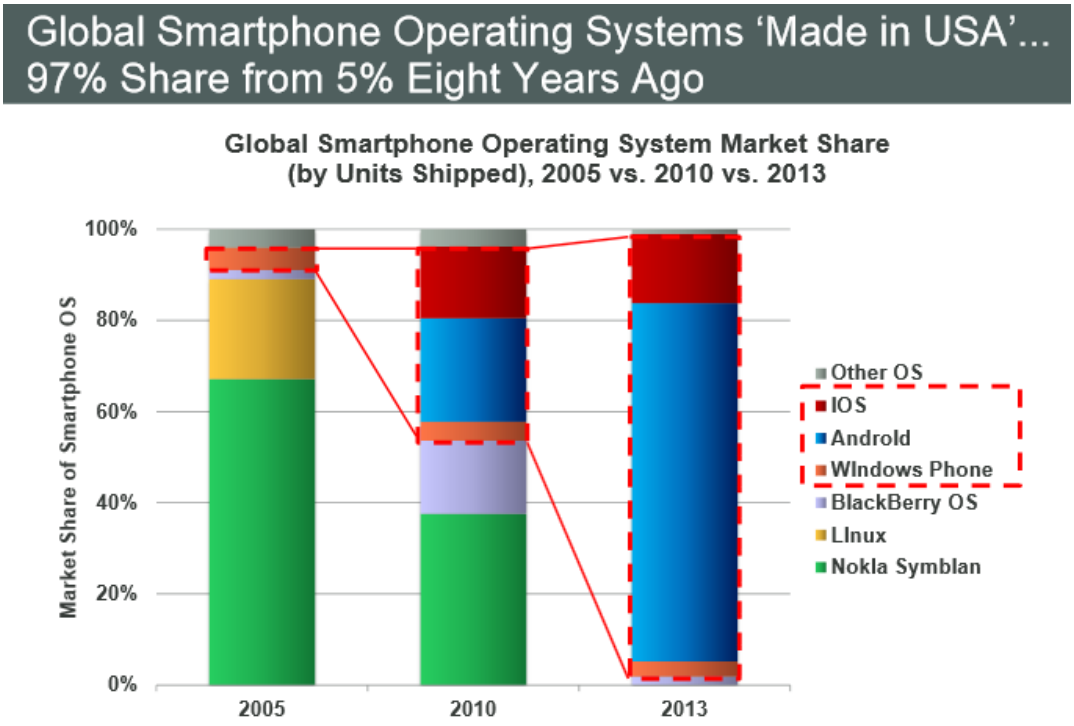

Figure 6: Smartphone OS share Trend
(Source: KPCB Report on Internet Trends 2014)

Also Figure 7 from a KPCB report on Internet Trends in 2014, below, draws our attention on the fact that each technology cycle usually generates about 10 times the installed base of the previous cycle.

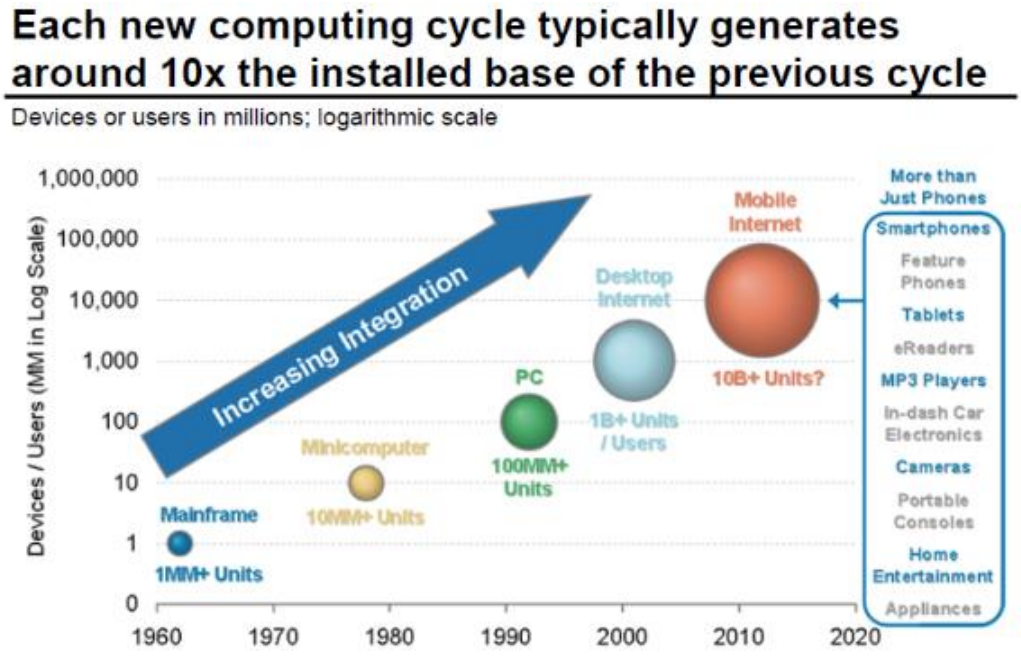

Figure 7: Technology Lifetime Cycles
(Source: KPCB Report on Internet Trends 2014)

This has in a major impact on TIMBUS when it comes to long-term preservation, as it leads to new challenges caused by a rapid evolution of technology. Again, we need to accept this trend and the challenges it brings to TIMBUS and find solutions.

We often like to show the other end of this problem in TIMBUS because it's easy to overlook that someday very soon, all the new technology we have around us, and which we take for granted, will be essentially an antique.

Figure 8: BBC News Article

(Source: http://www.bbc.co.uk/news/technology-30447563**)**

, below, shows a very recent example from December 2014 about how an old Apple 1 computer, one of only 50 in the world, was sold at auction for USD$365,000.

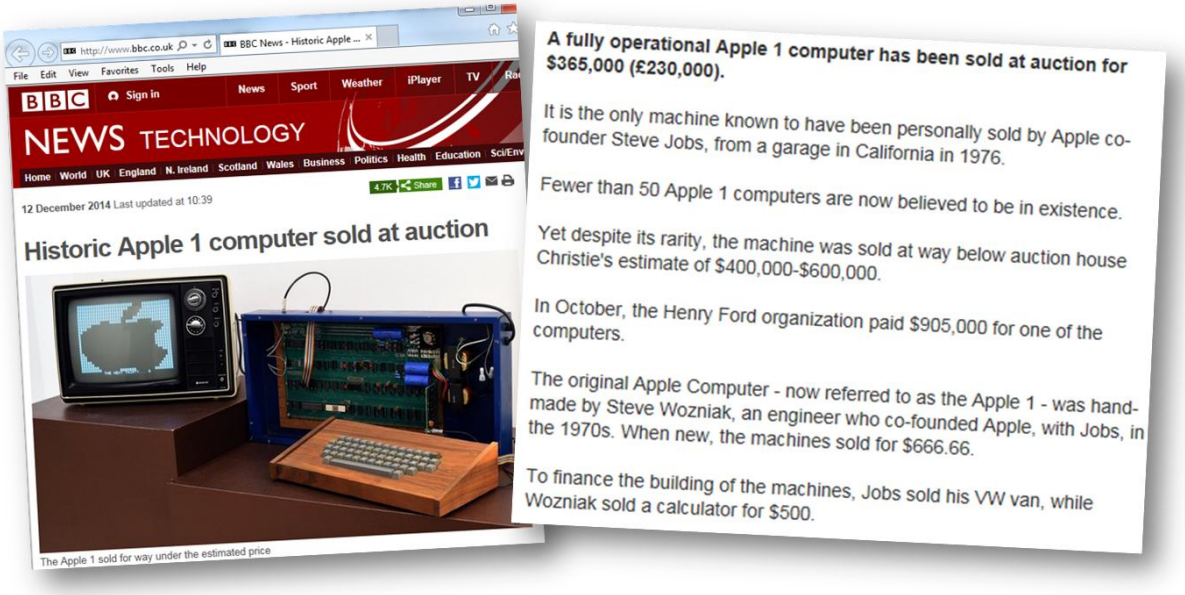

Figure 8: BBC News Article

(Source: http://www.bbc.co.uk/news/technology-30447563**)**

This is a device created within most of our lifetimes, in the 1970's. It looks as rudimentary to us in 2014 as our newest devices will look to people living in the 2020-2030's and beyond. These timescales are not epic, they are happening within a single human lifespan. If an organisation had important data on a medium which needs hardware and software which will only run on a legacy device, they may well find themselves trying to source old hardware and incurring significant costs with no guarantees that they can recover the data. Tape libraries are a typical example of this today. These libraries are retired once their serviceable life has passed. The tapes and the formats they supported are tied to a point in time so even if an organisation retains the tapes themselves, they will lack the hardware they need to read them and incur costs either trying to source hardware themselves or obtaining the services of a data recovery specialist who possesses the knowledge and equipment necessary.

3.3 Smartphone and Tablets

In the TIMBUS D2.2 deliverable, we highlighted the growth in tablet and e-Reader devices. As we approach the end of 2014, we can, but, notice that there is still a strong growth in mobile usage.

According to IDC, Smartphone and Tablet spending will reach just under $500 billion, generating 40% of all IT growth. The Smartphones sales alone will hit $412 billion and dominate smart mobile device

growth, representing an impressive 84% growth. IDC forecast that almost 500 million smartphones will be sold in China in 2015 alone, this is three times the number of smartphones expected to be sold in the United States and about a third of all the sales worldwide.

Error! Reference source not found., below, shows the figures published by *StatCounter* in May 2014. We can see that mobile usage is continuing to rise rapidly, with 25% of total web usage as of May 2014, as compared to 14% in May 2013, globally.

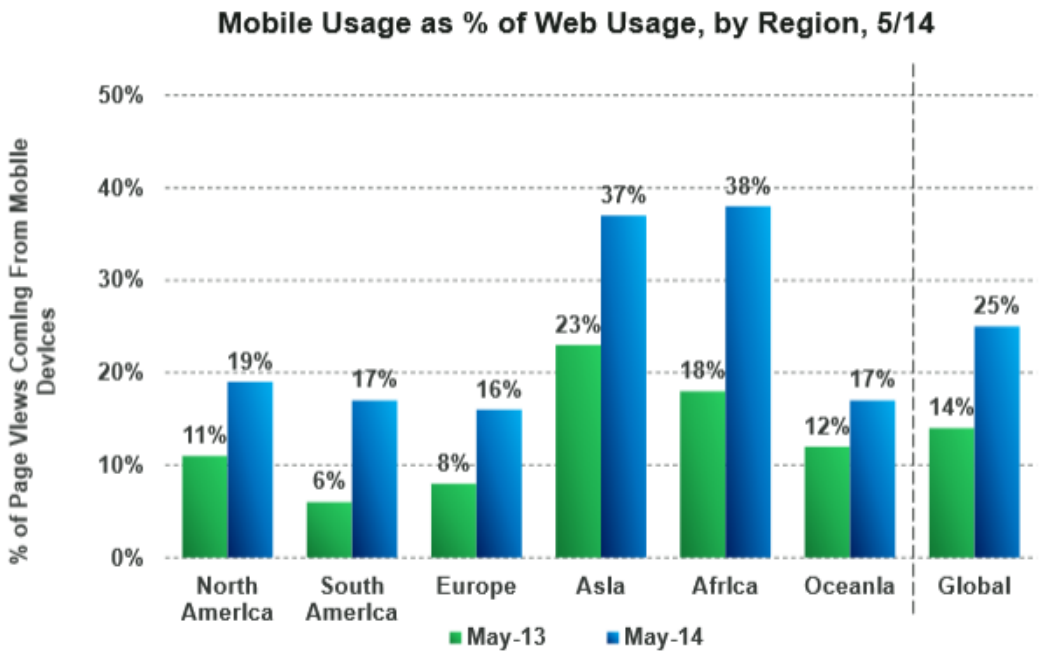

Figure 9: Mobile Usage by Region
(Source: StatCounter 05/12)

As we already pointed out in D2.3, **Error! Reference source not found.**10 below showed how rapidly tablets have caught up with Desktop PCs and Notebook PCs, growing faster than PCs ever did and reaching almost 80MMs units globally in 2013.

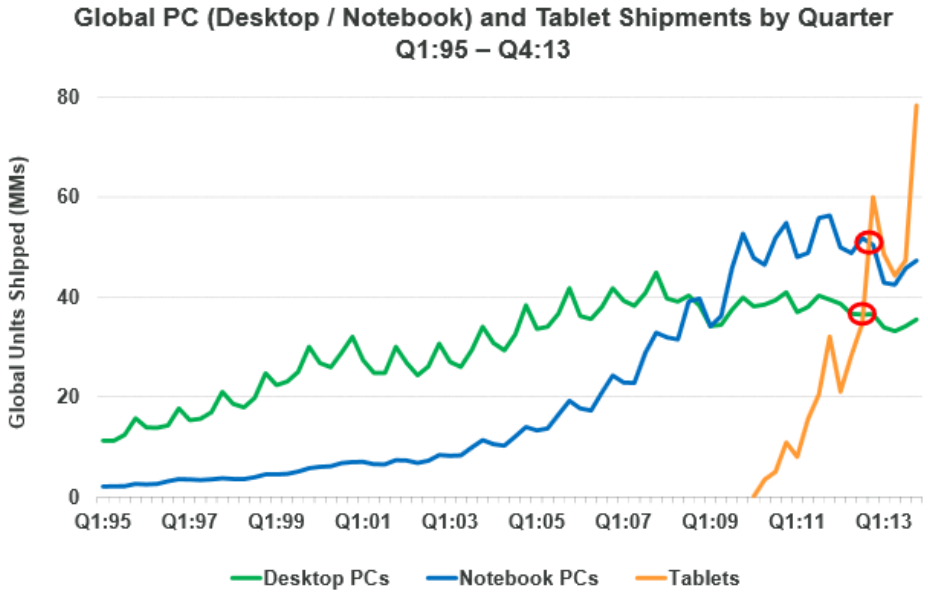

Figure 10: Global PC & Tablet Shipment (1995-2013)
(Source: Morgan Stanley Research)

However, there is still room for a lot of growth ahead in tablet usage, as tablet usage only represent a 6% population penetration as of 2013, with smartphone representing a 22% population penetration; a rate higher than Desktop and Laptop PCs together. Figure 12provides more details:

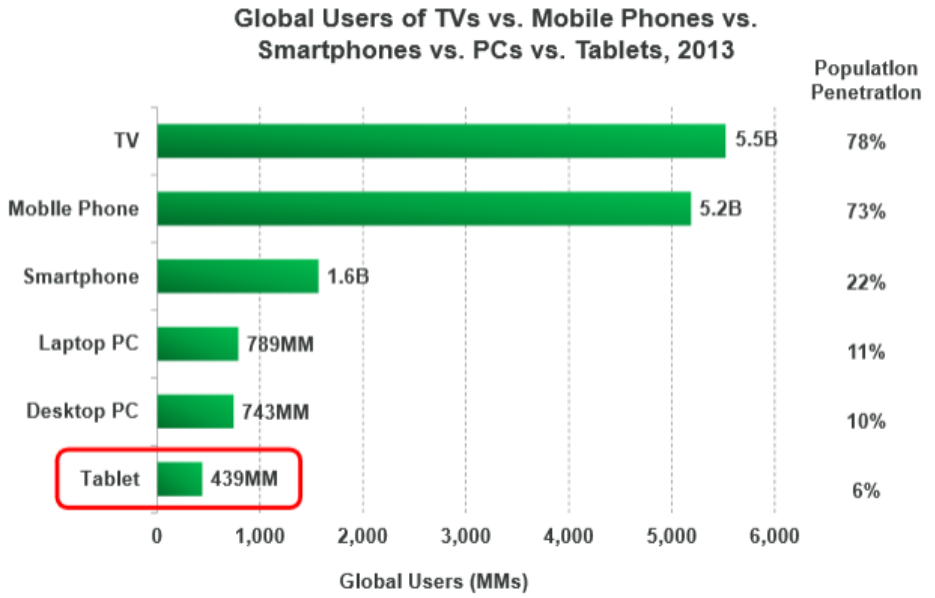

Figure 11: Device Usage Comparison
(Source: KPCB estimates based on Morgan Stanley Research and IT)

As can be seen in the new figures in Figure 12below, newer devices are seeing growth. Desktop and laptop PCs are losing out to smartphone and tablets, although the figures don't make it clear in what precise proportions those may be happening and eBook readers are continuing to rise in popularity, probably at the cost of traditional media such as books. Even the adoption of eBooks is not something to be ignored in the TIMBUS market research because it suggests that behind the scenes there is growing

momentum behind the migration from a relatively long-lived media such as paper to a short lived one in electronic formats. These sorts of social trends are important considerations if we are to preserve a representation of old literature on future devices. This is a problem which memory institutions have been tackling for hundreds for years as they preserve writings that date back to the middle ages and beyond.

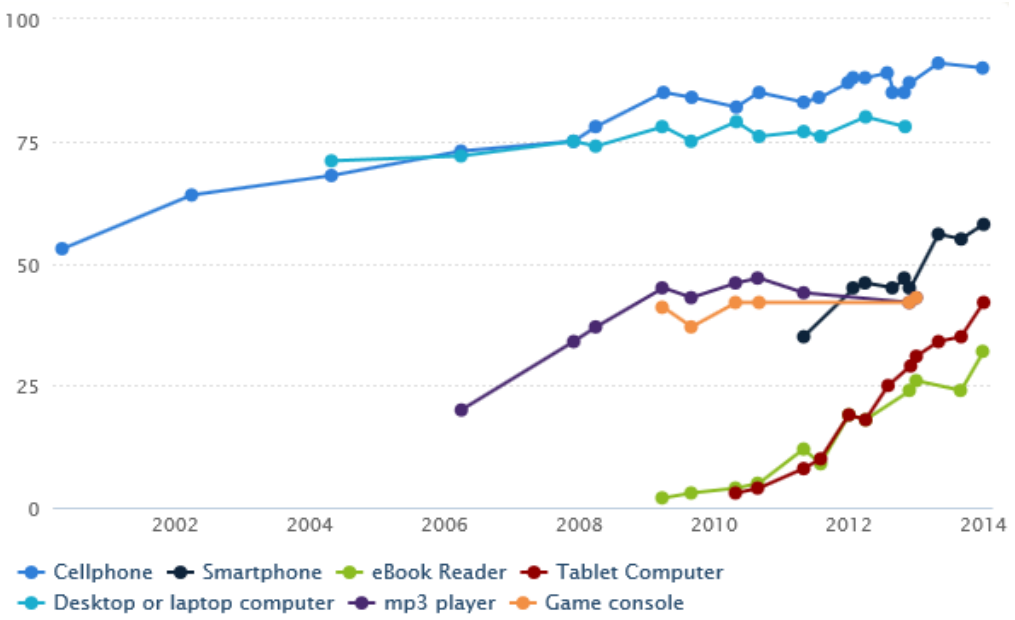

Figure 12: Updated Device Ownership Figures, as of January 2014

(Source: PEW Research Center)

3.4 Wearables

In the D2.3 deliverable, we noted that wearables had been around for a while, but this market had been particularly topical in 2013 with large players such as Intel, ARM, Sony, Texas Instruments and others all launching enabling products during the year. 'Wearables' is the term used to refer to an emerging market where compute devices become more personal than ever before. It is a sector that is being enabled by increasingly smaller compute devices such as the Intel® Galileo® and Intel® Edison® SoC's (System on Chip) which are powered by tiny powerful, microprocessors such as the Intel® Quark®.

According to IDC, wearables will underwhelm in 2015, with 40 to 50 million units; however it will remain a huge area of innovation in 2015 and become the fastest growing mobile app category in the next two to three years. It should be noted in our market research in the final part of the TIMBUS project, that there is more than a hint of these products underwhelming their potential buyers as shown below in Figure 13. It seems the killer wearable still eludes us, although all commentators are interested in the market and confident it will grow.

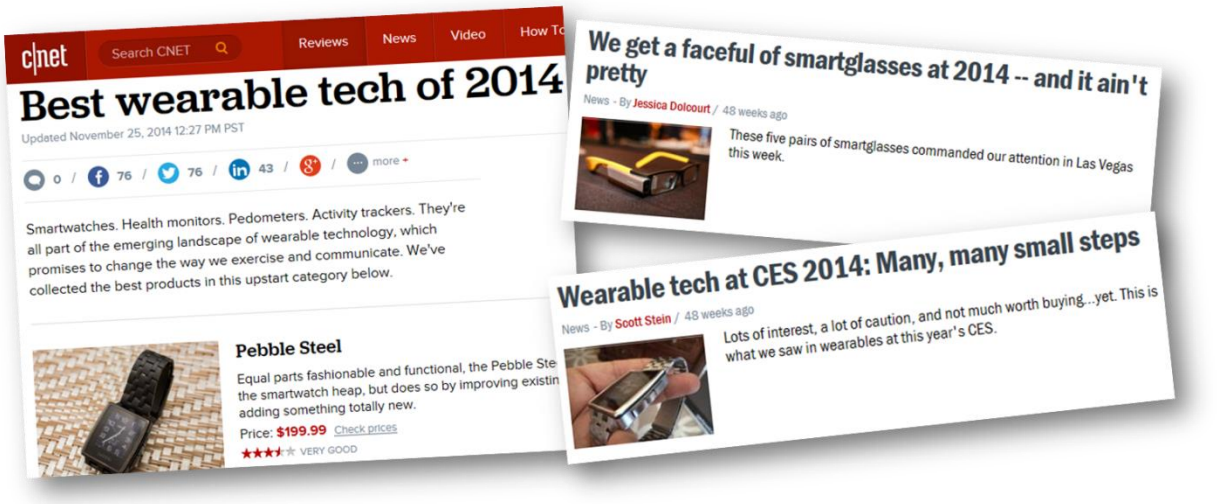

Figure 13: Wearables; Underwhelming Products in 2014-2015?

This is not preventing all of the big names in the IT industry are trying to influence the direction of this potentially large market by launching devices, applications and experiences.

Intel's Chief Executive Officer (CEO) Brian Krzanich has expressed, in his Consumer Electronics Show (CES) 2014 keynote address[5], Intel's intention to "make everything smart" for a future where computing is ubiquitous, the internet connects people and machines to each other inter-operably and interchangeably. Brian Krzanich also launched the Intel Edison® development board which powered some interesting wearable devices, including a baby monitor and state of the art fitness companion, to name only a few. More recently, in early December 2014, it was announced that Intel would supply the chips for the next version of the Google Glass, replacing Texas Instruments Inc. As the Wall Street Journal points out in its "*Google Glass Deal Thrusts Intel Deeper Into Wearable Tech*" article[6], this is "part of a push by the semiconductor giant into wearable technology."

For those, like us, in the Digital Preservation research world, these devices are presenting another new challenge, as they are contributing to acceleration in the pace of technology, which in turn are exacerbating the long-term digital preservation challenge. In fact, their usage results in more data being produced and eventually needing to be stored and possibly preserved.

As of now, only about 7 percent of consumers own a wearable device; however wearable technology ownership is forecast to double by 2015 to 14% and double again to 28% by 2016. The global wearable computing market will grow at a compound annual growth rate (CAGR) of 43.4% from around $5 billion forecast for 2013 to $9.2 billion in 2014 and more than $30.2 billion forecast for 2018.

In its "Top Predictions for IT Organizations and Users for 2015 and Beyond"[7], Gartner predicts that life expectancy will increase by half a year in the developed countries thanks to the adoption of wireless health monitoring technology. Gartner recognise the potential advance wearable technology can bring; with for instance simple wristband able to collect heartbeat, temperature and a number of environmental factors. Wearable technology also enable to monitor heart rhythm, transmitting the data through wireless immediately and easily. The data can then be correlated against large information database and a prognostics and medical advice can be provided based on the data transmitted.

A question that remains for TIMBUS is whether the data that lives in any of these applications has long term value. Again, the primary objective of the TIMBUS consortium is to preserve business processes, which are essentially software environments. But we don't want to just preserve all environments without understanding if these have a value in the medium to long term. On one hand, data about an individual such as captured by a wearable might seem trivial and of little value to anyone other than the individual concerned and even then, only at a certain point in time. The reality remains that this data is actually highly valuable to a lot of people and not just in the short term, but over a long a period of time, and from as geographically dispersed an area as possible. In fact, we have already pointed out, there are many health research projects funded globally that use small study groups to try to ascertain trends about various areas, such as obesity for instance. The type of data we are talking about from Wearables, if it were shared in some way and if it was sufficiently anonymised to take in to consideration any privacy concerns, is actually highly valuable research data which would be either impossible, or cost prohibitive to otherwise gather in any single study.

In TIMBUS we seek to preserve business processes because they have value in their own right or in the data artefacts which live inside them. In the context of Wearables, there are similar considerations about the data generated, its value as a research tool, how that data can be preserved and what software environments are required to interpret and render that data. All this must be undertaken in a legally approved way, which brings another challenge, as legislation across the globe at present and struggles to keep pace with a rapidly evolving technology landscape. Despite the varying degrees of legal protection offered in different jurisdictions, or perhaps because of them, Figure 14, below, shares data from 2013 showing that individual preferences for sharing data about themselves online varies significantly across geographical regions today. It shows that there is a global willingness to share some data, with its level varying drastically depending on the jurisdiction.

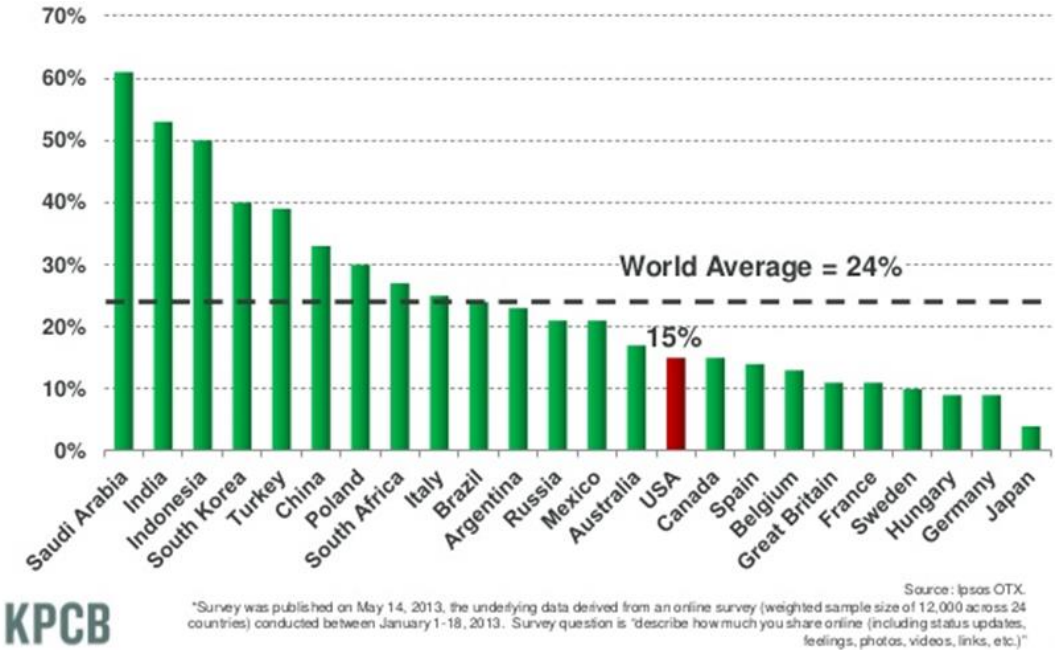

Figure 14: Percentage who share 'everything' or 'most things' online

3.5 The Social Network

In the previous D2.3 deliverable, we presented Table 1 below. We now provide an updated version, showing the top 15 Social Media sites as of September 2014, ranked in order of estimated unique monthly visitors. This data is published by *"The eBusiness Knowledgebase"* on their website at ebizmba.com[8]. Data such as this is important to consider because it shows how our relationship with the internet is evolving over time. While we notice little to no change in the actual top 5 ranking, with little changes after that; we do notice a general upward trend, with the estimated unique monthly visitors' numbers growing since February 2014. Once again, this information is important from a Digital Preservation research perspective in order to understand what sort of data we are generating and what combinations of software and hardware environments are being used to generate and consume that data. It also shows a trend we already highlighted, which is that the internet usage is continuously growing.

Table 1: Top 15 Social Media Sites (Sept. 2014)

Ranking (Sept. 2014)	Site	Stats
1	facebook	3 - eBizMBA Rank | **900,000,000** - Estimated Unique Monthly Visitors | 3 - Compete Rank | 3 - Quantcast Rank | 2 - Alexa Rank
2		12 - eBizMBA Rank | **310,000,000** - Estimated Unique Monthly Visitors | 21 - Compete Rank | 8 - Quantcast Rank | 8 - Alexa Rank
3	LinkedIn	18 - eBizMBA Rank | **255,000,000** - Estimated Unique Monthly Visitors | 25 - Compete Rank | 19 - Quantcast Rank | 9 - Alexa Rank
4	Pinterest	22 - eBizMBA Rank | **250,000,000** - Estimated Unique Monthly Visitors | 27 - Compete Rank | 13 - Quantcast Rank | 26 - Alexa Rank
5	Google+	30 - eBizMBA Rank | **120,000,000** - Estimated Unique Monthly Visitors | *32* - Compete Rank | *28* - Quantcast Rank | NA - Alexa Rank
6	tumblr.	34 - eBizMBA Rank | **110,000,000** - Estimated Unique Monthly Visitors | 55 - Compete Rank | *13* - Quantcast Rank | 34 - Alexa Rank
7	Instagram	77 - eBizMBA Rank | **100,000,000** - Estimated Unique Monthly Visitors | 49 - Compete Rank | 145 - Quantcast Rank | 36 - Alexa Rank
8		97 - eBizMBA Rank | **80,000,000** - Estimated Unique Monthly Visitors | *150* - Compete Rank | *120* - Quantcast Rank | 21 - Alexa Rank
9	flickr	123 - eBizMBA Rank | **65,000,000** - Estimated Unique Monthly Visitors | 138 - Compete Rank | 139 - Quantcast Rank | 91 - Alexa Rank
10	Vine	581 - eBizMBA Rank | **42,000,000** - Estimated Unique Monthly Visitors | 237 - Compete Rank | 335 - Quantcast Rank | 1,172 - Alexa Rank
11	meetup	596 - eBizMBA Rank | **40,000,000** - Estimated Unique Monthly Visitors | 791 - Compete Rank | 701 - Quantcast Rank | 296 - Alexa Rank
12	TAGGED	702 - eBizMBA Rank | **38,000,000** - Estimated Unique Monthly Visitors | 1,082 - Compete Rank | 615 - Quantcast Rank | 408 - Alexa Rank
13	ask.fm	779 - eBizMBA Rank | **37,000,000** - Estimated Unique Monthly Visitors | 2,046 - Compete Rank | 113 - Quantcast Rank | 179 - Alexa Rank
14	meetme	1,457 - eBizMBA Rank | **15,500,000** - Estimated Unique Monthly Visitors | 1,407 - Compete Rank | 635 - Quantcast Rank | 2,328 - Alexa Rank
15	classmates	1,487 - eBizMBA Rank | **15,000,000** - Estimated Unique Monthly Visitors | 153 - Compete Rank | *285* - Quantcast Rank | 4,022 - Alexa Rank

It is also important to think about the effect on the volume and types of data being produced by these new usage models, backed up by Figure 15. YouTube still continues to grow. The growth of the digital information appears to be very robust, while social media services such as Flickr, Snapchat, Instagram and Facebook are not only as popular as ever, but in terms of photo uploads, are actually still accelerating with no levelling off of demand in sight yet.

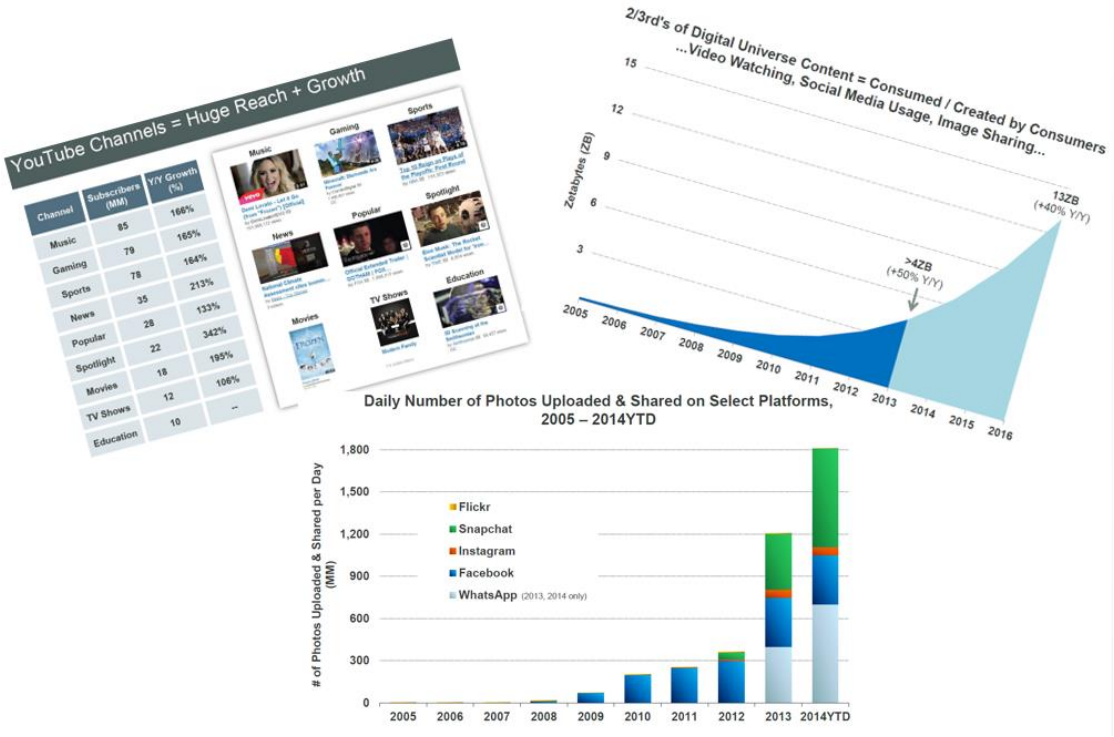

Figure 15: Selected Data from KPCB Report on Internet Trends 2014

According to the 2011 Pew Research results, nearly 80% of American adults are active online and about 60% of them use social networking sites, with more Americans getting their news via the Internet than from newspapers or the radio.

At first glance, these services may seem unrelated to the area of Digital Preservation research. After all, the long-term preservation of static video and photos is a large part of the activities that have been traditionally undertaken by memory institutions and therefore should not be too challenging a problem to deal with. The reality, as is often the case, is not quite so straightforward. Also, there are some concerns when it comes to the authenticity of the information available on social network as well as their privacy.

This workpackage previously quoted an IDC report[9], titled *Worldwide Storage Software 2013–2017 Forecast and 2012 Vendor Shares* from October 2013 backed this up stating: *"Although in its infancy, growing litigation will drive significant increases in social media archiving within heavily regulated industries. Fueled by enforcement of regulations, organizations will increasingly store, monitor, and govern social media communications."*

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Social media: The next generation of archiving

By John Moore Nov 25, 2013

Social media platforms such as Twitter, Facebook and YouTube have become commonplace tools for government outreach. Agencies tw ...everything from d engage with the public constantly evolve," said Richard Stapleton, senior deputy at the Digital t Communications Division and senior Web strategist at the Department of Health and Human f Services. "This past year, our office began using Vine, Pinterest, Tumblr and Storify. Each of these platforms requires a new evaluation and approach." missives, while You collection of briefings, speeches and agency news. And the number of social media platforms continues to expand, with services such as Pinterest growing in popularity among government agencies this year.

Against that backdrop, agencies have started retaining and archiving social media. It's a challenging endeavor. They need to determine which communications must be preserved and then devise archival strategies for a still-evolving set of platforms.

Figure 16: FCW Article on the Next Generation of Archiving[10]

This deliverable reported about Maureen Pennock's very comprehensive review of Web Archiving[11] conducted under the auspices of the Digital Preservation Coalition (DPC) in March of 2013 in its last iteration. In this deliverable we have a further update but first, to recap on the topic, the review was published as part of the DPC's regular Technology Watch report series, which are intended as an advanced introduction to specific issues in digital preservation. This series is available on the DPC website[12]. Maureen's review is an excellent introduction to the topic of web archiving, covering the motives for preserving web content and the technical challenges ranging from web crawler limitations to attempting to address long-term preservation issues such as format obsolesce and the complexities of interdependencies on the files that constitute a website and she discusses the approaches of several projects which the DPC of its members are either involved in or are aware of, as well as many tools which can help with the specific problems of web archiving, such as DROID[13] and PLATO[14].

Since we last reported on Maureen Pennock's Technology Watch Report, the DPC has added two additional reports on orthogonal themes of Preserving e-Journals (Beagrie 2013) and Preserving e-Books (Kirchhoff and Morrissey 2014). Beagrie's report, 'Preservation, Trust and continuing Access to E-Journals' investigates the emergence of third party preservation services that offer a crucial extension to the credibility and viability of scholarly e-Journals. Kichhoff and Morrissey examine the increasing diversity of electronic publishing platforms and problems that arise from the coupling of publications with hardware devices. Taken together these three reports represent a 'Preserving e-Publishing Trilogy' that helps the publishing industry and related institutions navigate an increasingly complicated and rapidly growing field. A fourth title – Preserving Social Media – is in the process of being commissioned.

Two other reports are closely related to DPC's work on TIMBUS. Firstly Preserving Computer Aided Design by Alex Ball includes consideration of how data and applications are embedded together in increasingly complicated ways. Published in 2013, this report has helped the DPC to work with new commercial partners in engineering and architecture, including BAE Systems, Airbus and RIBA – the latter joining the DPC in summer 2014. A further title – Preserving Transactional Data – is currently being commissioned which will further explore the interdependence of data and tools in the context of high volume, multi-user relational databases.

3.6 The Mobile Network

During our previous market analyses in the last 3 years, we had consistently seen that the mobile network has been growing rapidly. According to StatCouner, this trend is continuing, with the use of mobile devices to access the internet increasing by 67% worldwide over the last 12 months.

While the desktop PCs remains the most popular means to access the internet with a share of 64.6%, the mobile share has grown rapidly from 17.1% to 28.5%; this is a significant growth. Tablet devices now account for 6.8% of internet usage, compared to 4.8% 12 months ago.

Figure 17, below, from StaCounter, shows the increase in the mobile usage from September 2013 to August 2014; this is an impressive 66% year-on-year growth.

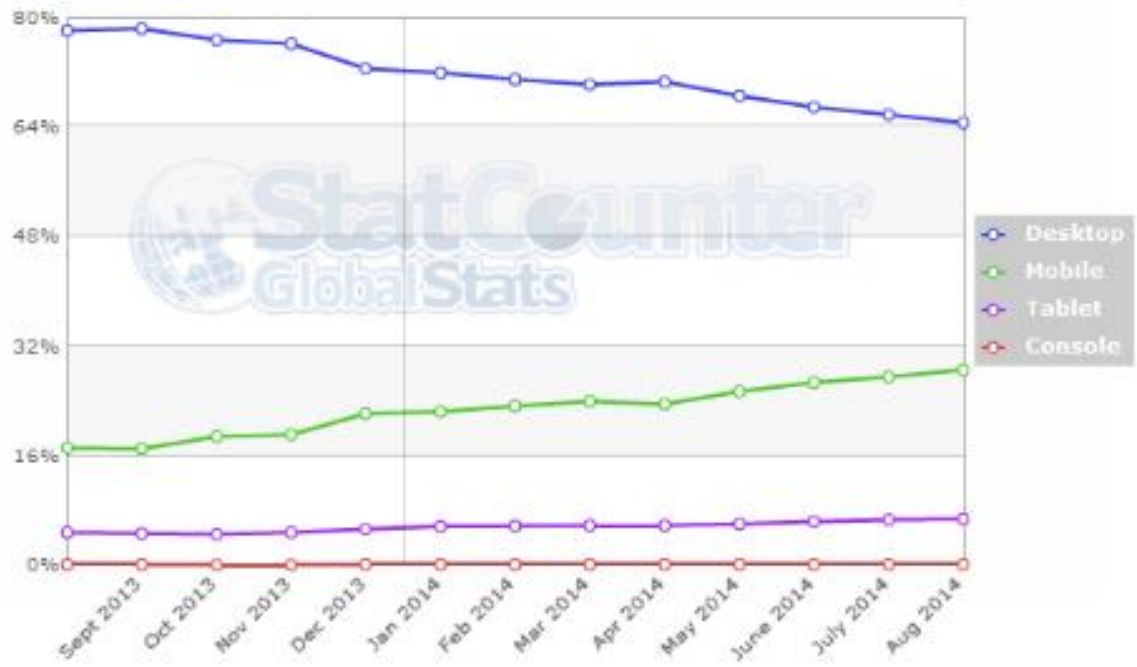


Figure 17: Mobile Web Usage (Sept 13 – Aug 14)

(Source: StatCounter Global Stats)

Aodhan Cullen, CEO at StatCounter, points out that "Mobile usage has already overtaken desktop in several countries including India, South Africa and Saudi Arabia," and "All indications are that this trend is set to continue, which creates new challenges and opportunities for businesses globally."

If we look at markets like the US and the UK, we notice that mobile internet usage there has grown respectively by 73% over the last 12 months to reach 24.4% and by 69% to reach 23.2%. In Europe, it has grown from 9.5% in August 2013 to 21.1% in August 2014.

The use of mobile networks for internet access remains significant, as explained below:

First, as already mentioned, it shows that computing is becoming more pervasive than ever before. As time goes, we seem to want the internet at our fingertips all the time which is one of the factors behind these continuous increases. That in turn shows that the devices we are using to access the internet must change from the traditional PC which was large, heavy and typically fixed to one location in the house or office, to laptops and Ultrabooks which were much better but still somewhat cumbersome to what we have today when we use smartphones and tablets.

Second, we are spending more time online. That's also significant as more of our footprint than ever before now exists in the essentially transient data of an increasingly digital existence. This section of the deliverable will further explore this trend and its likely impact on Digital Preservation research.

We have already seen in section 3.2 the growing use of tablets and smartphones. The implication for Digital Preservation research is that rapid technical evolution magnifies the problems of long term preservation. Not only does it create new devices and software environments but as a social movement, the momentum created behind it is accelerating as there are, of course, large potential markets for the companies and individuals who are successful with these undertakings.

The emergence of smartphones and tablets in the last 10+ years has seen the rise of the Android operating system with its easy to use touch-driven interface. The significance of this should be obvious to a digital preservationist; every technology appears to have a natural time cycle and it is crucial that efforts are made while the technology is still alive to preserve it. After-the-fact preservation becomes more challenging. This is because there is effectively a sliding time window where a critical mass of knowledge exists in the minds of software developers and hardware manufacturers about how to create, operate and support these systems. In just eight years from 2005 to 2012, the rise of smartphones has turned the mobile operating system on its head. This has also affected browser usage. In just two years, we are seeing the effect of the change in our usage patterns. The browser change is interesting because many applications are web based and these tend to be very sensitive to particular versions of particular browsers, which in turn, will only run on certain operating systems, which again in turn, only run on specific devices or hardware. Change is usually good, but for Digital Preservation researchers, this rapid change presents huge challenges if we are to be successful in capturing digital representations of legacy systems.

Even programming languages are not immune from extinction. There has never been such a diversity of programming languages and platforms as there are today. The question is will we continue to see an increasing number of new languages developed or will they eventually converge to a smaller set which would be easier for entities such as ESCROW providers, or more specifically, their customers, to deal with. Preserving a programming language is not a trivial undertaking. It's not just a case of preserving the documentation of the semantics and constructs of the language. It extends to having the compilers to turn source code into executable instructions, it involves development tools and the environments in which those languages used to exist and it incorporates access to the countless numbers of libraries what are developed and maintained by a vibrant and growing open source community worldwide. Programming languages are alive and share many characteristics with spoken languages in that they are constantly evolving and even taking on new functions, but the correct interpretations of their semantics can only be valid at a certain point in time.

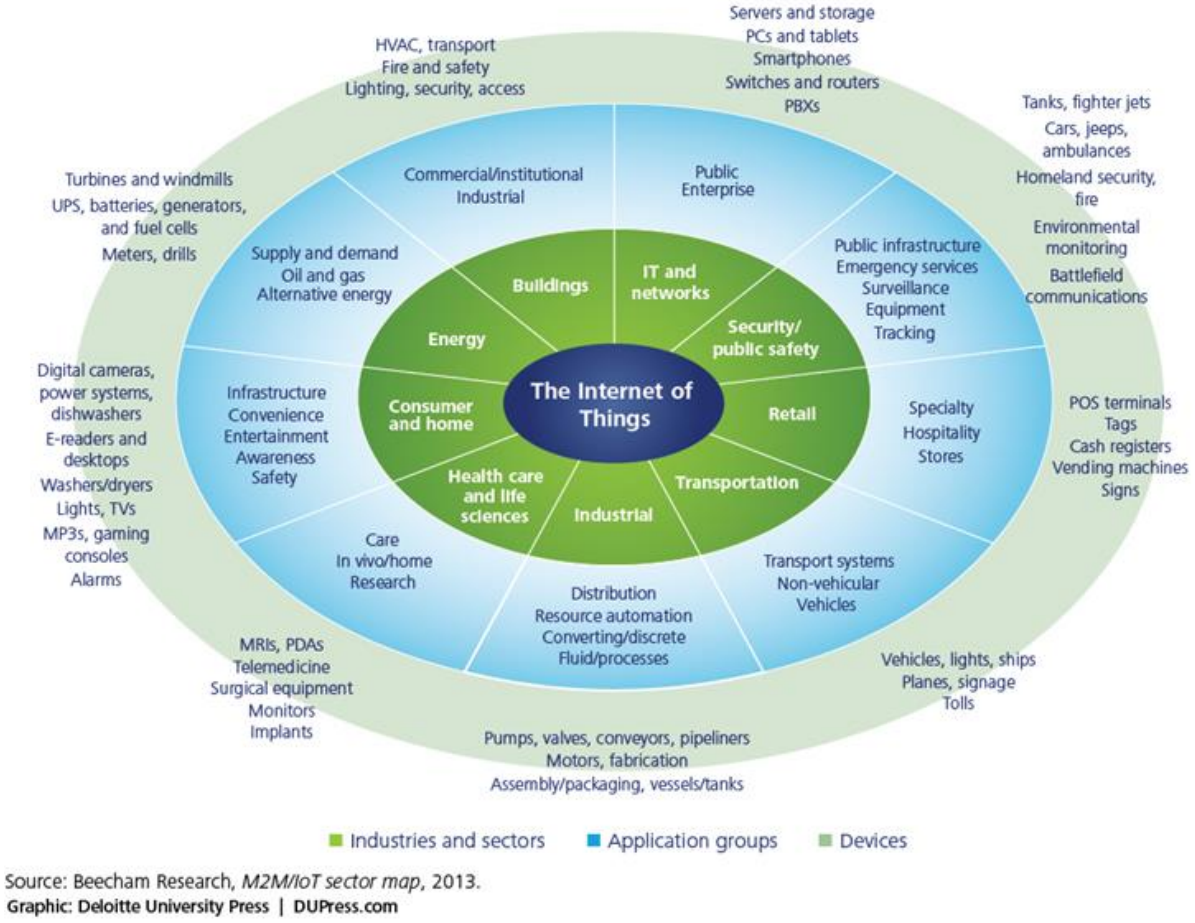
3.7 Growth of Embedded Devices/Internet-of-Things

The TIMBUS market report has said in previous iterations that the intelligent systems market is growing. In 2012, TIMBUS deliverable D2.1 stated figures that this market is expected to reach more than 4 billion units and create $2 trillion in revenue by 2015. This was according to International Data Corporation (IDC), a provider of market intelligence data and that by 2015, these systems will account for about one-third of all unit shipments of major electronic systems, compared with 19% in 2010. In the latest report[15] from IDC on this market, published in October 2014, the trends are accelerating, with IDC now forecasting that "*the Intelligent Systems market will ship over two billion systems in 2019; with the Industrial, Transportation, Smart Home, and Energy segments growing fastest".*

According to IDC, the market for intelligent systems will grow from 1.4 billion units and $755 billion in revenue this year to over 2.2 billion units and over $1 trillion in revenue by 2019. In 2019, IDC expect intelligent systems will represent over one quarter of a total available market of more than 8.5 billion systems in the combined intelligent and embedded systems market.

In its 2015 predictions report[16], IDC forecast that IoT spending will reach more than $1.7 trillion in 2015, representing a 14% rise from 2014. This is driven by 15 billion devices connected worldwide. The IoT spending is expected to reach $3 trillion by 2020, with almost 30 billion devices.

Figure 18, below shows the wide proliferation of IoT devices across industry at the current time. These devices are becoming far more widespread than is readily apparent to the casual onlooker.



Source: Beecham Research, *M2M/IoT sector map*, 2013.
Graphic: Deloitte University Press | DUPress.com

Figure 18: IoT – Proliferation across industry[17]

Figure 19 below illustrates the huge growth in M2M (machine to machine) or IoT devices predicted out to the end of the decade. While all available indicators show growth like this, one of the challenges that the market faces which is relevant to a digital preservation research perspective, is the lack of standards. As with many new technologies, priority is given to getting to the market first by many solution providers. This is understandable when all available market assessments are showing such potential growth in the coming years. However, this rush to market is a large driving force in adding to the complexity of digitally preserving business processes which contain IoT elements. Not only is there the possibility that some sort of functionally-equivalent, point-in-time emulator needs to be developed or preserved, but that the data formats and potentially also the network transports used by today's IoT devices are not necessarily based on mature standards and therefore subject to major revision in the future. We can only speculate about the lifecycles that the IoT devices themselves will have as these will vary on a use-case by use-case and device by device basis, but what is almost certain is that some will not survive in this competitive environment. They will either be rapidly replaced by newer, improved devices from the same supplier, in which case there is a better chance that the device will have some backward compatibility built-in, or they will simply disappear without a trace as the vendor either exits the market or goes out of business entirely. The relevance of this practice to digital preservation is important to grasp; essentially, the longer a technology is available, the more widespread its use is and the more standard based the technology is, the better it is from a digital preservation perspective. Once again, short lifecycles, rapid technological advancement and lack of standards are major challenges to successful, and complete, digital preservation as it is conceived in the TIMBUS project.

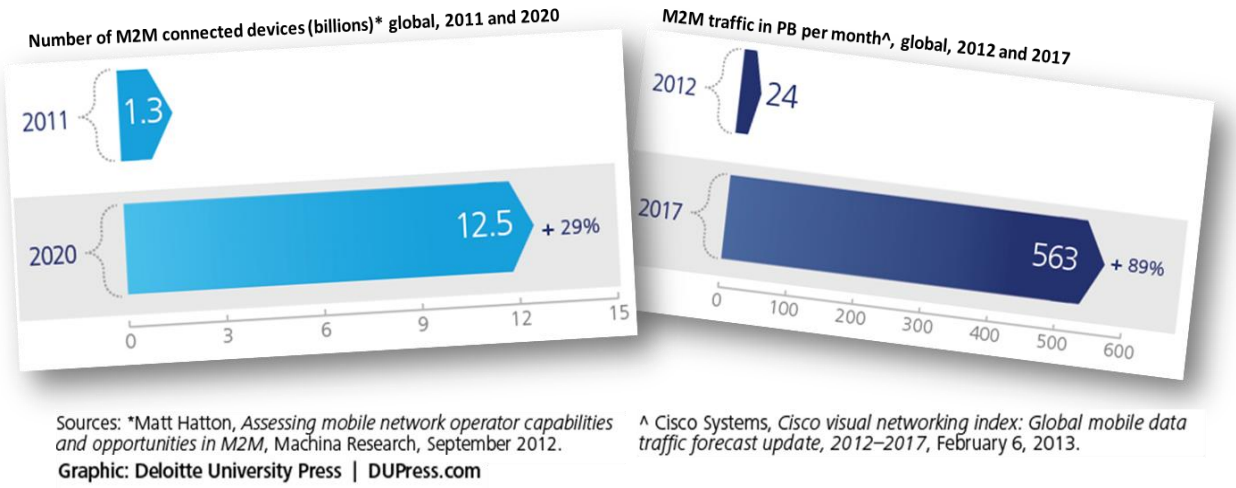


Figure 19: Number of M2M connected devices and M2M traffic[17]

Also, a recent Beecham report, highlights the importance of fixing the Internet of Things security for the long term. According to a new study announced on September 2014 by Beecham Research, the potential damage to people, possessions, businesses and national critical infrastructure from a successful attack on cyber-physical systems through the rapidly emerging Internet of Things (IoT), cannot be underestimated. This only adds to the number of challenges TIMBUS is facing when it comes to long-term digital preservation.

3.8 Conclusions

Our final TIMBUS market assessment of the digital universe has found once again that it is still growing rapidly. Richer content and internet usage growth mean growing volumes of network traffic. According the IDC, the digital universe is now expanding at a more rapid rate than IT organisations can manage.

IDC also states that “The Internet of Things is exploding”, with 20 billion of connectable “things” connected in 2013, representing 7% of the total (187 billion). They expect it will grow to 32 billion by 2020, representing 15% of the total (212 billion). The IoT will therefore become a fast growing contributor to the digital universe, growing over 3 times faster than the traditional ICT, generating up to 27% of the digital universe. When comparing to now, i.e. 2014, IoT generates about 18%.

The rapid growth of the digital universe and its diversity will present many challenges to digital preservationists, as they decide which data needs to be preserved, the best approach to do it and for how long to maintain this data. This will certainly add further storage burden. As we become more and more dependent on technology in our daily lives, preserving our data becomes very important in many levels. In the very fast changing environment we live in, it will become very difficult and complex to do so. The TIMBUS project has been looking at providing some solutions to these challenges and has been engaging with various stakeholders to discuss and exploit further their results. We will cover this in later sections of this exploitation plan.

4 Global Archives

In section 3.1 above, Figure 4 showed that the digital universe data has been growing rapidly over the last few years, with this growth remaining robust over the next 3 years, reaching 13ZB by 2016. This results on an increasing dependency on digital data. As we become more and more dependent of digital data, we, in turn, become increasingly dependent on archives, hence a rapidly growing need of storage.

According to IDC, the number of shipments of 'capacity optimized' storage systems worldwide will grow from approximately 15,000PB in 2012 to about 90,000PB in 2016. Figure 19Figure 4 puts well in evidence this 6-fold increase in just 4 years.

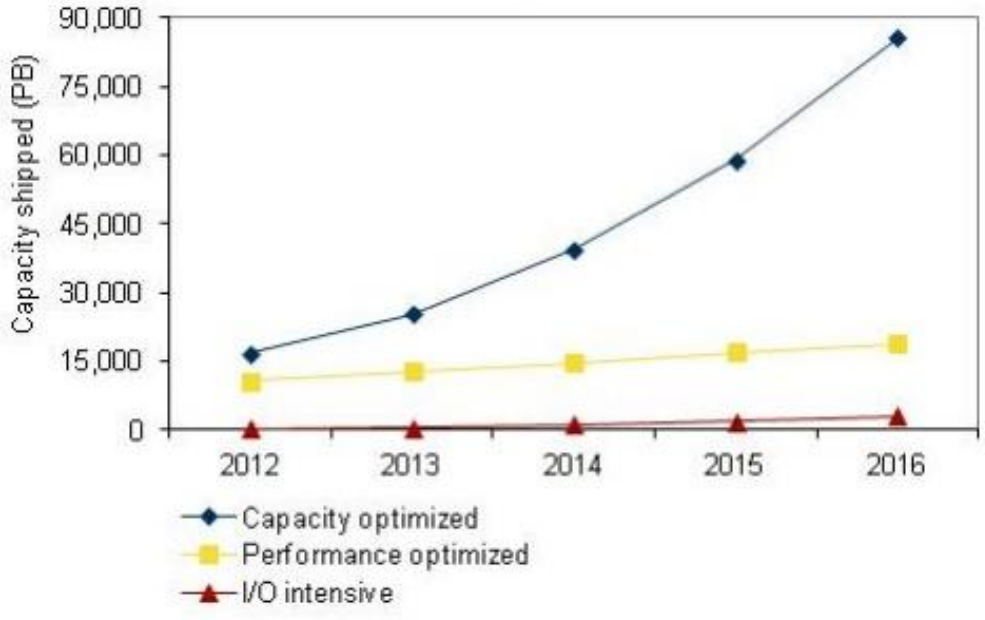


Figure 20: Storage Systems Shipments 2012-2016

(Source: IDC, 2013)

This is a trend we had already noticed and reported in our previous market assessments. This presents a number of challenges to organisations as they need to ensure they meet capacity, performance, allocation, and management needs while securing and protecting the fast growing data. Figure 21 shows how fast the demand for capacity optimised storage increases compared to the demand for performance optimised storage and I/O intensive storage.

In this section, we will look at some of the of the most significant storage trends and discuss about existing storage strategies as these will be important for TIMBUS when we look at solutions to long-term preservation.

4.1 Worldwide Enterprise storage

Figure 23, below, shows IDC's May 2014 forecast[18] for the worldwide enterprise storage systems revenue from 2008 out to 2018, in comparison to the November 2013 forecast, which was included in the D2.4 market assessment. It appears the forecast in terms of revenue remains unchanged, with a continued growth forecast in 2018 as well, reaching over $40 billion.

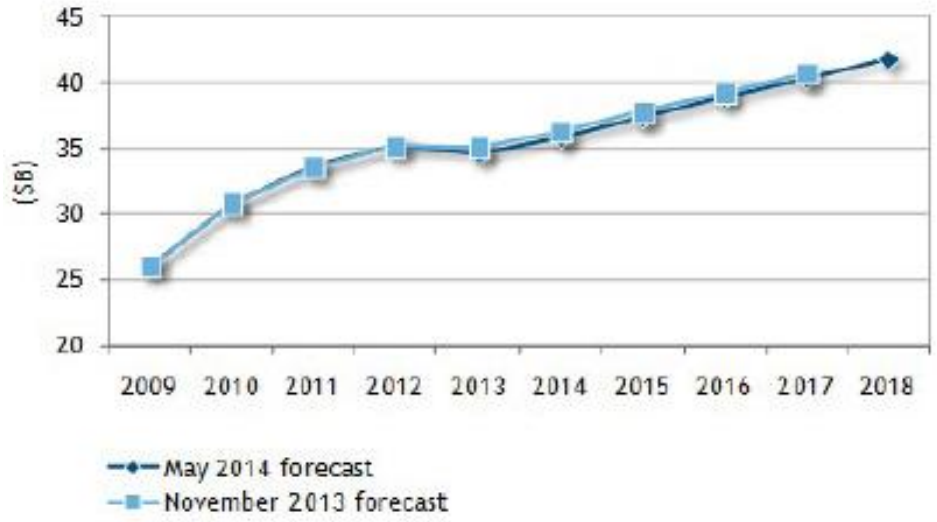


Figure 22: Worldwide Enterprise Storage Systems Revenue

(Source: IDC, 2014)

Similarly, Figure 23 below so no major changes to the forecast for the worldwide enterprise storage systems capacity shipped from 2008 out to 2018. IDC are still forecasting a strong growth for storage systems capacity shipped, reaching 180,000 PB in 2018.

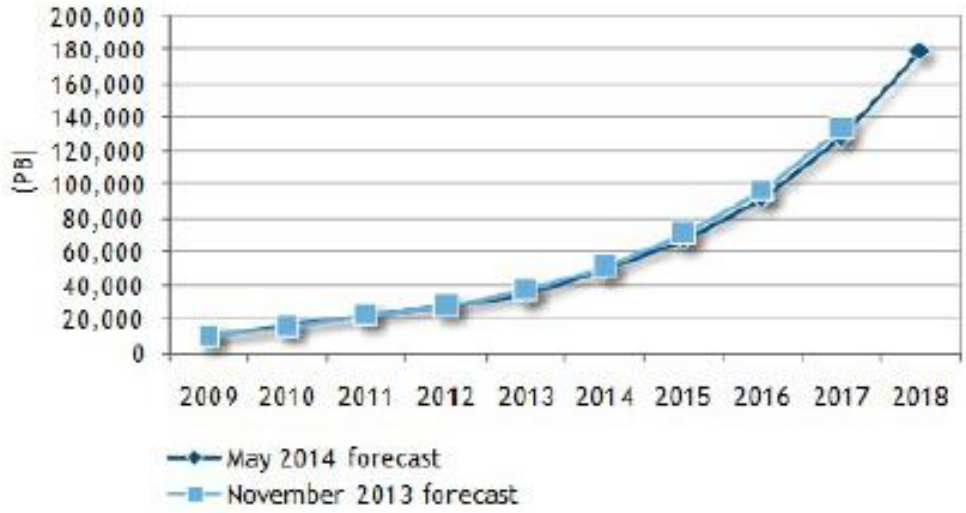


Figure 23: Worldwide Enterprise Storage Systems Capacity Shipped

(Source: IDC, 2014)

This demand is being fuelled by the growth that we are seeing in data in the digital universe as previously covered in section 3 of this deliverable. According to IDC, the digital universe is expected to double in size every two years from now till 2020 reaching 44 zettabytes (ZB) by then, which is a 10-fold increase from 2013. Taking this into account, we can forecast this growth in worldwide enterprise storage systems revenue and capacity shipped to continue during the next decade and possibly later.

4.2 The Software Landscape

According to IDC, the worldwide storage software market has increased 6.3% year-on-year during the second quarter of 2014, with revenues nearing $3.8 billion during that period.

EMC, IBM, and Symantec were identified as the leading storage software suppliers in the second quarter of 2014. Their market shares were as follows:

- EMC: 25.9%
- IBM: 16%
- Symantec: 13.3%

In our previous deliverable, D2.3, we shared the latest revenue predictions from IDC relating to the storage software market. As shown below in Figure 24, IDC forecast a growth in revenue for Windows and Linux operating systems which are perhaps a reflection of these operating systems being heavily deployed across enterprise. Proportionally, revenue on Linux storage software is growing faster than Windows, however Microsoft operating systems are predicted to continue holding a significant revenue lead. That may be a good metric for vendors of storage software on Windows platforms; another view point may equally argue that it is a worse situation for their customers who are perhaps paying more for services that are either cheaper or free on Linux or other open source platforms. From a digital preservation research perspective, the trend below is what is important rather than the scale or the exact figures forecast. The trend is predicting growth in software storage revenue meaning that it is reasonable to expect that there will be opportunities for those organisations in the market who can offer differentiated services over their competitors. There is no reason to think that those differentiations would not, at least in part, be based on enhanced support for long-term retention of data.

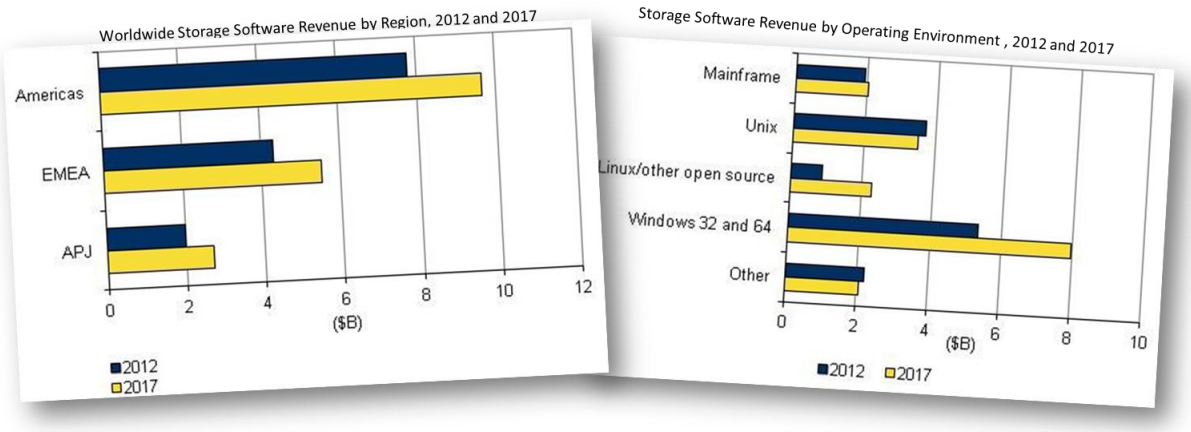


Figure 24: Storage Software Revenue[19]

(Source: IDC Worldwide Storage Software 2013–2017 Forecast, 2012)

A 2014 report titled *IDC's Worldwide Cold Storage Ecosystem Taxonomy, 2014*[22], refers to some of the characteristics that IDC believes will be required for long-term archives. Namely, these are:

- Open Standard Access: This should include Open API access and metadata to support querying of the integrity of data in the archive. We know in the research community how important open standards are to long-term preservation solutions. This is something that TIMBUS recognises in its licensing approach. A closed-source or proprietary solution is a large deterrent to many

organisations who have seen the impact of vendor-lock in's previously. In the area of archival, those are even more difficult to resolve. This is perhaps why, IDC in another report titled *Worldwide Enterprise Storage Systems 2013–2017 Forecast: Customer Landscape Is Changing, Defining Demand for New Solutions*[20] talks about the re-emergence of 'do-it-yourself storage architectures'.

- Media: Cold storage systems should support per device power-off states and protection mechanisms against bit-rot. There is an opportunity here for solutions which optimise incoming and outgoing traffic to disks to maximise power savings by minimising the number of disks which need to be spun up to read or write data. Similar opportunities would exist for performance (i.e. IO) optimisations. This could be an area for future research in the preservation arena.
- Data Security, Compliance and Durability: Previous TIMBUS deliverables have covered these sorts of requirements. Data needs to be secured, even at rest, so that only authorised users have access to it. Archival systems need to implement automated policy based data management capabilities. Many commercial offerings today are simply a deployment of some policy-based management on top of more traditional storage solutions. Lastly, it goes without saying that data loss needs to be guarded against. In this regard, there are many examples of implementations of multi-site solutions which are capable of eliminating the risk of a single outage, be that a hardware failure, a software failure or an environment impact of some other kind (flooding, fire, etc) causing data loss.

4.3 Tiered/Cold Storage

Archiving and preserving data for long periods of time can become very expensive as the size of the data we produce has been growing rapidly over the years. To address this, one needs to analyse the data we wish to archive and set a strategy to minimise the costs. In fact, not all data has the same importance and not all data needs to be accessed and re-used frequently.

Cold Storage is a more cost-efficient way to reliably store important that doesn't need to be y accessed data frequently for long periods of time. An IDC report titled *IDC's Worldwide Cold Storage Ecosystem Taxonomy, 2014*[22] was published in February 2014 and referred to the term *'Cold Storage'*. This phrase has been around since at least 2010 when Dell published a white paper called "Object Storage: A Fresh Approach to Long-Term File Storage[21]". Figure 25, below, comes from the IDC report in 2014 and goes further to give a definition of cold storage. This term is now being used in industry where previously the phrase *archive* might have been preferred.

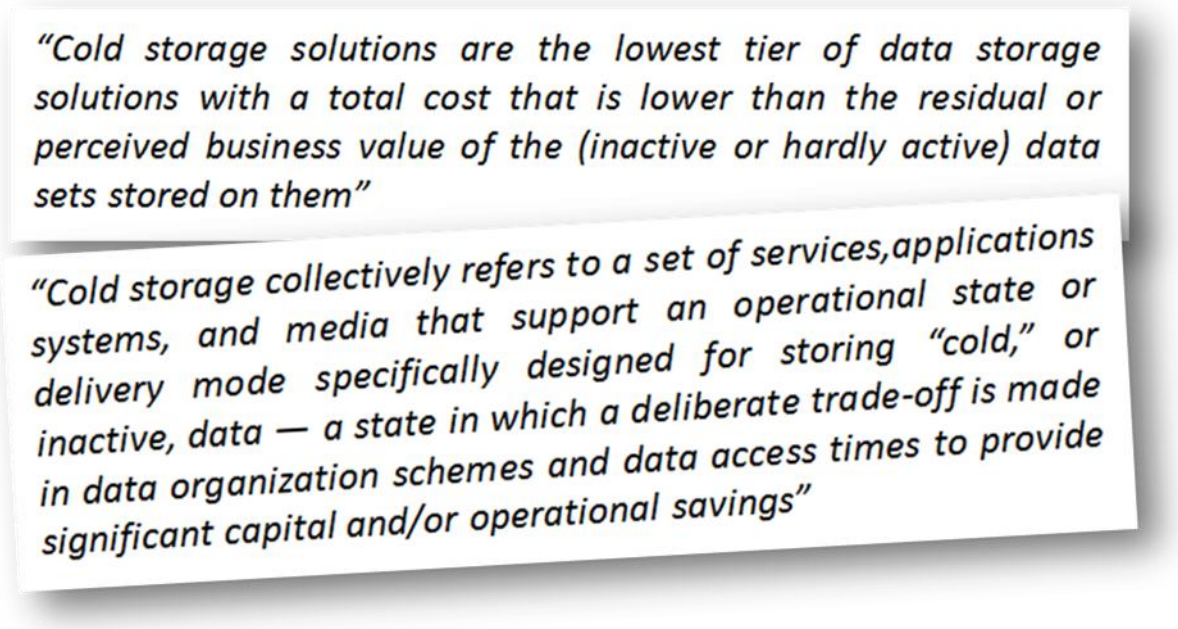


Figure 25: IDC Definition of 'Cold Storage'[22]

(Source: IDC's Worldwide Cold Storage Ecosystem Taxonomy, 2014)

To dramatically reduce data storage cost, trade-offs are required between service and risk, usually affecting response time. In the cloud storage service market, Amazon was the first company to offer a cold storage service named Glacier at a cost much lesser than Amazon's existing S3 service. Starting at $0.01 per gigabyte per month, Amazon Glacier allows you to archive large amounts of data at a very low cost; however it can take hours to retrieve your data.

A tiered approach for data storage is nothing new and has been an item covered in TIMBUS deliverable D5.3 previously. A typical classification scheme for tiers in an enterprise is given in the same IDC report and shown below in Figure 26. Tiered storage is a data storage technique, which moves different categories of data between high-cost and low-cost storage media to reduce total storage cost. Typical technology and data varies by tier and categories of data. Categories can be determined by performance requirements, levels of protection needed, frequency of use and other considerations. This rule also seems to apply to archives with vendors such as EMC, among others, saying that 90 days after the creation of a file, only 20% of your files needs to be accessed frequently and the remaining 80% is either never accessed again or only accessed very infrequently. IT service providers can take advantage of this and optimise the cost of storage solutions by implementing tiered storage infrastructures which automatically move data down to lower cost tiers over time if that data is no longer being regularly accessed. The trade-off in return for lower cost is that the data consumer must accept a lower performance level. This is achieved in practice through the use of less expensive, typically slower and typically higher capacity disks or tapes at the colder tiers. The hot tiers would involve the deployment of the highest speed disks, Storage Area Networks (SANs) and Network Attached Storage (NAS) which are generally more costly to provision on a dollar/euro per gigabyte scale.

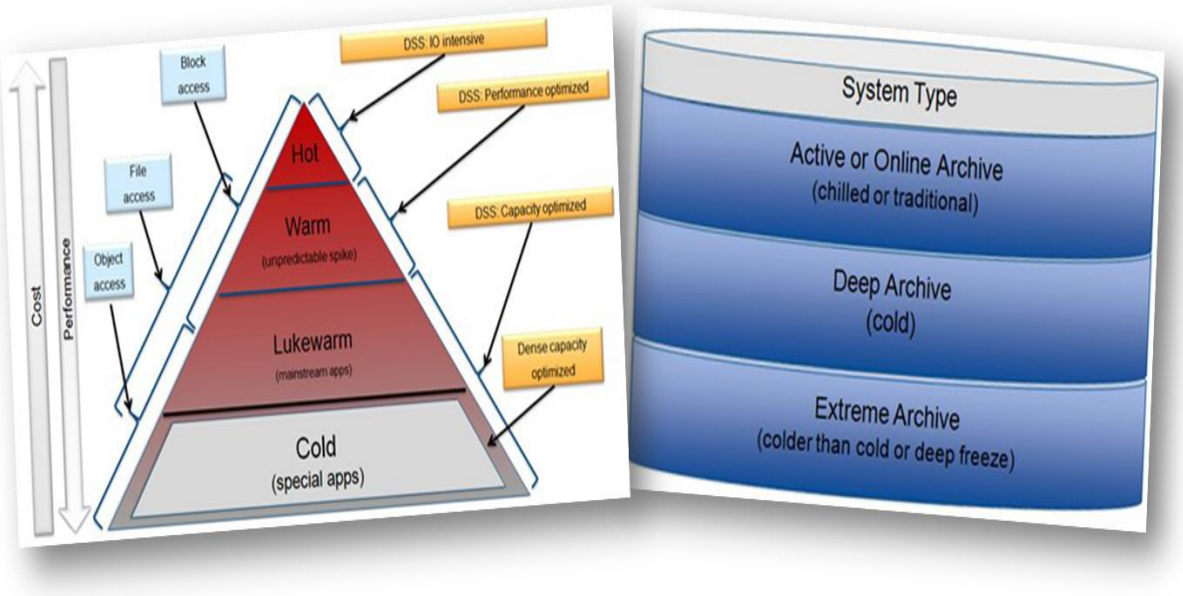


Figure 26: An Enterprise Classification Scheme for Cold Storage

(Source: IDC's Worldwide Cold Storage Ecosystem Taxonomy, 2014)

Figure 27, below, also from the same IDC report gives a better understanding of the differences between the media used at the various layers of a tiered-storage solution. As can be seen, the seek time, or total retrieval time increases at the colder tiers.

System	Media Used	Characteristics
Online or active archive	Flash	▪ Mainly random read/write access ▪ Mainly eMLC Flash
	Capacity-optimized HDD	▪ Mainly random read/write access ▪ Mainly 7,200rpm but can be slower depending on the data transfer rate expectations for a given application ▪ Data retrieval in <1 second when HDD is idle
Deep archive	Flash	▪ Mainly random read/write access ▪ Mainly eMLC Flash
	Capacity-optimized HDD	▪ Mainly sequential read/write access ▪ Less than 7,200rpm — sufficient for data transfer rate expectations ▪ Data retrieval in ~30–60 seconds
Extreme archive	Capacity-optimized HDD	▪ Mainly sequential read/write access ▪ Less than 7,200rpm sufficient for data transfer rate expectations ▪ Data retrieval in ~30–60 seconds
	Traditional magnetic tape or optical media based	▪ WORM availability in hardware (for compliance) ▪ Sequential read/write access ▪ Data retrieval in >60 seconds

Figure 27: Characteristics of Media used in Archives[22]
(Source: IDC)

The tiered storage concept is not new. It's actually a concept gaining in popularity and being more adopted to address the challenge we are facing with the digital universe growing rapidly. Since the beginning of the TIMBUS project, we have observed large divergences in the language used by industry, government and memory institutions that may essentially be talking about the same concepts and trying to address similar challenges, but are on different wavelengths when it comes to speaking to one another to share common learnings. This is merely one example which is a symptom of cultural differences between these organisations due to their foundation, growth, goals and ambitions. This point is again touched on by EMC as part of their feedback to the TIMBUS External Advisory Board (EAB) in section 6 of this deliverable.

4.4 Archival challenges facing organisations

According to IDC, the digital universe is expected to grow exponentially at a rate of 40% per year during the next decade, reaching 44 zettabytes (ZB) i.e. 44 trillion gigabytes (GB) by 2020. This is a 10-fold increase from 2013.

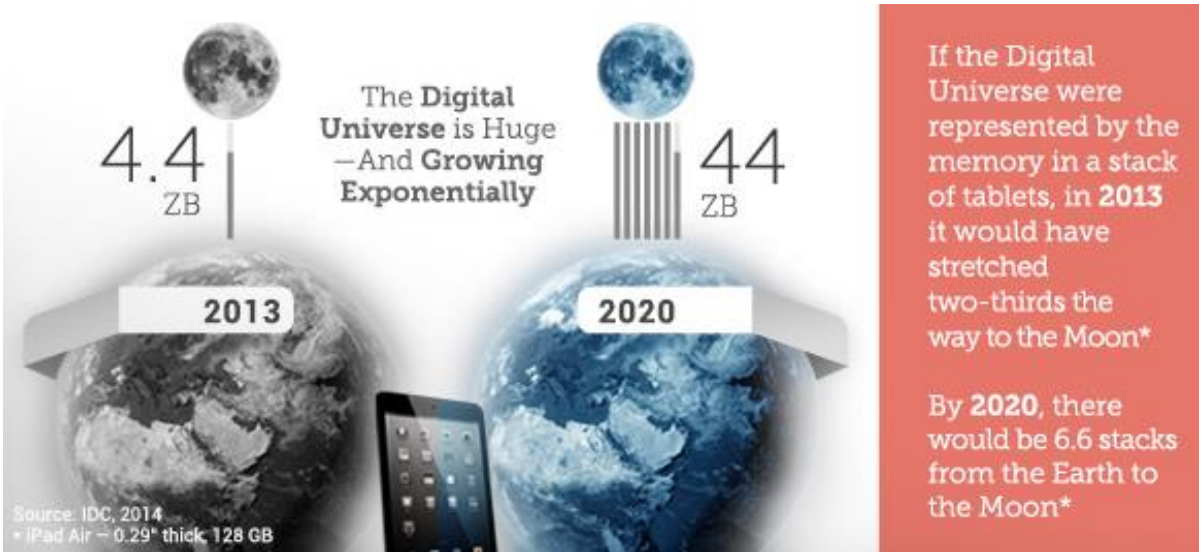


Figure 28: Digital Universe Growth
(Source: IDC, 2014)

The data that makes up this digital universe, created and copied daily, weekly, annually, comes from all across the globe and is broad and diverse, including e-mail, photos, audio, video, to name a few.

As the demand for storage rises, this leads to new challenges to ensure that storage remains efficient, with most organisations wanting to increase the storage capacity and performance, while reducing power consumption and cost. Figure 31 below shows that the longer-term backup, recovery and archiving technologies still remains key, as we could have expected, when it comes to storage. However, we can see that server & Storage virtualisation as well as storage tiering and cloud computing are also raised as one of the top storage technology segments, as companies look at ways to reduce their storage costs.

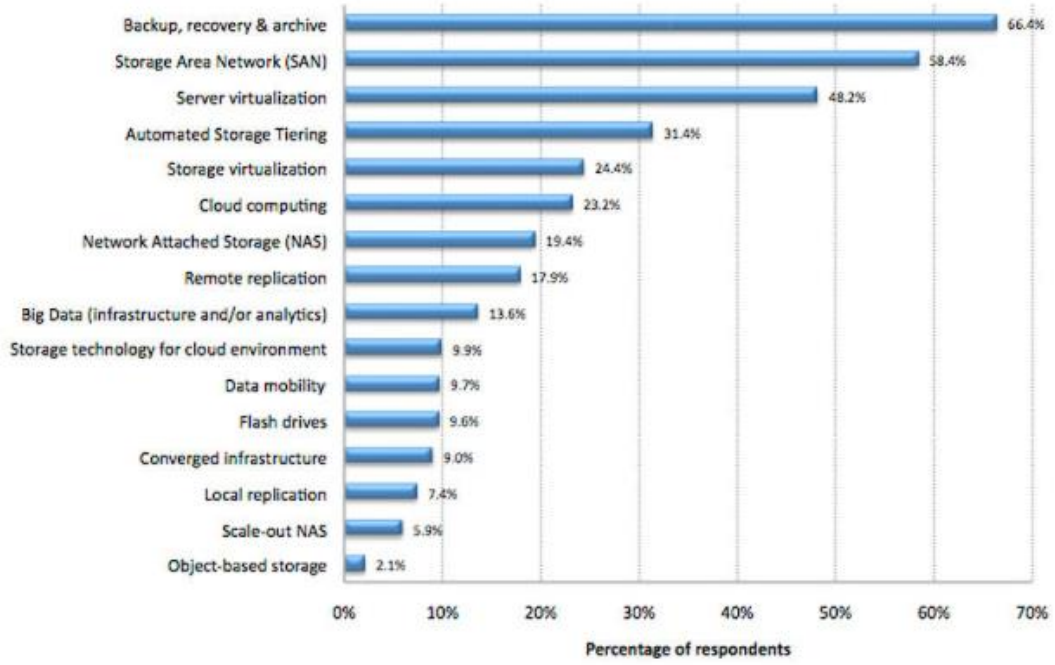


Figure 29: Storage Technologies & Importance
(Source: EMC, 2013)

These priorities are evident in EMC's 2013 survey, which asked IT managers and professionals to identify the most important storage technology segments to their organisations. Backup, recovery and archiving head up the list, while efficiency-promoting solutions like automated storage tiering and storage virtualisation are also prominent

Figure 31 below shows that IT managers and professionals worldwide reported, as we could have expected that managing the storage growth was their biggest challenge.

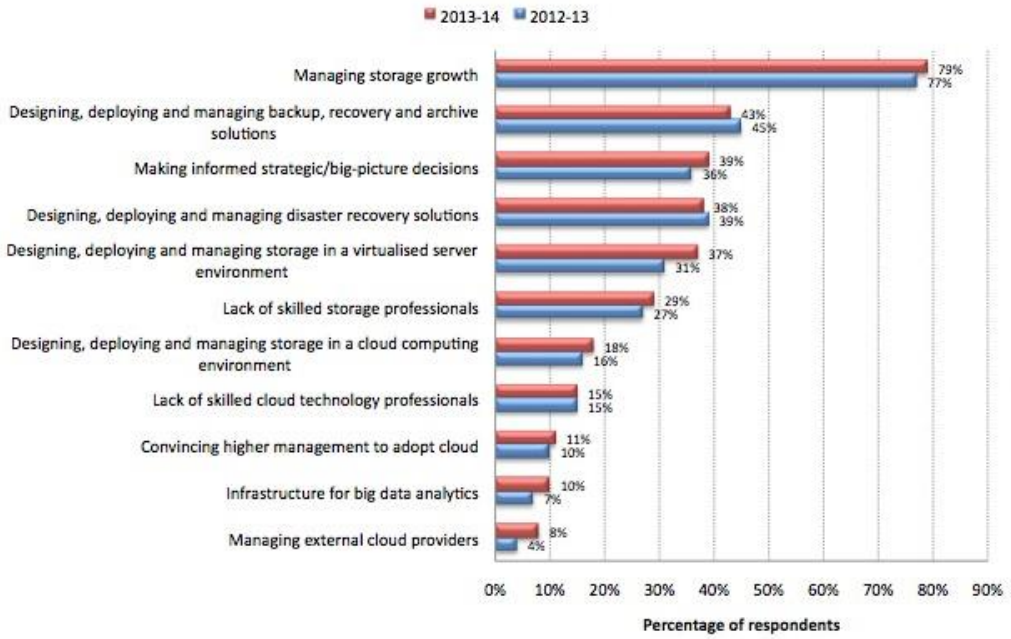


Figure 30: IT/Storage Professionals Top Challenges
(Source: EMC, 2013)

Figure 31 also shows that one of the top and rising challenges facing IT/Storage Professionals is "Making informed strategic/big-picture decisions". Our research work done in TIMBUS has shown us how important this is, as IT/Storage Professionals plan their archiving strategy.

We can also notice a 2-fold increase relating to "Managing external cloud providers" as organisations are looking at external options to store their data in the future. We will discuss about the use of Cloud for archiving in the next section.

When it comes to data protection, IDC believes that much of the digital universe is unprotected; however the percentage of data in the digital universe requiring protection is growing fast, going from only about 20% in 2010 to more than 40% in 2020. The level of protection varies significantly by region, with much less protection in emerging markets.

In the D2.3 report, we had shared the findings shown in a blog from Julia Lockner of Informatica[23] in April 2013[24], describing the impact of the data explosion. No updated data was available since this survey, so we share the same findings below, as these are still relevant to draw conclusions about the archival problems facing organisations today.

Figure 31 below, shows the responses from the attendees about the top pain points they are feeling due to the explosion in data. Over 60% responded that costs and the increasing effort spent on maintenance were the biggest factors, while about a fifth said that data discovery is challenging. Interestingly, compliance concerns are low. This may be because organisations feel they have this aspect of their business under control or else they simply have much larger problems to solve first.

The previous TIMBUS exploitation deliverables, D2.1 and D2.2, produced figures from various surveys and reports with a breakdown of what sorts of data, both structured and unstructured that organisations are archiving. The Informatica data lists data warehousing and reporting environments as by far the fastest growing category of structured data which organisations are dealing with. When it comes to unstructured data, unsurprisingly, e-mail and office documents appear as the largest growing data types but interestingly we see images, video, social networking and mobile/call record data in the top six which is a reflection of the increasing visibility these data types are receiving. Informatica's report listed databases as a type of unstructured data in their survey, which may be arguable as the more widely held opinion would be that these would constitute structured data. Leaving that consideration aside, the data would point to the requirement for organisations to plan for data growth in a deliberate manner and to develop strategies to cope with their individual circumstances.

However, one can forget, as shown in Figure 31, that one of the top and rising challenges facing IT/Storage Professionals is "Making informed strategic/big-picture decisions". This only reinforces the importance for organisations to develop well-thought and planned strategies; which is critical from a budget perspective.

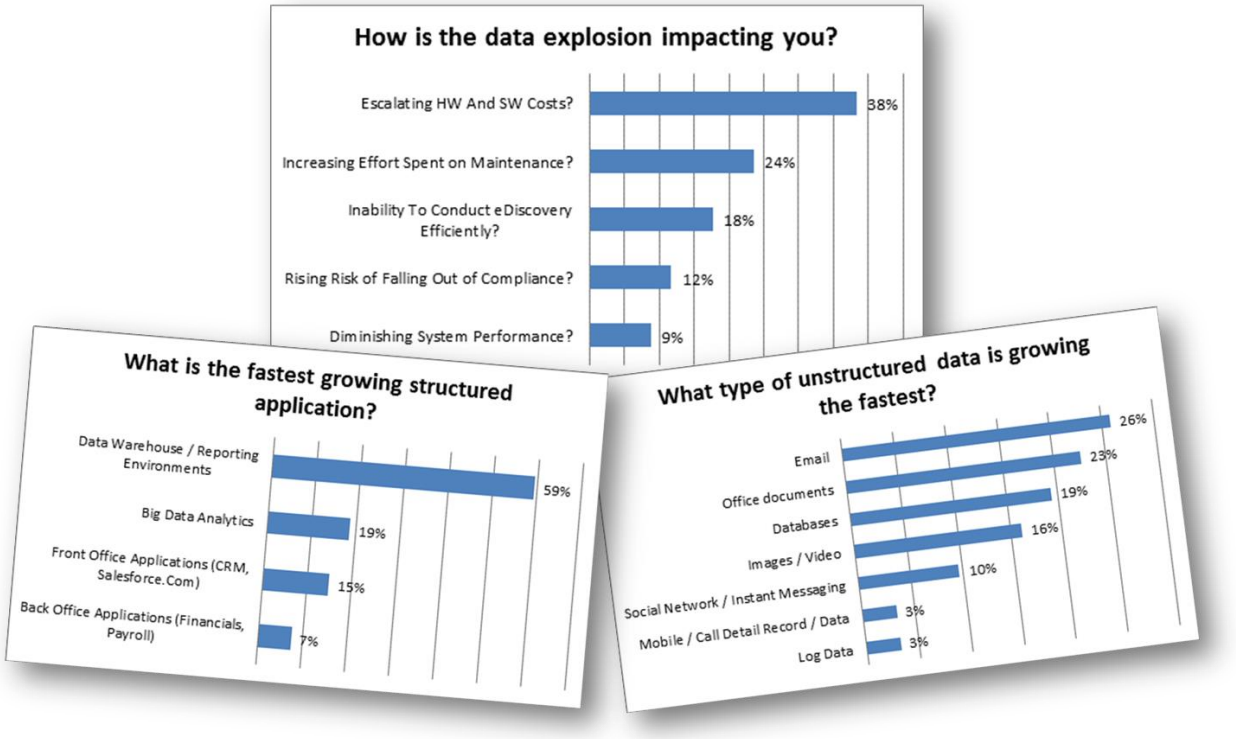


Figure 31: Responses on dealing with Data Growth
(Source: Informatica, April 2013)

Informatica also surveyed their attendees about data archival. Figure 32 below shows that just under two thirds of respondents say their organisations are actively archiving data. One may see a link to the IT/Storage Professionals Top Challenges shown in figure 29 above, with 33% pointing out the lack of skilled storage professionals. However, as pointed out in D2.3, the definition of what actually constitutes archiving is open to the interpretation the respondents put on it, so it is not clear from these figures how many of those are for long term retention versus medium-term, versus perhaps, even just for disaster recovery purposes.

From the TIMBUS perspective, the consortium would feel that there is always a need to define exactly what is meant by *archival* as there are different interpretations of that it means to different individuals and organisations. Improving application performance and regulatory compliance are seen as the largest reasons to perform archival. Arguably, data centre consolidation, streamlining of IT operations and reduction of infrastructure costs are really different strands of cost management and if grouped together, this category would actually be the largest. If this interpretation is accepted, then cost management and application performance are seen to be a more important benefit than regulatory compliance.

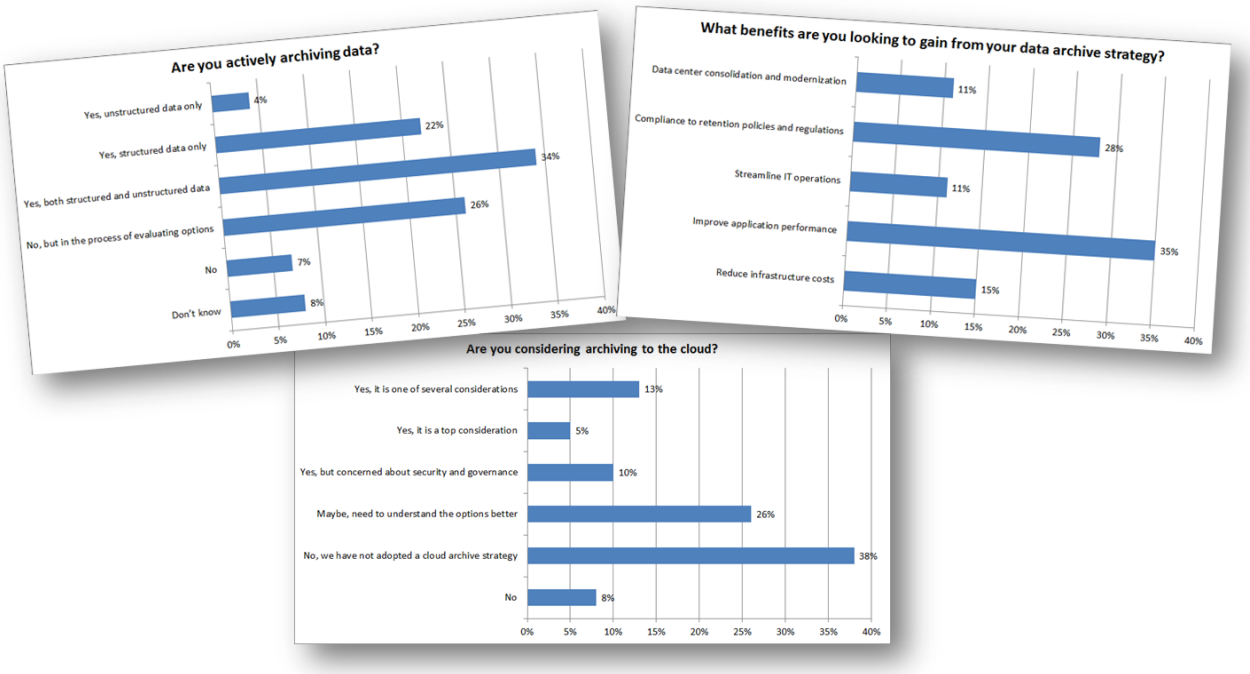


Figure 32: Responses on Archiving
(Source: Informatica, April 2013)

Section 4.5 of this deliverable will discuss the use of cloud for archival but the topic is introduced here as part of Informatica's blog and the IT/Storage Professionals Top Challenges. Again, the question is not as precise as we would like it to be as it does not make it clear if respondents are already using cloud services for archival or simply considering it. The conclusion this deliverable draws from that question is that there is a small, but significant percentage of organisations strongly considering using cloud for archival, up to perhaps 25% and this number may be as high as 51% if the figure who responded with 'maybe' are taken into consideration. If we again make the reasonable assumption that 'consideration' means an organisation feels archiving in the cloud is an option for them but they have concerns about doing it, then the survey shows a healthy level debate on the issue of using cloud for archival. We also reported earlier a 2-fold increase in concerns relating to "Managing external cloud providers" as organisations are looking at external options to store their data in the future. We will discuss about the use of Cloud for archiving in the next section. In the opinion of the TIMBUS consortium, and based on our market assessments to date, we think that such a move is highly risky, particularly for sensitive data or data which needs to be archived for a long period of time. Cloud providers are poorly equipped to meet the requirements of long-term-preservation and they are not cheap despite lower cost options such as Amazon's Glacier service which undercuts their S3 storage service in pricing terms and is aimed at the archival market.

4.5 Using Cloud for Archiving & Digital Preservation

While consumers have been easily adopting public cloud storage services such as Dropbox for some time, as very cost-effective and convenient, companies have been a lot more cautious due to the sensitive nature of their data and its confidentiality; although it still remains an attractive option as they look at ways to reduce their storage costs.

Error! Reference source not found. below shows the data migration from traditional to virtual and cloud environments.

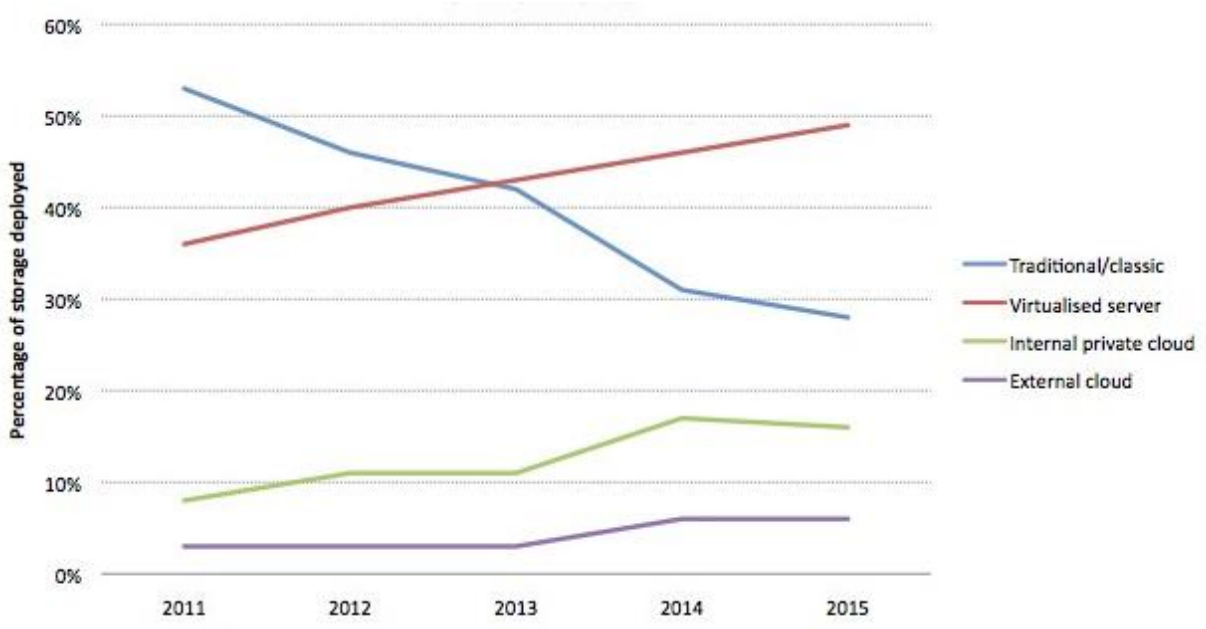


Figure 33: Data/Storage Migration (2011-2015)

(Source: EMC, 2013)

Outside a small inflection in 2014, we can safely make the assumption that the use of internal private cloud storage will continue to grow, benefiting from a decline in traditional storage, which is becoming increasingly expensive. However, organisations are still facing a number of barriers to the adoption of Cloud, as shown in **Error! Reference source not found.** below.

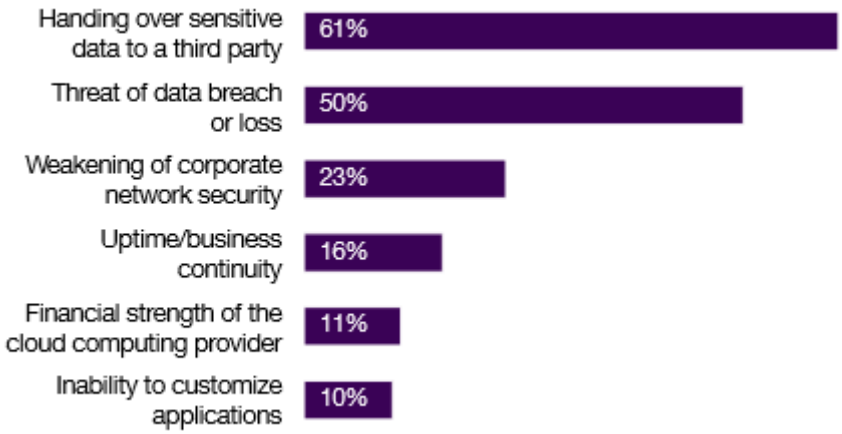


Figure 34: Cloud Adoption Barriers

(Source: 2010 IBM Global IT Risk Study[25])

However, despite the existence of these barriers, according to IDC, as shown in **Error! Reference source not found.** below, just under 40% of the information in the digital universe will be stored or "touched" by Cloud by 2020, with some of the cloud services being public, private, and hybrid.

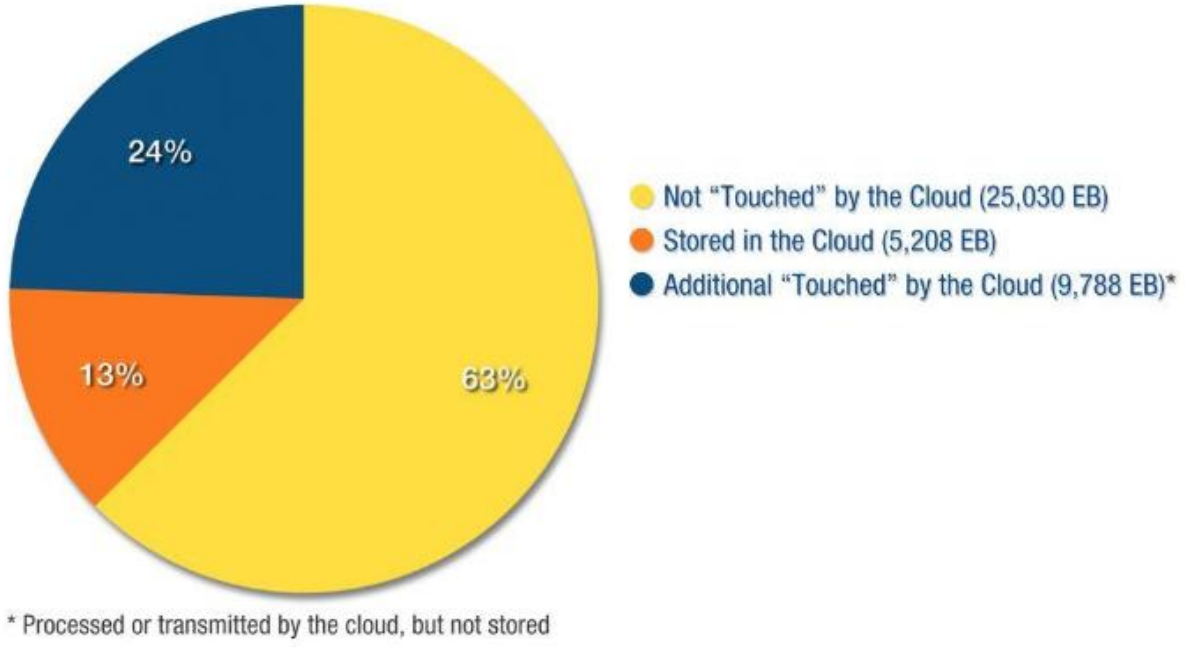


Figure 35: The Digital Universe and Cloud (2020)

(Source: IDC, 2012)

IDC estimates that cloud services spending will significantly grow over the next few years. By the time the TIMBUS project ends, it is expected almost 10% of software spending and almost 15% of infrastructure spending will have transitioned to the cloud.

Michael Peterson, Chief Strategist to SNIA has published on the LTDP (Long term digital preservation reference model) and shared his thoughts on the Requirements for Preserving Information in the Cloud:[26]

- Information must be Organised, Identified, and Indexed
- Complete, Authentic and Valid
- Catalogued (including metadata & required manifest) and Tracked
- Transformed to a standard format
- Transferred reliably and verified (non-repudiation)
- Tamper proof
- Confidential, secure, protected from change
- Digitally Audited and protected from damage or loss
- Accesses Logged
- Direct Access
- Self-validating

- Migratable (physically and logically)
- Portable (independent of the physical storage) and interoperable
- Useable and accessible
- Retention management including Deletion capabilities

As the TIMBUS project comes to an end, this debate is continuing. As we pointed out in D2.3, the market that the cloud service providers cater to has been one which is the least concerned with privacy and assurances about Service Level Agreements (SLA). This has allowed cloud providers to build up a reasonable sized and very profitable market, while at the same time, putting very minimal, if any, effort into addressing concerns from that segment of the market which is unwilling to use external cloud providers due to the lack of SLAs and quality of service guarantees.

Truman Technologies published a blog article[27] in February 2013 which we previously discussed in D2.3. In it, the top 5 questions to ask before outsourcing archival to a cloud vendor are considered. The five questions raised in the blog, and the thoughts of the TIMBUS consortium on each of the points raised in the blog remain relevant as given below in Table 2.

Table 2: Top 5 questions to ask before outsourcing archival to a cloud vendor

Question	TIMBUS assessment
What happens to my digital assets if the vendor goes out of business or ends the service?	We have seen what happened to Nirvanix[28] when they went out of business. We know that several storage providers are brokers who offer services on top of a tier 1 provider such as Amazon or Google. The relationships which these organisations have with the underlying provider are not necessarily visible to the end consumer. SLA's, if present at all, are difficult to measure and if terms are breached, the financial compensation at best will amount to a partial refund of the subscription cost of the service. There is no allowance made for the value of data beyond that. Cloud providers have been hesitant to provide open API's and interoperability between cloud providers is still not very advanced. Vendor lock-in is a distinct possibility and the data owner has very little influence on the providers' charges.
Does the cloud vendor understand the requirements of digital preservation and archiving versus digital storage?	The Minnesota History Society's assessment of cloud venders carried out in April of 2013 was referred to in Figure 20 of this deliverable. This is the latest independent assessment available to us and its conclusions are that very few cloud providers understand the requirements of long-term preservation. Cloud providers are essentially offering a "data-dump" service to customers with very few guarantees. There are some niche players who do understand the problem domain better than others, but in general terms, the largest players in the cloud storage market are not catering for long-term archival needs and that takes into account services such as Amazon Glacier which is aimed at archival. The reason is they don't have to. The part of the market that cares about long-term preservation is still small enough that the larger vendors feel it can be safely bypassed for the moment while they

	concentrate on winning as much of the low-hanging global storage business as possible.
How much preservation management and workflow is handled or aided?	The OAIS model defines the basic steps in correctly preserving a digital artefact and David Rosenthal in a recent blog[29], stated that "*the research into the historical costs of digital preservation can be summarized by the following rule of thumb. Ingest takes about half, preservation (mainly storage) takes about one-third, and access about one-sixth of the total".* The ingest and storage are expensive processes which must generate, or at least support, metadata storage, fixity checking, replicas, potentially encryption/access controls, and so on. If a cloud provider is simply just providing a place to dump data and read it back, then they are not necessarily saving the organisation as much as they could be.
In what location will my archive collection be stored, and who owns my data and copyright?	These issues would apply to any storage of data in the cloud. It should be possible to know which geographies your organisations data resides in, if not the data centre itself. This may be of concern if the data is going to be held in a different legal jurisdiction. Cloud providers, for cost or performance optimisation purposes may have the right to move this location without your prior consent or even your knowledge. It may be advisable to find out if any legal assurances are given about this. Copyright access to data can often differ from the assumptions that users make about it. By storing data on a providers cloud service, your organisation may be giving up certain rights on how that cloud provider can use your data for their own purposes. It is best to take legal advice and check terms and conditions through a lawyer. What position is your organisation in if there are no details about access rights to data in the terms and conditions? This could potentially leave a service provider free to mine your data for whatever purposes they see fit.
How do I (easily) get my thousands of terabytes of digital content into – and out of – the cloud?	Sometimes a vendor may support an organisation sending in tapes or disks full of data to speed up the process of getting the data onto the vendor's service. Network bandwidth can be a limiting factor for large data volumes in terms of time and costly to provide bandwidth. Cloud vendors also have metered tariffs for data access; if for example, your organisation wanted to make a digital collection accessible to the public and it proved very popular, there could be raising costs in continuing to host the service as more users access it. If a vendor goes out of business, will it even be possible to get your data back in a reasonable period of time?

These are only the top 5 questions Truman Technologies listed in their blog. As we research further the main questions that should be asked before outsourcing archival to a cloud vendor, we realise that many more important questions arise, with these re-appearing. The key areas appear to be as follows:

- Data location
- Backups

- Speed
- Cost
- Licensing agreement
- Data centre credibility
- Cloud suitability
- Security
- Continuity provision

4.6 Conclusions

We have seen in this section that global archives are continuing to grow, with IDC estimating that, by 2020, close to 40% of the information in the digital universe will be "touched" by Cloud, with some of the cloud services being public, private, and hybrid. Increasingly cloud providers are attempting to lure this potentially lucrative business away from in-house data silos and on to their cloud storage platforms. This is clearly a much easier proposition for certain types of data and certain use cases than it is for archives. However, we should not discount the role of cloud providers entirely. One may suggest to organisations, as Michael Peterson, to start out with private cloud, moving to hybrid; in fact, a hybrid cloud approach may well make sense in certain situations. In this scenario, a cloud provider may keep one or more copies of the data for your organisation on their infrastructure while you also retain a copy. This may be beneficial as a protection against natural disasters or other service outages. Whichever way an organisation may decide to proceed, it’s important they develop well their archiving strategy.

5 Influence of Emerging Technologies

This is a section of the deliverable which we introduced last year based on reviewer feedback. The previous exploitation deliverable, D2.3, used this section to discuss several big-data technologies and their relevance to the general digital preservation domain, but more specifically to TIMBUS. That report included some examples of classic big-data challenges, some of the technologies being used such as Hadoop, SAP-Hana, Storm, Apache Kafka, Akka as well as an analysis of multi-lingual processing techniques. In this final deliverable, we have retained this section and used it to capture changes in these domains in the last six months and evaluate trends and technologies which perhaps did not fit into preceding topics already covered in sections **Error! Reference source not found.** and **Error! Reference source not found.**. In those sections, this deliverable has already covered some trends such as new devices, Wearables, the embedded market and made some conclusion about their relevance and influence on the digital preservation domain. Essentially, the creation of new technology, and specifically, the increasing pace that they are turning into mass markets, is a major driver for more research into ensuring that the data and the software environments needed to interpret the data are described adequately so that they can be preserved and accessible into the future.

5.1 Top Technology Trends for 2015

It is interesting in this section of the deliverable to look at some obvious, and also some not so obvious trends happening in the technology sector. We will focus the discussion on topics with relevancy to TIMBUS and/or digital preservation. **Error! Reference source not found.**, below highlights some of the top ICT trends that are being predicted for 2015 by some of the leading industry analysts, namely IDC and Gartner.

Figure 36: Top 2015 Trends from IDC and Gartner

IDC bases its 2015 technology predictions around the "3rd Platform" concept. This is essentially a layer of core IT technologies which are becoming mainstream and commonly affordable/accessible in the second decade of this century (2010-2020). As shown in the IDC graphic in **Error! Reference source not**

found., the 3rd Platform consists of some technologies that we are already familiar with such as *cloud*, *mobility*, *social business* and *big-data*, but also includes ones that are still maturing and are not yet commonly available or fully mature, namely this include areas such as *robotics*, *cognitive systems*, *IOT*, *3D printing*, *next generation security*. Gartner uses different language in its reports but the technologies are similar, with Gartner preferring terms such as *Smart Machines* to cover areas of robotics and autonomous systems and sticking to more familiar terms such as *Context Rich Systems* and *Software Defined Applications & Infrastructure* to cover technologies such as embedded intelligence platforms and cloud/data centre services respectively. While there are differences in the various reports, there are far more commonalities present and therefore logically some higher certainty can be assigned to similar trends being predicted from different independent sources.

5.1.1 Big Data and Analytics

As we had previously stated in the last deliverable, big-data is such an all-encompassing term that we chose to define it in the TIMBUS context. In general, Big-data refers to data sets that are so large that they pose problems for traditional relational databases, or traditional tools and applications to process. We used the example of an internet search engine as a common big-data problem because it combines three aspects that must be present for a task to qualify as a big-data problem. These are known as the three V's, namely these are Volume, Velocity and Variety and are explained well in a wired.com30 article by Chris Taylor. Volume refers to the amount of data which needs to be processed. Today, big-data sets are many terabytes in size and petabyte scale data-sets are becoming more frequent. Velocity refers to the speed that the query needs to be executed in. Variety refers to the types of data to be queried which are no longer just rows and columns of text in a relational database but now include videos and images which are not so easy to perform contextual queries against. Embedded, IOT, and sensor systems are now generating increasingly large volumes of data. These platforms host software stacks, without which future emulation of the systems as they existed including how they generated, processed and communicated data is not going to be possible. Speaking at the Gartner Symposium October 5-9 2014 in Orlando, David Cearley, vice president & Gartner Fellow said something that not many would disagree with: "Organisations need to manage how best to filter the huge amounts of data coming from the IoT, social media and wearable devices, and then deliver exactly the right information to the right person, at the right time. Analytics will become deeply, but invisibly embedded everywhere." There is still no silver bullet solution to these types of problem as those engaged in these technologies continue to develop potential solutions and tools. Many organisations are developing their own in-house solutions based on frameworks and technologies being made available in the market. These specialised solutions are clearly trying to address similar types of problems but are diverse in their nature due to their multitude of sources. These are complex issues for long-term digital preservation as the temporal and ad-hoc nature of such implementations exacerbates the issues creating more layer of applications and custom implementations which need to be maintained into the future if the data generated, stored and analysed in such systems is to remain accessible and intelligible.

5.1.2 Smart Machines/Autonomous Systems

Our previous exploitation deliverable, D2.3, contained a review of tools and technologies which could arguably be included in this domain. Those tools included Cyc[31] (an Artificial Intelligence (AI) project which has been running since 1984), supporting technologies such as COLIBRI and jCOLIBRI[32], Apache Jena[33], OntoGen[34], DEX[35], and linguistic processors such as Enrycher[36] and AnswerArt[37]. Into this mix this year we add some AI developments which are again becoming popular as shown below in **Error! Reference source not found.**. The DARPA[38] robotics challenge has received a lot of positive press in the second half of 2014 with new advances in the development of robotic mechanical and software control systems. IBM has re-invented an initiative that Intel had undertaken in the early 1990's and developed a computer processor chip based on a neural network approach. Since its birth at the hands of Alan Turin

in his 1950 paper "Computing Machinery and Intelligence"[39], Machine Learning has arguably had several golden periods which have coincided with technology advances only for them to be stalled each time in the late 1960's/early 1970's with the invention of microprocessors, in the early 1990's with initiatives such as Intel's below in **Error! Reference source not found.** and again today with advances in embedded and autonomous technologies and examples such as IBM's. Time is required to learn if these initiatives will, as many such as Gartner and IDC predict, become mainstream in the current decade. Regardless of if they do or not, the mere example of a technology concept which has had life since 1950, but is still not mature and still requires research should prove to be an example of the need for digital preservation solutions as it enables any gains made during such golden periods to be properly archived in order to more quickly reach a point where the technology is viable, be that in the next 12-24 months or perhaps decades into the future.

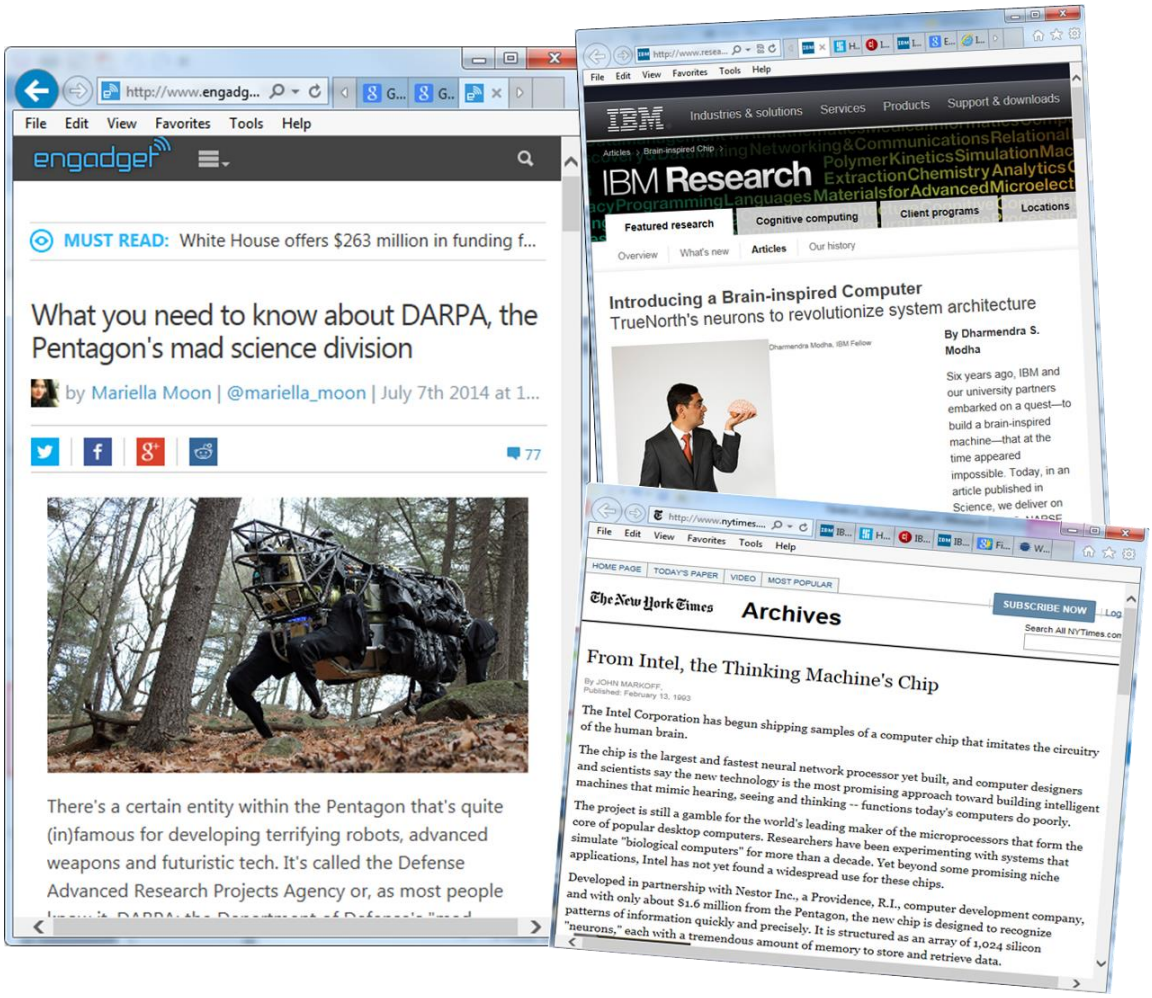


Figure 37: Robotics/AI Articles[40]

5.1.3 3D Printing

3D printing has been around for a while but many analysts see it having huge value in the next few years as a rapid prototype tool. Presently, 3D printers are expensive, bulky and extremely slow. Advances in the next 12-36 months, and beyond, could make the technology more affordable. 3D printing is especially popular among technology enthusiasts such as the *Makers*, a worldwide grouping of loosely coupled and self-identified DIY technology aficionados. The TIMBUS view on the technology is that while

its applications today are embryonic and not quite mainstream, it is not hard to imagine a future where such tools are used across many industries such as Bio-medical, pharmaceutical, mechanical/other engineering and so on. Once again, a new technology form factor will be introduced to design cycles for products with extremely long lives from the point of their initial concept to being withdrawn from the market. Analysis of product failures in the field will most likely require going back over many iterations of the product and perhaps examination of the early prototypes and the tools used to create them in an attempt, for example to find a cause and solution to a specific fault/failure in the product. Equally, the reason to go back to such data and prototypes may be for IP reuse purposes or to accelerate new product lines currently under development.

5.1.4 Software-Defined Applications and Infrastructure

This is another emerging field in which industry consultants are predicting growth. Many people are familiar with traditional computing models and infrastructure but there is increasing demand for more flexible and dynamic architectures. The evolution of technologies such as emulation, virtualisation, Software Defined Storage (SDS) and Software Defined Networking (SDN) have given rise to the concepts of software-defined applications and infrastructure. The primary concept is to introduce several levels of abstraction. On one level, abstraction is introduced between the software layer and its supporting physical infrastructure to enable more dynamic and efficient utilization. On another level, abstraction is introduced in the software layer between internal producers who support or maintain a system and consumers whose applications and business processes reside and run in the environment. For Digital Preservation projects such as TIMBUS, these models both help and hinder our objectives. Firstly they hinder it because they offer yet another new computing paradigm which must be considered and is especially relevant as it is one which is highly focused toward the hosting of business processes. Secondly, these abstraction layers are actually very beneficial in aiding long term preservation. Any layer of abstraction that can be introduced to insulate the higher level application and business logic from the underlying hardware infrastructure is a vital step on the path toward a TIMBUS-style solution to long-term business process preservation. In fact, TIMBUS employs application and infrastructure virtualisation technologies in its research results as viable tools currently available which offer the ability to run legacy software stacks on hardware platforms into the future.

5.1.5 Risk-Based Security and Self-Protection

This is a fascinating and highly relevant domain which Gartner has defined in its 2015 trending technologies. However, in its definition, Gartner and other industry consultants are primarily talking about a new layer of security added into the application layer to augment traditional perimeter security measures such as firewalls and anti-virus technologies. In the past decade we have seen that trend already as initially organisations implemented firewalls between their networks and the broader internet to the situation today where there are many layers of corporate firewalls exist and almost all personal devices such as laptops and smartphones have encryption and anti-intrusion measures implemented. This is simply the next step in the security battlefield where applications themselves will be designed with such self-protective measures. Additionally, Gartner and IDC talk about the requirement for risk mitigation tools to help assess the vulnerability of their networks and applications. TIMBUS uses its iERM component to assess risks to the long-term viability of a business if its prior business processes and data were not available for any reason in the future. Therefore, there is huge potential for research in the area of security and long-term preservation because security adds a layer of complexity and its ever evolving state means that it’s a moving target where todays security preservation solution will not suffice tomorrow and we must ensure that the same controls which secure our IT environments today do not end up preventing future users from being able to access and understand data. It is also a topic which cannot be divorced entirely from risk management.

5.1.6 Quantum Key Distribution (QKD)

This is a related but slightly different topic to the previous one. It is also one which is slightly more forward looking in that it is probably more than 3-5 years off being a main stream technology. Security has always being a moving target with data owners implementing increasingly more secure systems to stay ahead of the technical capabilities available to hackers and cyber criminals. Public/Private key cryptography is widely used today where a data producer used one key to encode a message and a recipient uses a different key to decrypt it. This method has proven to be susceptible to man-in-the-middle attacks where an eavesdropper may be able to compromise the keys by monitoring traffic between the producer and recipient. QKD attempts to address this weakness by using keys which have a property that causes their state to change each time they are read. This makes it possible to detect eavesdroppers. BBN Technologies, Toshiba and ID Quantique use QKD today. It's easy to see how this adds to the challenge facing digital preservation researchers in scenarios where such encryption techniques are employed and as these types technologies become more affordable and widespread, preserving such highly secure systems will create new difficulties in how security can be maintained as part of a preserved business process.

5.2 Conclusions

The discussion on emerging technologies will always be changing just as it is inevitable that humans will continue to invent and apply new technologies and ideas. We could exhaustively list many other technologies in this section but instead the work package has highlighted a small number in order to make some interesting points. Through the course of the TIMBUS project, we have seen each year how the latest technologies mature and evolve into the lists that industry consultants are talking about today. There are no technologies on those lists which are not an evolution of earlier initiatives or ideas. As always, the high pace in the turnover and development of new technologies continues to drive the need for long-term preservation of business and software environments in order to maintain the accessibility and intelligibility of the data generated, processed and stored within it.

6 External Advisory Board Report

The previous exploitation deliverable, D2.3 included a section on the External Advisory Board (EAB). This section of deliverable D2.4 re-caps their feedback and communicates what has been done in the final months of the project regarding the consortium's interactions with the board. The concept of an external board was one which was specified in the description of work specified. The objective of the advisory board was to provide additional opinions, input and feedback on the modelling and technical work carried out in the project. Essentially, this would add the EAB as stakeholders providing valuable input from outside of the consortium. In addition, the EAB has also been an important dissemination channel. In the final phase of the project, the consortium has reached out to the board members to make them aware of the final results of the research.

6.1 Re-introducing the TIMBUS EAB

As communicated in the previous deliverable, the EAB has provided the TIMBUS consortium partners with the opportunity to approach any organisation they know of whom are interested in the TIMBUS research and offer them a potential informal role in the project. This process was managed by the project coordinator, SAP, in consultation with the TIMBUS Project Coordination Committee (PCC) members. As a result of this process, the EAB was formed back in 2013. The members of the EAB have remained the same in the final phase of the project as shown below in Figure 38. The profile information below is sourced from the EAB member's public profiles on LinkedIn or from their organisation's homepages.

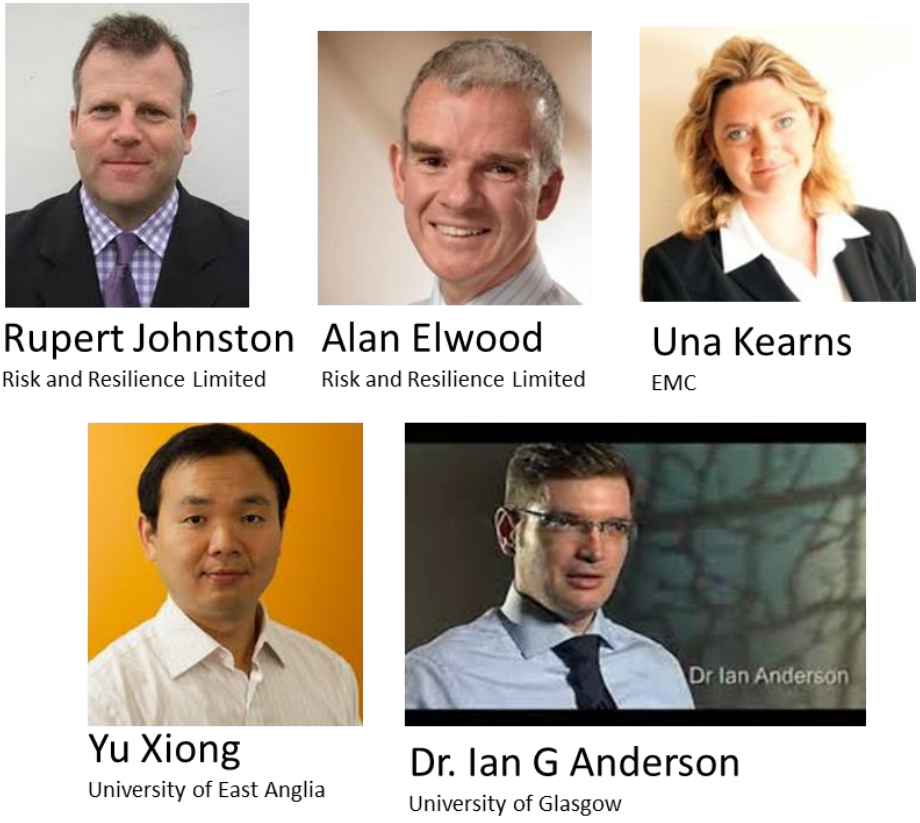


Figure 38: TIMBUS EAB Members

This deliverable now briefly re-introduces the EAB members so that the reader is familiar with their backgrounds and credentials.

Rupert Johnston[41] is a Director at Risk and Resilience Limited (R2)[45] and formerly a Director with Emergency Planning Solutions (EPS)[42]. EPS is a consultancy and training company based in Belfast which provides professional services to reduce the negative business impacts of emergencies or major business interruptions. Their company homepage states that their goal is to *"provide everything an organisation needs to plan for, respond to and recover from significant incidents and business disruptions."* While at EPS, Rupert wrote an excellent *Business Soapbox* article for the Belfast Telegraph from August 2012[43] in which he discusses why businesses are not as proactive as they should be in managing disruption related risks. Businesses today have increasingly complex supply chains upon which they have become dependent. In that article, Rupert suggests that a prevailing "*it'll never happen to us*" attitude is no longer sufficient defence given the higher frequency and more costly impact that disruptions can cause. Rupert is very interested in the aspects of TIMBUS which can help understand such risks and mitigate against them through improved contingency planning which includes preservation of BP software environments. Now with R2, Rupert applies his 25 years of experience to support customers who need to address their risk response plans. Rupert contributed to the development of PD 25222 (Supply Chain Continuity), ISO 22301 (Societal Resilience – the successor for BS 25999) and is currently working with the British Standards Institution to develop BS65000 - the new standard for organisation resilience. Rupert's LinkedIn profile references his work on the TIMBUS EAB.

Alan Elwood [44] is a Director at Risk and Resilience Ltd (R2) [45] and was recently a Director for Emergency Planning Solutions. Alan has a background in supporting the development of resilience systems within organisations and this includes risk and business continuity management. His role with R2 is to oversee the delivery of all projects undertaken by R2. Like EPS, R2 is a consultancy and training firm and is based in Belfast. Alan is a Fellow of the Institute of Civil Protection and Emergency Management and member the Emergency Planning Society. He has served on the executive committee of his Forum of the Business Continuity Institute for six years, being awarded an Achievement Award by the Institute in 2012. He is an active member of BSI committees contributing to Exercising and Testing guidance (PD25666) and reviewing ISO 22398 as well as PD25222 (Supply Chain Risk). He is currently helping to develop a standard for Organisational Resilience and his LinkedIn profile also references his work on the TIMBUS EAB.

Una Kearns[46] is Director of Technology in the CTO Office for EMC's Information Intelligence Group (IIG). Una's team offer an Enterprise Archiving Solution[47] (EAS) which is shown below in Figure 39. At its heart, EAS migrates data from its current format into a XML schema within the unified archive and it implements governance capabilities to help with compliance. Reduction in Total Cost of Ownership (TCO) is a major driver of EAS and EMC has been able to show positive return-on-investment for its customers who wish to end-of-life legacy systems but maintain access to the data.

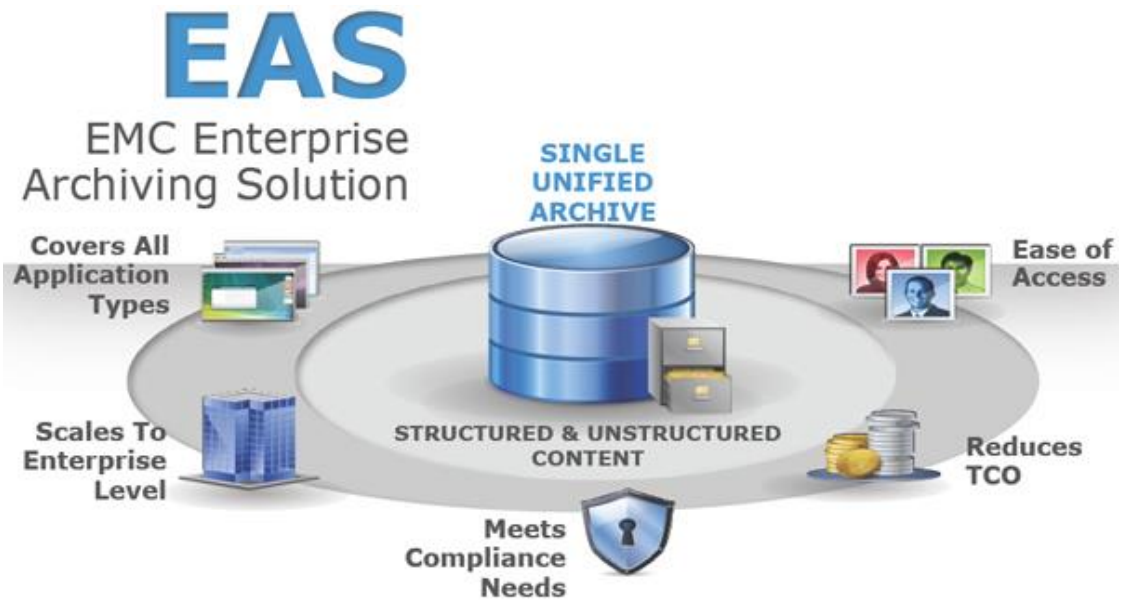


Figure 39: EMC's Enterprise Archiving Solution

Yu Xiong[48] is a senior lecturer (Associate Professor) of Operations Management and Associate Director of Enterprise, Engagement and External Relations at Norwich Business School in University of East Anglia. His research focus includes innovation in supply chain management using IT based solutions. Yu's work is widely published and he works outside of academia with Bombardier, Dow Chemical, Northgate and SAP. His profile page on the University of East Anglia's website[49] references his role on the TIMBUS EAB.

Dr. Ian G Anderson[50] is a senior lecturer at the University of Glasgow's Humanities Advanced Technology and Information Institute (HATII). Ian's[51] main research interest is in the field of Digital Heritage, across the archive library and museum sectors. He is interested in particular in examining the relationship between users, creators and information systems in the cultural heritage sector. He is concerned with how user evaluation can inform the development of information systems, the influence of organisational culture and communities of practice on the development and use of information systems in practice, digital content creation, and innovative ways of representing information online. Ian also has research interests in historical information science and the economic, social and creative impact of Web 2.0 technologies.

6.2 TIMBUS External Advisory Board Engagements

The TIMBUS consortium previously hosted a face-to-face meeting with the external advisory board in the Hilton Grosvenor Hotel in Glasgow on the 12th November 2013 which was reported out on in the previous exploitation deliverable D2.3. This section of the deliverable summarises their inputs from that meeting and have augmented those where new inputs have been available. In this reporting period, the consortium has again sought the input of the EAB. Our specific intentions in contacting the EAB in this reporting period were:

- Make the EAB aware the project is closing and that its final results are available
- Provide collaterals, web links to our project website and code prototypes
- Promote the TIMBUS newsletter
- Thank the individual EAB members for their valuable inputs over the course of the project

- Offer to stay in touch with each partner. We let the EAB members know that our door is always open and they can contact any individual partner if they wish for one-on-one discussions during the project or after it via the individual contact points they have made in the consortium.

Ask for their final thoughts, conclusions, and feedback on the TIMBUS project results, their relevancy in their respective domains and any trends they are seeing in their own technical realms.

6.2.1 Feedback from Rupert Johnston & Alan Elwood (R2)

The main feedback from Rupert and Alan was summarised in the points below:

- From a non-technical perspective, Rupert and Alan liked the context analysis and risk tools as demonstrated during the day. It is always a difficult undertaking to understand the link between technical infrastructure implementations (that is, a BP) and the business itself. The TIMBUS iERM component tackles this for the use cases which TIMBUS is addressing as a risk mitigation strategy. Rupert made the comment that there is no other direct link between the TIMBUS risk tools and the kind of risk management work they would do. That is expected because TIMBUS's iERM component would seek to augment an overall larger risk management plan for the entire organisation and is not meant to be the only risk management that an organisation engages in. They could absolutely see the value of the TIMBUS risk management tools in this overall process.
- Rupert and Alan raised the point that businesses still do not grasp that there is a threat posed to them by failing to properly address the issues which TIMBUS is researching. Many are not planning for disaster and those that do are, in general, not taking sufficient steps to safeguard their organisation. The result will be some future crisis within the organisation when they go searching for some important data and realise that it is either no longer available, or if it is, then it is in a format which not readily consumable. The dissemination of this knowledge being undertaken in work package 3 is very important. The TIMBUS consortium and its members are very aware of these risks, but R2 deal with customers every day who are not thinking about these risks. The large risk mature organisations are the only ones that are aware of it. A lot of SME's are substantial businesses in their own right but are not even thinking about the risks posed to their organisation by failing to properly plan for the long-term preservation of information systems. The reasons are fairly understandable. If the issue is raised, the typical response would be that this may not be a problem for 10 years and therefore it is not a priority spend for us right now. This is a major challenge. If TIMBUS can do anything to raise the awareness of this problem on the horizon for as many organisations as possible, then it will do a great service in helping to channel the funding and resourcing required to service these issues.

6.2.2 Feedback from Una Kearns (EMC)

Una gave the consortium some very interesting and thought provoking inputs thanks to her unique position in heading up a team in an industrial setting which is currently offering a commercial archival product. Her feedback is summarised in the bullet points below:

- For the last year Una has been working with EMC customers trying to solve these types of problems. The approaches she saw in TIMBUS looked really good but there are other approaches.
- EMC is seeing a huge pipeline and growing interest in the market not only from their existing enterprise customers but also from Global System Integrators (SI's).
- EMC customers use a completely different lexicon to what Una heard from the TIMBUS consortium. For example, their customers often have large application rationalisation programs. They are looking across all their legacy applications and figuring out what they can do about making the data they need in the long term accessible. The only place EMC would generally find the term *Digital*

Preservation used is in the public sector. In their customers rationalisation programs, the accepted terms would be around live archiving and big data systems.

- EMC are seeing implementations in the market and are working with their customers to address them. The EMC EAS solution is already being used by several very large customers. Una spoke about one particular customer who is an OEM which has firmware and software running across a diverse range of devices which they have brought to market over a long period of time. They want to keep that legacy IP available to them.
- A second Global life-sciences customer of EMC's is also facing similar challenges. Some of the scenarios they have worked on include closing down sites around the world. The data and knowledge generated at that site over years and potentially decades of operation needs to be captured. They also undertake drug-study reports and have the requirement to keep data on these for 50-100 years. It's not just the data in the drug-study report but its meta-data including everything needed to understand the data. This can also include information on individual workers who worked on the report, assumptions or conditions that were in place as constructs on the composition of the study and so on. The artefacts that need to be kept therefore, are not necessarily the exact Business Process as it was run originally but just the information and data needed to interpret it. They also have calibration systems in data centres which need to be taken offline but the data contained with those systems needs to be preserved for the long-term.
- A third customer is involved in the construction of dams around the world and they need to keep data for the long term.
- All these business interactions between EMC and their customers has shown them that they don't necessarily want or need to preserve the original business process as it existed. Instead, they want a global, business view of their information.
- EMC's EAS system is based on the OAIS model and is completely XML driven so it is schema agnostic. Their customers take information from many systems which could, for example, range from email, tax and financial information, design data about products and bring it all together in one hybrid view.
- Compliance is a big issue for customers. It's important to have data governance capabilities.
- Accessibility is also a key consideration. There has been a big drive to create e-customers in the past few years. This ranges from utility companies to banks. Customers do their business through a website and they expect to see 10-15 years of bank statements online when they need to look for them. That is a lot of information to manage and keep around. There are a lot of storage techniques as to how you might do this.
- EMC has been looking at using VMWare as a container for customers who do want to keep data around and that perhaps all the data could be packaged into a container and kept in that way. Una has not come across this at a scale larger than individual systems in the way that TIMBUS proposes. Some software may be kept for very specific purposes (for example firmware for a mobile or IoT device), but in general this is not done and certainly keeping the entire software stack is not something she had heard before. Instead, the EMC solution is more around creating that global, hybrid view of information from different information systems over time.
- Una wondered about how accessible the data would be in the TIMBUS solution. If the accessibility of the data depended on re-deploying the original system and getting it back up and running, then it's not really readily searchable, nor it is instantly available at your fingertips. But from what she had seen during the day, she really liked the work and is interested in finding out how TIMBUS would address these.

- The iERM approach of TIMBUS was something that Una also liked very much. iERM is helping to answer questions about what TIMBUS should preserve and why. TIMBUS includes a return-on-investment (ROI) calculation that is very interesting because for many organisations the decision to preserve or not is going to be a matter of weighing up the risk versus the cost. EMC's customers want to undertake projects which eliminate risks but also save them money. They want to know how much they will save by migrating their data from several disparate legacy systems into one unified archive. Unless there is a positive cost benefit in doing so, it is very hard to make a compelling argument.

6.2.3 Feedback from Yu Xiong

Yu was very excited to see the progress in TIMBUS. He felt that a lot of what TIMBUS is doing is related to the work that he does and would like further engagement throughout the remainder of the project lifetime. Yu's comments were summarised as follows:

- Interested in working together at a later stage on some joint-dissemination. The dissemination to date in the project is good and the project is creating impact.
- Identifying potential users could be valuable for TIMBUS. Yu is an advisor to Department of Business and Economic Skills for Sustainable Manufacture Structure global strategy.
- For the technical part of the project, he learned a lot from the method, process and the model that the TIMBUS research presented.
- Works for UEA, good location, can be possible to do some joint event, possibly co-host an impact event in London and Yu is willing to approach his contacts to get them involved.

6.2.4 Feedback from Dr. Ian G Anderson (University of East Anglia)

Ian made some valuable comments which reinforced some of the learning within the TIMBUS consortium. These included a general lack of ownership around the problem, the difficulties in penetrating the market, the complexity of the models used to address it, the risk of exposing sensitive data and understanding the relationship between agency and structure. Ian's feedback on what he saw during the face-to-face meeting are summarised below:

- Ian used a white swans' analogy in relation to the DP market; if all swans that you have seen are white you assume all are white. You need to see only one black swan to contradict that. In other words, everyone thinks the problems associated with long-term preservation are not theirs to solve as they won't necessarily be the ones to suffer the consequences in the future.
- The obvious case for DP is not obvious in the building sector, for example. Be cautious about new sectors and how deeply you can penetrate them. Cost and risk in terms of impact is really important for those sectors. Legal and regulatory change may assist the DP case. This regulatory environment can change quite quickly.
- A lot of models are not complex enough for the TIMBUS challenges, but even the existing models that do exist are too complex to be used. Expertise and capacity are lacking. Therefore, a service model has to be the solution rather than having organisations themselves implement it. Cloud providers cannot do it, or at least are not currently doing this.
- Legal requirements. Ian has worked on copyright in the creative industries. Sensitivity of the data is more important than legal issues: Reputational damage through the exposure of data. That scares businesses. Pay attention to the sensitivity of information.

- The relationship between agency/autonomy of action and structure goes to the heart of social science research. TIMBUS does a lot of capture of structure. Several of the work packages presented how they also allow for the capture of agency. When we think of agency we think of autonomy of action but business processes are more like actors which interact with each other and the system. They are therefore not the same as agency because they don't necessarily possess that autonomy property because they typically have an input to spur them to action. It's very important for a research project like TIMBUS to consider this to ensure that enough of the knowledge that "Brian" possessed is captured to allow a future designated community to re-deploy the BP even though Brian retired 20 years ago. It's very important to emphasise the role of agency in preservation undertakings such as TIMBUS, even if a BP was successfully re-deployed in the future.

6.3 Conclusions

The EAB engagements proved to be an extremely valuable undertaking and it is something we would recommend to any research project. The opinions of external parties on a research project can be significant and a strong validator of the research trajectory, or can offer slight course corrections in the case where a research vector could be improved to yield more targeted results to an interested audience. Overall, the EAB continues to feel that the consortium approach is novel, interesting and valuable. Some of the most interesting aspects of the feedback were around the difficulty of penetrating the market, but that the efforts undertaken by the various dissemination and exploitation partners is starting to have an effect. However, significant barriers remain due to many reasons, including, but not limited to:

- Lack of clear ownership/responsibility within organisations for long-term risk mitigation strategies (such as BP process preservation)
- The complexities of the problem and the models involved (agency and structure relationship)
- The nomenclature differences between public sector, memory institutions and industry
- An ever changing legal landscape

It was interesting that many of the largest barriers that the EAB spoke of remain to be non-technical. In reality though, they are perhaps more accurately centred on the merger of non-technical legal and risk processes with Business Intelligence (BI) systems capable of helping to assess risk, make recommendations and then accurately reflect these in the capture of a digital representation of the business process. The generation and capture of enough BP metadata and context is crucial as is the ability to understand the legal constraints around what should be preserved versus what is permissible to be preserved, assuming that these two lists will not always be identical.

Therefore, the iERM, legal and context parts of the TIMBUS research still stand out as the most important parts of the work the consortium is doing and that while a solution may be complex in terms of the model it implements, every endeavour should be undertaken by the consortium to simplify the process for an end-user of the system.

7. Collaboration with OPF

In the TIMBUS Year 3 report, the reviewers mentioned that it was "of high importance the relationship with the Open Planets Foundation to ensure that some of the TIMBUS prototypes are explored after project ends." The TIMBUS consortium agreed with this assessment and acted immediately to engage more actively with the Open Planets Foundation (OPF), now the Open Preservation Foundation. This engagement led to a cross-work package initiative, involving WP2, WP3 and WP6. The objective of this collaboration between OPF and TIMBUS was to ensure, as advised by the reviewers, that some of the TIMBUS tools are maintained and sustained after project ends, creating a new exploitation opportunity for TIMBUS. This section of the deliverable introduces the Open Preservation Foundation and will summarise the outcomes of the TIMBUS consortium's interactions with them up to this point in the project.

7.1 Introducing the Open Preservation Foundation

The Open Preservation Foundation (OPF)[52] is a membership organisation which enables collaboration in Technology, Knowledge, and Advocacy and Alliances to support our members in developing their digital preservation capacity. Amongst its members are:

- AIT Austrian Institute of Technology[53], an Austrian research institute with a European format and focuses on the key infrastructure issues of the future
- Bibliothèque nationale de France[54], one of the largest research and public libraries in the world collecting and conserving the national heritage entrusted to its care, in whatever form, for the use of all researchers, students and professionals
- British Library[55], as the national library of the United Kingdom, provides world class information services to the academic, business, research and scientific communities and offers unparalleled access to the world's largest and most comprehensive research collection
- Goportis[56], the Leibniz Library Network for Research Information, including the German National Library of Science and Technology (TIB) in Hannover, the German National Library of Medicine (ZB MED) in Cologne/Bonn and the German National Library of Economics (ZBW) in Kiel/Hamburg

Its main goal is to develop practical and sustainable tools and services to ensure long-term access to digital content. The profile information below is sourced from the OPF Staff page from their organisation's website[57] and from LinkedIn.

Figure 40: OPF Members

Ed Fay[58] is the Executive Director at OPF. Ed has worked in digital cultural heritage for a decade developing approaches to digitisation, digital preservation, and online user experience. Prior to joining the Open Preservation Foundation he led the introduction of a user-centred approach to digital library services at the London School of Economics and previously worked on several digitisation projects under JISC programmes in the UK. He holds an MA in Philosophy and an MSc in Information Science.

Becky McGuinness[59] is the Community Manager for the Open Preservation Foundation. She joined the organisation in 2010, after working for The British Library on the EU Planets project. Becky is responsible for the OPF events, internal and external communications, and the day-to-day running of the office. She is a Chartered Marketer since 2011, and has a degree in English Literature. Her background includes marketing and branding roles in the publishing and engineering consultancy sectors.

Becky was the work package lead for the SCAPE project training programme, and worked on the dissemination and take up activities. She also contributed to the SPRUCE project events.

Carl Wilson[60] is the Technical Lead for the Open Preservation Foundation. Prior to that he worked for The British Library's Digital Preservation Team on internal and external projects, including a spell as Technical Co-ordinator for the SCAPE project.

He spent three years as Technical Lead on the Planets project, developing the Interoperability Framework and Service Interface definitions. He also helped organise and run the Planets Service Developer's Workshops. Carl particularly enjoys hackathon style events, and is a regular attendee at OPF events, as well as those which were organised as part of the SPRUCE and AQuA projects.

7.2 TIMBUS – OPF Meetings

Last March, Angela Dappert (DPC) approached the OPF to discuss the possibility of the OPF acquiring one or more of the TIMBUS tools for maintaining and sustaining. At that point, the TIMBUS Legality Lifecycle Management (LLM) tool was discussed as a potential candidate.

Following the feedback received during the Year 3 review, Didier da Costa (Intel), the new WP2 Lead, met with Angela Dappert to review and discuss the status on this topic and agree on the best approach moving forward. During this meeting, it was agreed that this would be a cross-work package initiative and that other partners' involvement would be needed. This process was managed by Didier da Costa, with the support of Angela Dappert. As a result of this process, a stronger partnership between the TIMBUS consortium and OPF was build. This section of the deliverable highlights the steps that were taken from July 2014 until now and the outcome.

7.2.1 Initial TIMBUS consortium meeting

In August 2014, Didier da Costa (WP2 Lead) organised a meeting with identified key stakeholders within the TIMBUS consortium to discuss and agree, first on what tools would be the most suited and best candidates for sustainability. This meeting involved members from WP2: Mike Nolan and Didier da Costa, WP3: Angela Dappert and Sara Day, WP6: Carlos Coutinho and the PCC Lead: Mykola Galushka.

During this meeting, the following tools were identified as the most mature and reusable and therefore good candidates for sustainability.

- LLM tool
- Extraction Framework
- Digital Preservation Expert Suite (DPES)

Once these tools had been identified, the TIMBUS consortium agreed to provide the OPF members, ED Fay, Becky Mc Guinness and Carl Wilson with a demo.

7.2.2 Tools demo to OPF

In September 10th 2014, the TIMBUS tools owners provided demonstrations to OPF. These demos were recorded by OPF and are available on:

- Digital Preservation Expert Suite

https://www.youtube.com/watch?v=rcAZU3Hvp2w&list=UUjGEQyuK6LAmmUyT00ztDvg

- Context Model Extraction Framework

https://www.youtube.com/watch?v=Bqt81KDbUA4&list=UUjGEQyuK6LAmmUyT00ztDvg

- Legality Lifecycle Management tool

https://www.youtube.com/watch?v=M8tXR4olwuU&list=UUjGEQyuK6LAmmUyT00ztDvg

At the end of this demonstration session, OPF expressed some interest in discussing further opportunities for collaboration, with the possibility of providing a long-term home for some of the tools from the TIMBUS project, depending on requirements and the implications for their membership.

Following this session, Ed Fay included these three TIMBUS tools in their members' tech survey so that they could decide if they wanted to include any of our tools to their portfolio.

7.2.3 OPF Members' survey result & next steps

On November 7th 2014, Ed Fay, Executive Director at OPF, informed the TIMBUS consortium that the results from their member survey showed interest in the TIMBUS tools, giving them a mandate to pursue some work on them, although some further clarifications were required in relation to the actual specifications.

OPF also highlighted some resourcing constraints this year, but agreed to spend ten days working on aspects of TIMBUS software sustainability before the TIMBUS project ends on December 31st 2014. Taking into account OPF's resourcing constraints, the TIMBUS consortium and OPF decided that it would be more sensible to proceed only with one of the tools; ensure a smoother and more efficient handover.

The TIMBUS consortium chose the Extraction Framework and a subset of the accompanying Extractors for curation. These were chosen because:

- they're logically independent from the other TIMBUS software and can be reused in another context, though they provide information for populating the TIMBUS context model
- the extraction and recording of contextual information about a computing environment is of wider applicability

The following list was suggested by WP6 Lead, Carlos Coutinho, after consulting with the TIMBUS partners and was also agreed on, in principle, by the OPF:

- TIMBUS Extraction Framework, an OSGi-based service environment + API
- the Extractor Framework GUI an nodejs application with a testbed currently running at http://testbed.timbusproject.net:3001
- the Linux Debian Software Extractor, which extracts packages and licenses information from Debian distribution-based Linux environments

- the Linux RPM-based Software Extractor, which derives package and license information from Red Hat distribution-based Linux environments
- the Linux Hardware Extractor, which is believed to work in Debian and Red Hat environments, and extracts hardware characteristics
- the SSH Wrapper Extractor, which generically executes commands on remote systems via SSH and captures the results
- the Extractor Template + Tutorial, specifically for anyone developing new extractors

7.3 Conclusions

The OPF and TIMBUS consortium are currently finalising a work plan for Sustainability of TIMBUS Extractor Framework. Both will work closely until the end of the project, and beyond, to complete the work agreed on the work plan, ensuring that the Extraction Framework and the chosen subset of the accompanying Extractors are exploited post-TIMBUS, thanks to their collaboration. Specific reference will be made to this activity and its status at the final review.

Adopting the TIMBUS Solution. Adaptions to Implement TIMBUS: Policies to Govern Data Classification and Retention Schedules

8. Adaptions to Implement TIMBUS: Policies to Govern Data Classification and Retention Schedules

Following the year 2 review, the consortium was asked to include a section in a selected deliverable before the end of the project which comments on the: 'Effort, necessary organisational and business adaptations, and competencies needed for an organisation to implement TIMBUS. Try also to provide lessons-learned from the implementation in the use cases' (Y2 Review, No. 8). This section of the deliverable addresses the first part of this and is intended as a place to start for decision makers and business managers who may need to adopt new practices to enable TIMBUS-style solutions. The second part regarding lessons-learned, is provided in the respective use case deliverable documents.

When implementing TIMBUS, an organisation must consider a number of adaptations, including both operational and technical adaptions to ensure the TIMBUS tools will function effectively, however, there are some policy-level adaptions they might need to consider. While TIMBUS has an underlying risk-driven approach to the preservation of business processes, further information management will ensure a comprehensive implementation of the TIMBUS approach. Further information management should include data classification and the creation of retention schedules for responsible digital preservation planning. While the risk assessment components of TIMBUS will identify some requirements for keeping or destroying information, each organisation will have institutional values that determine the need to keep data and supporting processes. For example, though common risks such as legal restrictions and audit requirements will determine how an organisation classifies data for retention (for either short term or long term preservation), objectives such as Knowledge Management or Corporate Memory might motivate an organisation to classify relevant information for long term preservation. These types of motivations might not trigger a formal risk, so must be established in corporate policy.

Data classification and corresponding retention schedules support effect information management by instituting policies, methods, and operations for deciding what should be kept and for how long. A strong classification scheme will help employees identify relevant information for retention and help facilitate cohesive workflows, particularly when information flows between separate departments or divisions of the same organisation. In tandem with this classification scheme, whether based on a generalised standard or on internal practices, policy-makers should establish a retention schedule that informs whether different classes of data are preserved for the short term, medium term, or the long term. With a policy in place to govern data classification and retention schedules, organisations have a greater likelihood of successfully preserving and managing their digital information assets, especially policies that address the preservation needs of each data class from the creation or receipt of digital information.

The digital preservation community has developed a number of guidelines and international standards to inform best practice for data classification and the development of retention schedules. Stakeholders in memory institutions, as well as information managers and archivists within corporations have a vested interest in establishing best practice for data classification and retention scheduling in order to facilitate responsible preservation planning. Digital preservation planning, as part of an organisations larger information management policy, will ensure long-term access to digital assets, but also ensures that an organisation properly disposes of digital material that should not be preserved, due to legal restrictions, for example, or restraints on storage capacity. Deciding what not to keep is just as important as what to keep. This vested interest extends to industries that generate valuable data and interact in dynamic activities that could provide valuable information in the future for shaping the Corporate Memory, recycling the unique and experienced knowledge and insight of veteran employees, or for the education of future industry professionals.

When implementing policies to govern data classification and retention schedules when making adaptations for TIMBUS, organisations can consult a number of resources for guidance on best practice. Just like any standard or set of guidelines, these resources act primarily as suggested actions and all organisations should tailor these principles to their own values and requirements. Published guides for preservation planning, such as the Digital Preservation Handbook (Beagrie, 2002) and Practical Digital Preservation (Brown, 2013) offer high-level recommendations for how to develop good preservation policies, including retention schedules. Similarly, Managing Records (Shepherd and Yeo, 2003) gives an overview for how to implement data classification schemes. Two international standards have been established specifically for developing policies for good information management, 1- a high-level model for information management (OAIS), and 2- an audit and certification for trustworthy digital repositories. These standards offer valuable guidance on the development of effective data classification and institutionalised retention schedules. Both types of resources, guidelines and standards, provide a benchmark for organisations in the process of implementing TIMBUS and creating policy to govern the management of their digital assets.

One of the underlying principles of the TIMBUS approach is effective management of digital resources: business processes, data, and metadata. Though TIMBUS offers a number of strategies for capturing and preserving business processes, it cannot operate at its greatest capacity without complementary policies and practices. In order to fully exploit TIMBUS, an organisation should integrate its various components within a context of responsible information management. TIMBUS itself derives from principles of best practice and uses a number of different industry standards (for more information, see D3.6, Section 8). Operational and technical adaptations go a long way to facilitate the implementation of TIMBUS, but these adaptions should be supported by a policy-level integration of data classification, retention scheduling, and overall digital preservation planning.

Additionally, the very development of the TIMBUS operation requires the interaction of the underlying business, as a thorough knowledge acquisition must be performed on the system. This will mean the need to canalise and allocate resources for the interaction with TIMBUS, particularly human resources which have most of the business' tacit knowledge embedded in their minds. Moreover, this need is not limited to the interviewing and context model definition. It also spans to the need to develop specific tools tailored for capturing the business information (which has been the case of some of the use-cases that were used to validate TIMBUS, e.g., specific extractors that were developed to store some of the information in the RCAAP use-case). The interaction with TIMBUS is also needed deeply in the phase of validation of the TIMBUS outcomes, particularly on the risk management support for decisions. These also spread to backing the search for solution providers to mitigate the risks that were elicited towards the business.

The following is a list of useful resources for more information on this topic:

Beagrie, Neil and Jones, Maggie. Digital Preservation Handbook (online), 2002. http://www.dpconline.org/advice/preservationhandbook, last accessed 1 December 2014. Note: This Handbook will be updated in 2015.

Brown, Adrian. Practical Digital Preservation: a how-to guide for organizations of any size. London: Facet Publishing, 2013.

ISO16363:2012 Space data and information transfer systems – Audit and certification of trustworthy digital repositories

ISO 14721:2012 Space data and information transfer systems – Open archival information system (OAIS) – Reference model

Shepherd, Elizabeth and Yeo, Geoffrey. Managing Records: A Handbook of Principles and Practice. London: Facet Publishing, 2003.

9. Partner Exploitation Reports

This section of the deliverable outlines exploitation objectives by partner and gives the updated status of each. In the final review, planned for February 2015, each partner will augment this information with a brief presentation on their current plans at that point in time.

The reviewer feedback from year 3 was given to the project with the intention of assisting it to be successful. This feedback has been welcomed and incorporated in the introduction to this deliverable.

In this final report, the partners used the same template, as used in Year 3. Table 3 below, explains the purpose of each category in the template.

Table 3: Explanation of Initiative Templates

Exploitation Initiative #1		Name of the Initiative.
Audience(s)		A clearly identified audience for the initiative. This may be an internal group within the organisation or an external one.
Exploitation Goal		The objective of the initiative.
Expected Exploitation Benefit(s)		Clearly articulated benefits which are expected to be achieved upon successful completion of the initiative.
How to measure the Benefit		An explanation of how the benefits will be measured.
Exploitation Resources		This section of the template comments on the resources which are required to be successful. It is intended to highlight issues where adequate resourcing may be an issue.
Dependencies		This section details technical and non-technical dependencies which the initiative has. In other words, risks to the success of the initiative.
Roadmap		
	Steps and actions needed	A brief comment on the remaining actions required to be successful.
	Actions taken	Brief re-cap of actions taken to date for the initiative.
	Current status	The current status of the initiative.
	Timeline	A mile stone level timeline of planned actions.

9.1 CMS – Caixa Mágica Software

9.1.1 CMS Organisational Profile

Caixa Mágica Software
Lisbon, Portugal
CMS Partner Summary

Caixa Mágica Software (CMS) is an SME company, the leader in different open source market segments in Portugal such as software engineering services for Telecoms and Utilities companies, Linux desktop and server solutions and Android mobile solutions.

CMS is the responsible for the development and marketing of Linux Caixa Mágica (LCM), the leading Portuguese Linux distribution. LCM is available at hundreds of Portuguese computer stores and specialised resellers. In the private sector, it is installed on thousands of enterprise systems, and in the public sector, it is installed on computer systems in Hospitals, Municipal Authorities, in more than a thousand schools located all over the country and in more than 10 universities. LCM is also installed on over 650,000 computers as part of wide-scale Portuguese initiatives. In the scope of the e-school initiative, CMS also developed a commercial product (LCM notebook) which is very popular (over 50,000 systems sold).

CMS is also involved in the deployment of more than 120 Linux-based security appliances distributed geographically and overseas for the Portuguese Army. The company has a history of working with industry and with the Portuguese Military and Judicial System for providing support and installation of network resources and as such has expertise in on-going technical relationships and implementing innovative solutions as and when it is required and is cost-effective. CMS has been subcontracted since 2006 by the Portuguese Ministry of Justice for maintaining Linux Servers in critical datacentres.

Since 2007, CMS has been working with Portugal Telecom, installing and giving support for open source platforms (e.g., Linux Servers, Apache Farms, MySQL clusters). The company also developed technology for Android App Stores (Aptoide) that is being used for several Android marketplaces like Bazaar Android, which is one of the most successful and largest Independent App Stores within Europe, currently being exploited by a CMS spin-off company. It was also involved in the customisation of an Android ROM for the Sapo A5 mobile phone.

CMS is a company that has been growing through the recession, providing open source solutions to industries and the government while developing its lead product, Linux Caixa Mágica. It offers expertise in Linux Systems from the individual user level through migrating Enterprise systems.

CMS has a significant background in European research projects, having participated in the EDOS (FP6 STREP), MANCOOSI (FP7-ICT-214898 STREP) and NITEC (226/32/06) projects. The company is actively working on FP7 on-going projects ULOOP (FP7-ICT-257418 STREP), PROSE (FP7-ICT-318218 STREP), and TIMBUS (FP7-ICT-269940 IP) as well as on the ICT-PSP project STORKv2 (CIP-ICT-PSP-297263 CIP).

9.1.2 CMS Exploitation Introduction

Within the TIMBUS project's year 2 and 3, which were much more focused on the implementation of tools, CMS had the opportunity to start implementing its exploitation plans. This included the definition of new strategies for development of the tools, the understanding of new business cases and new internal capabilities, and the dissemination of these techniques and the developed tools within the CMS community: internal consultants, partners, customers, academia and industry.

CMS is developing expertise and gaining understanding in an emerging area of research that is likely to expand, given indications in trends on legislation and the complexity and reliance of software systems currently. This expertise has been captured in terms of training staff. It will then allow for new software products and related works to the outcomes of TIMBUS to be worked on.

The main part, which aligns with CMS's goals, is to be at the forefront of emerging technologies such that it can increase its client base and profit from an ahead-of-the-curve understanding of the systems through offering customer services.
CMS also wishes to contribute in a large way to Open-source alternatives to what has been largely dominated by closed-source systems. This will improve the market by offering alternatives and encouraging more development. Ultimately, this will help CMS's reputation and standing in the Open-Source and research communities.

CMS is also very actively involved in the Linux and Research communities, attending multiple conferences and part-hosting the popular annual National Linux event in Lisbon[61]. Therefore, CMS's exploitation plans focus on their strengths, and can be divided into four main areas as follows:

Applying TIMBUS knowledge

Applying TIMBUS knowledge and developments promotes the use of state of the art in the industry, to provide services to create new business opportunities, by providing consulting services and collaborative projects in industry. The absence of Business Continuity Management (BCM) solutions and knowledge in the open-source environment is notorious. CMS seeks to increase its influence and market share by offering specialised consulting services in the areas where it operates. The target is to consolidate its position as a major player and value-add partner in its business area.

Contributing to Open Source

The experience that is being derived from the development of WP7 into applying Digital Preservation to an open-source system will be used in the development of tools for digital preservation that are able to be included on CMS's main development product, Linux Caixa Mágica, in this case in the Server deployment area. The target is to implement features on the operating system itself that support digital preservation, or to ease the integration of tools coming from the TIMBUS experience; This will improve the CMS product, providing the industry and the open-source community with mechanisms that support the digital preservation of businesses, hence promoting artefacts for Business Continuity Management.

Being the leader for WP6, CMS also pushed that the code for the development of the TIMBUS tools would be as much as possible open source and freely distributed (FLOSS – Free and Libre Open Source Software), available on public repositories, initially on GitHub (http://github.com/orgs/timbus-project), but afterwards in a repository developed by CMS within the scope of another EU-funded project, OpenSourceProjects.eu (http://opensourceprojects.eu/p/timbus). All TIMBUS code that has been found eligible as Open Source is currently being hosted in that site.

New Business Opportunities *(details confidential)*

The contributions in the task T6.1 – iERM and the interaction with ERP specialised companies like SAP, together with CMS's experience and integration with the industrial tissue in Portugal is providing CMS with knowledge to be able to strive in a starting branch on the open-source market, which relates with ERP solutions. The purpose is to be able to initiate the development of a set of tools that is able to consolidate in a near future and provide the open-source community with an ERP solution, together with the corresponding consulting services that will be allowed to be provided to industry.

The establishment of the use-case RCAAP (WP7) is also providing CMS with capabilities in the field of management of public repositories and hence increasing its consulting abilities with academia and industry related to the retrieval of information from these repositories. RCAAP (Scientific Open Access Repository of Portugal) is a real business case, started in 2008. The RCAAP project[62] is a result of the collaboration between public and private bodies, with the aim of providing services to the different players of the Portuguese scientific community with the following targets:

- To increase the visibility, access to, and dissemination of the Portuguese academic activity and scientific research;
- To optimize the access to information about the national scientific production;
- To involve the Portuguese community in different international open access initiatives and projects.

For this purpose, RCAAP aims to aggregate all open-access information in Portugal (and other Portuguese-speaking countries). As it is an institution highly promoted by the Portuguese government, it is getting a lot of visibility in this area. More information about it can be attained in deliverable D7.5.

CMS's Influence to on-going standards

CMS intends to develop expertise in order to be able to influence the developing standards. CMS software development on TIMBUS is using UML 2 for the modelling and design, software architecture patterns like the Model-view-controller (MVC), and the developing format CUDF (Common Upgradeability Description Format).

This format was first developed in the FP7 project Mancoosi[63], and aims to describe upgrading scenarios for Open Source package-distribution of software.

CMS aims not only to reuse this format, but to enhance it from its software-based premises to business-related items, to be able to describe properly the scenarios for recommendation of the digital preservation of business scenarios. The purpose is to consolidate the CUDF format into a format able to describe the upgrade of packages but also of businesses.

9.1.3 CMS Exploitation Initiative #1: Develop reusable architectures and programming paradigms

This exploitation initiative considers our interest in developing new approaches to development with the objective of becoming even more competitive in the response of new challenges and proposals. Table 4 below details this initiative.

Table 4: CMS Exploitation Initiative #1: Develop reusable architectures and programming paradigms

Exploitation Initiative #1		Develop reusable architectures and programming paradigms
Audience(s)		1. Other parts of the CMS research department not engaged in the TIMBUS project 2. CMS Business Product Groups, namely the CMS development department
Exploitation Goal		The goal is to develop platforms and use programming strategies that can be reused on future solutions
Expected Exploitation Benefit(s)		The capability to build modular solutions, based on the developed architectures, which are faster to respond to the demands of new proposals and projects. To be able to better estimate effort and costs on the development of new solutions.
How to measure the Benefit		Measure the current development time of solutions and compare it to future ones. Measure the capability to respond to new proposals.
Exploitation Resources		There are requirements in both headcount and skillsets that are not sufficient to currently meet the objective. However, as this is proof-of-concept work, it is expected to be the initial work from the CMS research department, to be continued in the future.
Dependencies		Technical: An integrated work package 6 toolset that is implemented using some of the developed paradigms. Non-Technical: Resource management is always difficult, as the research team has many priorities that do not always converge.
Roadmap		
	Steps and actions needed	Research and definition of the architecture that will host the solutions.
	Actions taken	2013-present: Analysis has been performed on several platforms, before establishing OSGi standards and bundles as a basis. H2 2013: The development of the T6.5 tools based on these principles and methodologies.
	Current status	Several tools were developed using these methodologies as part of work package 6, task T6.5 (e.g., Extractors Framework, Dependencies Reasoner). Templates and tutorials were developed and are continuously being improved on http://opensourceprojects.eu/p/timbus/context-population/extractors/wiki/Tutorial%20draft
	Timeline	1. M18: Requirement gathering

		2. M22: Feature selection/prioritisation 3. M26: Implementation of MVP version (minimum viable prototype/product) 4. M30: Testing/bug fixing 5. M30: Demo to stakeholders 6. M36: WP6 D6.10 Prototypes will be running built over these technologies

9.1.4 CMS Exploitation Initiative #2: Gain expertise in open source alternatives

This exploitation initiative considers our interest in learning about new contexts, initiatives and businesses, with the objective of being able to respond to proposals in other areas and to try to enrich further CMS's portfolio of solutions. Table 5, below, details this initiative.

Table 5: CMS Exploitation Initiative #2: Gain expertise in open source alternatives

Exploitation Initiative #2		Gain expertise in open source alternatives for emerging technologies and ERP systems
Audience(s)		CMS consulting. This is a set of consultants internally in CMS.
Exploitation Goal		The goal is to develop TIMBUS-based capabilities for CMS, to meet the requirements of the TIMBUS project and also those of an emerging Open Source ERP market.
Expected Exploitation Benefit(s)		Improve CMS's competences in consulting and development to include these areas hence increase the overall profit for the company.
How to measure the Benefit		Improvement on the number of new proposals being applied due to the increase of know-how.
Exploitation Resources		Currently the exploitation resources are being filled by the CMS research team, the purpose is to be able to disseminate this in the other areas of CMS. Also, CMS is currently already seeking to hire new resources specifically for this purpose.
Dependencies		Technical: Being able to gain contact, expertise and experience with the technologies being used (ontologies, OSGi, Development paradigms, Digital Preservation, Risk Management)
Roadmap		
	Steps and actions needed	Knowledge capture
	Actions taken	2011-present: CMS is leading the development WP, which provides us a good position to be involved in all tool developments, and apprehend the techniques and solutions.
	Current	Ongoing activities: Currently the work being performed concerns searching for

	status	new resources to hire for the accomplishment of this development.
	Timeline	1. M12: Internal definition of new areas to improve know-how 2. M18: Participation in joint publications in the research area 3. M24: Analysis of the internal documentation generated for new targets 4. M30: Internal meetings in F2F project gatherings to perceive approaches and other information in the risk management and other areas 5. M36: Hiring of new resources in CMS to manage the new developments 6. M42: Expose CMS's approach for developing solutions and get validation from other partners 7. M45: Expected to have obtained some know-how in these subjects

9.1.5 CMS Exploitation Initiative #3: Promote open source activities

This exploitation initiative considers our interest in disseminating open source development and free software systems. This is part of the company's vision and promotes the image and recognition of CMS in the open source community. Table 6, below, details this initiative.

Table 6: CMS Exploitation Initiative #3: Promote open source activities

Exploitation Initiative #3	Promote open source activities
Partnerships	The Open Source community, particularly other partner companies teaming CMS in other projects like PROSE (http://www.ict-prose.eu/about)
Audience(s)	The Open Source community, particularly current customers and partners
Exploitation Goal	To enhance the use of open source and dissemination of code, and to increase the adoption of CMS solutions through enhancing the use of, and dissemination of code from the TIMBUS project. Also, the adoption of the opensourceprojects.eu site by other EU open source projects to store their solutions.
Expected Exploitation Benefit(s)	Increase the acknowledgement and expertise of CMS within the open source community, as well as of the tools developed by TIMBUS.
How to measure the Benefit	Page views on the opensourceprojects.eu site (we already have a set of metrics in place there), the number of other EU open source projects adopting this site due to its dissemination in TIMBUS, the adoption of CMS solutions
Exploitation Resources	All CMS resources working in TIMBUS, in various areas, from developers (disseminating their ideas and code) to managers and board (influencing partners and customers)
Dependencies	Technical: Appropriate tools and support to make other partners comfortable with adopting open source software for development. Non-Technical:

		Evangelising and convincing other partners of the benefits of open source development and sharing of knowledge.
Roadmap		
	Steps and actions needed	Creation of a platform for hosting the open source code resulting of TIMBUS tools. Dissemination actions to convince other partners. Dissemination of the tools developed by TIMBUS in the open source community, making them available in the CMS repository and in the Debian repository. Promote TIMBUS and the developed tools in some of the events which have the participation of CMS (in academia, industry and open-source communities)
	Actions taken	2011-present: CMS performs all its development (documentation and code) using open source tools, and most of the code produced by TIMBUS was agreed to be open source, licenced by the Apache v2 licence. 2013: Development of an open-source platform by CMS to host European open source projects (opensourceprojects.eu)
	Current status	The platform is public and available. On a PCC call of TIMBUS, it was ruled that all code that is eligible for open source release will be made available on the site http://opensourceprojects.eu/p/timbus. All TIMBUS code that was eligible as Open Source has been released on this site and is being maintained there. Some of the TIMBUS tools (Context Acquisition Framework) were already made available on the Linux Caixa Mágica repository, available on LCM 18, 19 and 22.
	Timeline	1. M30: opensourceprojects.eu platform available 2. M33: TIMBUS started feeding the code in the platform 3. M36: Analysis of which tools are mature enough to be exposed and published in the Linux Caixa Mágica repository 4. M39: Availability of the chosen tools from TIMBUS in the Linux Caixa Magica repository, making them available to all users of this operating system. 5. M39: Contact Linux Debian responsible to propose submission on their repository. 5. M42: From the analysis of the applicability of the available tools, and the maturity of the development, determine which ones could be integrated in the Linux Debian repository; 6. M45: Availability of the chosen tools from TIMBUS in the Linux Debian repository.

9.1.6 CMS Exploitation Initiative #4: Influence the use of project-defined standards

This exploitation initiative considers our interest in promoting and lobbying CUDF to become widely used as a standard in development. This intention promotes the image and recognition of CMS in the research community. Table 7, below, details this initiative.

Table 7: CMS Exploitation Initiative #4: Influence the use of project-defined standards

Exploitation Initiative #4		Influence the use of project-defined standards
Partnerships		All companies involved in the development of tools for TIMBUS
Audience(s)		Current customers and partners
Exploitation Goal		To develop expertise for influencing the developing standards. Besides the use of UML2 for the modelling and design, software architecture patterns like the Model-view-controller (MVC), TIMBUS is promoting the use of other standard approaches like ontologies, Archimate modelling, SPARQL queries for accessing data. Packaging configurations using Maven and decentralised development using OSGi are some of the reused standards, but our aim is also to promote the developing format CUDF (Common Upgradeability Description Format), created by CMS.
Expected Exploitation Benefit(s)		Increase the acknowledgement and expertise of CMS within the research and industrial community, as source of innovation and best-practices in software development. To increase the quality of the solutions developed by CMS
How to measure the Benefit		The adoption of CMS solutions that are using these standards, the reuse of these standard approaches in other CMS projects.
Exploitation Resources		All CMS resources working in TIMBUS, in various areas, from developers (disseminating their ideas and code) to managers and board (influencing partners and customers)
Dependencies		Technical: The extending of the CUDF format, originally defined for handling the upgradeability of software packages, to a wider and more abstract conceptualisation of service or business functionality. Non-Technical: Evangelising and convincing other partners and research institutes of the benefits of the use of standards, particularly of CUDF.
Roadmap		
	Steps and actions needed	The extending of the CUDF format to a wider and more abstract conceptualisation of service or business functionality. Dissemination of this format to be used by the tools developed by TIMBUS. Promote CUDF and its use in the developed tools on TIMBUS in some of the events which have the participation of CMS (in academia, industry and open-source communities).
	Actions taken	2011-present: CMS has abstracted the CUDF format to also consider services and functionality. This abstraction is being used in tools on TIMBUS task T6.2.
	Current status	The tools in TIMBUS were designed and developed using several standard approaches and formats, including CUDF, they are already working and being integrated.

	Timeline	1. M18: The abstraction of CUDF to handle services, business steps and functionalities. 2. M24: TIMBUS tools on work package 6 (T6.5, T6.2) have been designed and developed using standard approaches like UML 2.0 and MVC, and are using ontologies and CUDF formats. 3. M30: After having a proof-of-concept as standalone tool, the work package 6 tools like Extractors and Reasoning tools (D6.10, D6.2) change their design to include distributed and decentralised development by contributions using OSGi. 4. M36: The CUDF format is mapped directly to the DIO and widely used in the tools of TIMBUS. 5. M45: The TIMBUS tools and the CUDF format use are shown in various dissemination events and meetings with customers and partners.

9.2 DPC – Digital Preservation Coalition

9.2.1 DPC Organisational Profile

Digital Preservation Coalition,
United Kingdom,
DPC Partner summary

The Digital Preservation Coalition (DPC) is a not-for-profit membership organisation, supporting members through knowledge exchange, capacity building, assurance, advocacy and partnership. The DPC is an advocate and catalyst for digital preservation, enabling its members to deliver resilient long-term access to content and services, and helping them derive enduring value from digital collections. Our vision is to make our digital memory accessible tomorrow.

The DPC's primary goal is to set the agenda for digital preservation research and practice in the UK and EU, raising awareness of the importance of the preservation of digital materials and the attendant strategic, cultural and technological issues. It links and fosters digital preservation expertise across sectors and disciplines. The DPC acts as a dissemination partner to the TIMBUS project, linking the work of partners to the wider business process management and digital preservation community and maximising interest and exposure.

9.2.2 DPC Exploitation Introduction

Over the course of the TIMBUS Project, the Digital Preservation Coalition has identified a number of exploitation opportunities and exploitation benefits which have arisen from our involvement in the TIMBUS project. This exploitation has applied to the DPC at two levels.

First, we have experienced the concrete benefits at an internal, strategic level, where our involvement with TIMBUS has allowed us to update and extend the DPC's research capacity. This has allowed the DPC to update its strategic plan, confirmed in November 2014, in order to ensure that it continues to take an active role in meeting its members' research needs. In addition, TIMBUS has equipped the DPC with the most relevant and up-to-date research which has helped to influence and define the direction of preservation standards, including the PREMIS preservation metadata standards. A new version of the PREMIS Data Handbook incorporating these updates is forthcoming in 2015. The DPC is now, therefore, playing a vital role in expanding digital preservation metadata standards so that they capture the entire process context.

Secondly, our involvement in TIMBUS has provided benefits and opportunities for our member institutions. By contributing case studies of DPC use cases and reviewing project deliverables we have, and will continue to, influence TIMBUS research. In doing so, we have seen concrete benefits for us and for our members. TIMBUS has developed tools and processes for preserving business and scientific processes, and our involvement has made it easy for DPC members to identify what aspects of their preservation action workflows need to be preserved.

To an extent, TIMBUS has also helped us to widen our membership by incorporating new sectors. We have welcomed a number of new members this year, including Lloyds Bank, a major business organisation in the banking sector. The focus of TIMBUS on business processes is therefore extremely important to the DPC, because it expands our knowledge base and helps us to demonstrate the relevance and importance of digital preservation activities to a wide range of sectors. TIMBUS has played a vital role in demonstrating our value to this new sector, and we are already seeing the benefit through membership applications from institutions, such as that by Lloyds Bank, which are outside our existing membership of memory institutions. This is facilitated by the benefits TIMBUS has offered

through helping to increase the DPC's own understanding of process preservation. Furthermore, this increased understanding has allowed us to enhance member preservation actions to include processes, and to produce high quality training materials which can be deployed for the benefit of our members, and the wider digital preservation community. As a result, DPC has been invited to give a paper at the Information and Records Management Society (IRMS) Conference in 2015. DPC has also been asked to run a focus group on digital preservation in business and to do a joint workshop with the Business Archives Council (BAC).

DPC will continue to benefit from its involvement in TIMBUS past the completion of the project. In 2015, the DPC will commence a research project for which they were specifically commissioned by the UK Data Archive to contribute digital preservation specialism to a greater project carried out as part of the Economic and Social Research Council's 'Big Data Network' Programme. The DPC's role will be to analyse and report on the current conditions and approaches to the preservation of inter-relational databases and also to the preservation of social media. These two projects run parallel in time but also conceptually. Transactional data and social media present similar difficulties for preservation for a number of reasons. For instance, the data they produce is both large and volatile, also both are perpetually on-going, and the data produced by both has multiple entry points posing challenges to the verification and validation of the authenticity of records. The DPC is uniquely qualified to address these challenges, in part, because of their experience with TIMBUS and the conceptual development of preserving an environment, rather than just data. Thus, the DPC will sustain the outputs of TIMBUS by applying TIMBUS outputs to new projects.

The following Final Exploitation Report largely builds on previously established initiatives rather than new initiatives, however, as the TIMBUS Project comes to a close DPC has recognised a new, unique benefit of our involvement in the form of a communication model for integrating new sectors and also reaching out to different roles within our established base of memory institutions, such as information managers and business managers. DPC's involvement with TIMBUS has allowed the DPC to communicate with sectors that focus on similar concerns as digital preservation but from different perspectives. Most notably, the DPC's involvement with stakeholders in business continuity management has helped to further align the cousin concerns of risk management and digital preservation. While the concept of implementing digital preservation as risk management is not a new approach, digital preservation has not fully aligned with the broader domain of risk management in the business and industry sectors. By collaborating with experts in business continuity management and exhibiting at events such as the Business Continuity Institute World Conference, the DPC has begun to develop a language and a conceptual framework for communicating the solutions provided by digital preservation to other sectors through the common denominator of risk management. Furthermore, the DPC's experience with experts in business continuity management has allowed us to report back to the greater digital preservation community about the needs of the business and industry sector regarding digital preservation as a risk management approach, thus helping to facilitate a use of this language among other researchers and practitioners of digital preservation.

The following section introduces the DPC's exploitation initiatives, and provides further details for each. Though these initiatives have not changed since the last Exploitation Report, they have grown through new activities and on-going integration of TIMBUS outputs into the DPC strategic plan 2015-2018.

9.2.3 DPC Exploitation Initiative #1: Provide value by enhancing membership preservation actions

The first opportunity for our members in memory institutions is that TIMBUS will develop processes and tools for preserving business and scientific processes. This is of interest to digital preservation managers, digital curators, repository staff and end-users of digital materials. One of the core aims of the DPC is to act as an advocate and catalyst for digital preservation by enabling our members to derive enduring value from their digital collections. TIMBUS has a role to play in this by enhancing member preservation

actions to include processes. This is driven by a desire to make it easy for DPC members to identify what aspects of preservation action workflows need to be preserved. The tools and processes developed in TIMBUS are of interest to digital preservation managers, digital curators, repository staff and end-users of digital material. The DPC is a not-for-profit membership organisation, and to retain members it is important for us to be able to demonstrate that their subscriptions provide them with value. As such, our involvement with TIMBUS expands the portfolio of services and information that we can offer, increasing our value to members. It provides a clear example of how we can enable their digital preservation activities, thus providing clear reasons for their continuing membership of the Coalition.

We are influencing the research direction of the TIMBUS consortium by contributing case studies of DPC use cases and reviewing project deliverables. In the first year of TIMBUS we developed a case study for preserving a workflow which migrates a collection of TIFF files to JPEG2000 files in order to save on storage costs for the bulky TIFF files. The migration workflow needs to be preserved in order to be able to diagnose possible sources of corruption in the derivative files. We developed the case study, contributed it to Deliverable D4.5, and presented it at three events to illustrate the TIMBUS approach to potential stakeholders in the memory institution sector[64], the computer gaming industry[65] and the higher education sector[66] for digital curation training. In addition we have published it as a book chapter on preserving complex objects, which was published in *The Preservation of Complex Objects (Volume 3): Gaming Environments and Virtual World* in 2012.

The DPC has not been content to confine its contribution to the TIMBUS project to just dissemination and training and we have sought to add value wherever possible. For example, as one of our exploitation highlights from the second year of TIMBUS, the DPC collaborated with Secure Business Austria (SBA) to study how the PREMIS standard could be improved in a use case on the preservation of a scientific process for music classification. This led to further exploration of how the TIMBUS approach can be applied to the preservation of this and other research processes. This study was targeted at Higher Education Institutions, which represents a significant number of our members. TIMBUS methodologies therefore help our members achieve the goal of archiving research results alongside scientific workflows or execution results of scientific workflows.

We also studied issues related to the preservation of open source workflows and open source software systems, in particular open source long-term repositories, such as Phaidra and RCAAP. These 2 categories of open source applications are broadly used amongst our members and there are concerns about determining the degree of their longevity, preservability and reusability. We also specifically focused on establishing a definition of what 'preservability' of software means and what criteria could help establish a measurement of the preservability of software.

Changes to PREMIS, resulting in version 3.0 of the de-facto standard, were co-led by the DPC, as our membership has a fundamental need for the most practically appropriate development of this standard. It resulted in improvements to the integration of descriptive and preservation metadata, and in the improved incorporation of computing environment descriptions and other forms of representation information into the standard, which will help the future reuse of digital assets.

In the fourth year, we have continued to illustrate the TIMBUS approach to our stakeholders through presentations and other forms of dissemination, across TIMBUS-specific publications such as blogs and newsletters as well as the DPC website, training sessions and events[67]. We were again involved this year in delivering a week-long "Advanced Practitioner Training" course in collaboration with APARSEN with sponsorship from the European Commission. This took place in Vienna from the 7th – 11th July 2014, and covered issues across the complete digital preservation cycle, including TIMBUS context and process preservation and preservation metadata as influenced by TIMBUS. This event was highly successful, with representatives from DPC member organisations attending. This sits alongside our other dissemination and training activities, ensuring that the DPC and its members continue to benefit from our involvement in TIMBUS.

The DPC organises the production of a monthly blog on the TIMBUS website, with a different project partner contributing each month to highlight a facet of their work. We also organise and produce a TIMBUS newsletter, which is released quarterly and currently has 80 subscribers. It is publicised through relevant mailing lists and personal contacts[68]. The latest version was released in the final month of the project and is also available from the TIMBUS website, where we are able to track usage statistics. The previous issue of the newsletter is still the most-read article on the webpage with 407 views between 4 March 2014 and 9 November 2014.

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31st January 2014

TIMBUS

TIMELESS BUSINESS PROCESSES AND SERVICES

TIMBUS TIMES

Inside this issue:

Letter of the Project Coordinator

Dr. Wasif Gilani

The TIMBUS project is now nearing the end of its 3rd year of execution. At this stage, the major focus of the project is on the development and customization of the tools and technology against the use cases requirements. New use case scenarios from the open source domain were introduced in the beginning of Year 3 (repository systems and open workflows). These new use cases have enabled us to analyse the applicability of TIMBUS tools and methodologies from the perspective of open source systems.

The TIMBUS project work relating to the development of models and processes for risk management and digital preservation is almost completed. The Context Model, which captures the complete context of the target business process, continues to evolve alongside the further refinement of the use cases, and with the introduction of new requirements coming from the new use cases from the open source world. The Context Model has been extended to deal with PREMIS, patents, software licenses, and sensors. Additionally, a draft security ontology for the specification of relevant security and authorization aspects of business processes has been designed and implemented. Processes including the risk management process, risk monitoring process, and software escrow process have already been defined, including an end-to-end TIMBUS process which incorporates all these processes for digital preservation.

On the implementation front, we have made significant progress in the development and customization of the TIMBUS tools and their integration, to offer an integrated TIMBUS platform.

The iERM (Intelligent Enterprise Risk Management) tool is undergoing further refinement and automation. The tool has been extended to produce a risk report as output, which contains information about the target business process, resources, risks, impact analyses and preservation recommendation. The tool is being integrated with addi-

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Figure 41: TIMBUS Newsletter front page, January 2014

Our priority for the final year is to provide a single point of access for all available TIMBUS tools, including appropriate documentation. This will provide our members with the tools they require to learn more about digital process preservation, and provide them with the tools to integrate it into their own digital preservation activities. Table 8, below, details this work.

Table 8: DPC Exploitation Initiative #1: Provide value by enhancing membership preservation actions

Exploitation Initiative #1	Provide value by enhancing membership preservation actions to include processes.
Audience(s)	DPC Member organisations (a full list is available at http://dpconline.org/members/list-of-members)
Exploitation Goal	We aim to make it easy for DPC members to identify what aspects of preservation action workflows need to be preserved, and to develop and make available tools that semi-automatically support the preservation of workflows.
Expected Exploitation Benefit(s)	DPC members stand to benefit from this initiative through building knowledge of the importance and practicalities of digital process preservation, which will be manifested in improvements in their digital preservation activities. Thus the benefit to the DPC comes from two sources: an increase in staff skill levels relating to process preservation; and a demonstrable increase in the range of services we provide to members which provides a convincing case for continued membership. As we are a not-for-profit organisation which relies on membership fees for our activities, projects such as TIMBUS play a major role in allowing us to continue these activities.
How to measure the Benefit	The success of this exploitation goal can be measured from our perspective in two ways. First, the DPC has a managing board drawn from its members, where our work on TIMBUS is regularly reported: this benefit can therefore be analysed by gathering project feedback from this advisory board. Second, membership levels provide a soft indicator for success; in particular, new member organisations from new sectors could indicate benefits. We will also track the number of users who download tools, or access the TIMBUS website to for documentation. This will help to identify how many people are using the tools.
Exploitation Resources	Staff: In the final year of the project, the DPC has had two staff members working on TIMBUS. This includes a newly appointed project officer with responsibility for work package 3, appointed until the end of the project. We therefore see no risks relating to staffing in terms of meeting our goals Website: The DPC is also responsible for maintaining and updating the TIMBUS project website. This plays an important role in reaching target audiences. In the final year of the project we have designed and implemented a Tools Portal to replace the older version of the 'working' website, where we have ensured that training materials and project outputs are high quality, easily discoverable and relevant to DPC members and other relevant communities. The Tools Portal allows the DPC members who are not experts in process preservation access the outputs of TIMBUS without a great deal of previous knowledge.

Dependencies		Technical: To fully benefit from this exploitation goal, we require the TIMBUS use cases and tools to reach maturity so that we can place them online and develop appropriate training materials. Non-technical: We are partly dependent on effort from other partners in developing papers, presentations and other materials to augment our own efforts. The DPC will take ownership of ensuring the buy-in of all partners without which some of our exploitation objectives will be put at risk.
Roadmap		
	Steps and actions needed	We need to facilitate a smooth transition of the TIMBUS website to the DPC website, effectively integrating the new TIMBUS page as a resource on the DPC site.
	Actions taken	2011: Case study for preserving a workflow for migrating TIFF files to an alternative format. 2011-present: We have publicised TIMBUS activities through regular blog posts on the TIMBUS website, which are cross-promoted by DPC staff through mailing lists, the DPC website and our social media presence to reach our members. 2011-present: We have released a regular bi-annual newsletter with articles about TIMBUS 2012: Publication of book chapter on preserving complex objects. 2012: Collaboration with SPA: case study to preserve workflow for music classification process. 2014: Developed an online presence for TIMBUS tools as they are were completed throughout the year and provided documentation and appropriate training materials on the Tools Portal 2014: Identified four of the strongest outputs from TIMBUS in order to create white papers that widely report the project findings. 2014: Collated available statistics and liaised with members to assess overall effectiveness of activities for this initiative.
	Current status	Continuing to publicise TIMBUS through DPC online channels and include TIMBUS outputs as a part of DPC workshops and training when appropriate
	Timeline	M36-45 onward: Work to increase awareness of TIMBUS among membership. M38: Released TIMBUS newsletter with ‘special edition’ on tools. M38-42: Populated TIMBUS website with project tools as they are released. Wrote appropriate documentation to help members understand and use the software. Addressed online sustainability of project outputs. M42-45: Developed and delivered training on tools to DPC members, and gathered feedback on value added to membership organisations. Identified and prepared topics suitable for white papers to present major project outcomes. M43: Released 4 white papers on the major outcomes of the TIMBUS project,

		and publicised through DPC channels. M45: Collated available statistics, and liaised with members to assess overall effectiveness of activities for this initiative.

9.2.4 DPC Exploitation Initiative #2: Training material and events

The DPC provides training in a number of issues relating to digital preservation. These training activities previously did not include process preservation, but our involvement in TIMBUS has increased our internal understanding of process preservation to a point where we will be able to develop training materials to deploy for the benefit of a variety of stakeholders.

In July 2014, TIMBUS partnered with APARSEN[69] to deliver a training week entitled 'Digital Preservation Advanced Practitioner Training.'[70] This event was sponsored by the European Commission and hosted by the Austrian National Library in Vienna. It brought together representatives from projects and organisations at the leading edge of digital preservation research, providing attendees with training at an advanced level. Through funding from the European Community's FP7 for Research and Development, we were able to provide free attendance for DPC members, considerably enlarging the benefits to member organisations. The event covered the complete digital preservation life-cycle, including TIMBUS training covering two full days on Process and Context Preservation and on Preservation Metadata. Attendee feedback was extremely positive and suggested a desire for further events of this type. Preservation Metadata, given by Angela Dappert, scored the highest among all feedback for the entire course.

As a result of our involvement with TIMBUS, we will be able to participate in similar events in future, expanding the range of topics in which the DPC provides training. These activities will be supported by the production of high quality online training modules in issues relating to digital process preservation, including teaching material that can be deployed in practical situations such as university teaching. These materials have already been showcased: at the DPC Briefing Day 'Virtualisation and Preservation: How cloud computing changes what we think about digital preservation' in Cambridge 22nd July[71], for instance, Intel presented DPES, one of the more mature TIMBUS tools, in order to demonstrate the applicability of process preservation to an audience of mainly DPC members. This shows how our materials can be repurposed for new audiences, and we continue to develop suitable outputs for this purpose. For instance, we are engaged in ongoing work in collaboration with our fellow partners ITM to produce an online training module on the legal aspects of digital preservation; these videos will be used by ITM in their teaching activities, and made freely available on the TIMBUS website by month 45. TIMBUS has also worked hard to identify new communities and venues for training. As a result, TIMBUS has presented at BCI World Conference and Exhibition hosted by the Business Continuity Institute where TIMBUS tools were showcased to new audiences in the business sector. Table 9, below, details this work.

Table 9: DPC Exploitation Initiative #2: Training material and events

Exploitation Initiative #2	We will use our participation in TIMBUS to increase our understanding of process preservation to a point where we can develop training material to deploy in practical situations.
Partnerships	APARSEN (Sharon McMeekin), ITM (Barbara Kolany-Raiser), SAP (Wasif Gilani).
Audience(s)	Digital preservation professionals; organisations involved in, or interested in implementing digital process preservation; higher education; business continuity managers and researchers in business continuity.

Exploitation Goal		The goal is to create a number of high quality training materials which will be used to educate stakeholders in process preservation. We aim to make these materials available online, and expect them to be suitable for teaching within a Higher Education context.
Expected Exploitation Benefit(s)		We expect to benefit internally from our ability to deliver high quality training in process preservation. This will have wider benefits for digital preservation professionals through attendance at training, and online access to training materials. It will also benefit Higher Education, with teachers able to deploy our training materials and students able to learn effectively about issues relating to process preservation. This will improve the reputation of the DPC as a source of expertise for digital preservation, and assist us to reach both technical and non-technical audiences with our message.
How to measure the Benefit		We will track the number of available training modules online, and the number of training sessions delivered using material from TIMBUS. We track attendee feedback at all DPC events, and we will continue to do so to ensure that our audiences are happy with the quality and impact of the training they receive.
Exploitation Resources		Again, there are two DPC staff members with direct involvement in TIMBUS. They will both work on the training materials. However, we are also dependent upon contributions from partners to ensure that training materials are of an appropriate quality. We do not envision any problems that would prevent our goals from being met as a result, but the DPC will work with project management and work package leads to plan and assist in the production of training materials. .
Dependencies		Technical: We require completed and functional tools in order to most effectively train users in their use. Non-technical: expertise of project partners including involvement in creation of some materials and provision of suitable speakers for training events.
Roadmap		
	Steps and actions needed	Identify further opportunities for training and work with partners to maximise the impact of these opportunities.
	Actions taken	Throughout project: uploaded training materials to the TIMBUS website for external reuse. July 2014: Presented TIMBUS training materials at DPC Briefing Day. Nov 2014: Distributed new DPC digital preservation awareness materials influenced by business continuity management Nov 2014: Planned and supported CMS and INESC-ID tutorial at international 4C Conference 'Investing in Opportunity' Dec 2014: Planned Webinar with INESC-ID to showcase OS Risk Assessment and Treatment Tool in Jan 2015 Dec 2014: Uploaded all new Training Videos to new Tools Portal and arranged

		existing training materials to make them more accessible to wide audience
	Current status	Taking measures to ensure that the DPC is able to maintain the TIMBUS Webpage, including training materials, past the end of the project.
	Timeline	M45: Deadline for all training materials on the Tools Portal

9.2.5 DPC Exploitation Initiative #3: Growing the DPC membership

Growing our network of members is a strategic goal within the DPC's agenda. A larger membership base enables the DPC to reach out to an ever-increasing network of members and increase its influence and ability to be an agent for positive advancement in the area of digital preservation. Growing new members can be a slow process as new relationships take time to establish. The DPC, through its involvement in TIMBUS, wishes to reach out to potential new partners outside of its traditional partner base in memory institutions.

The membership of the DPC has traditionally been drawn from organisations in the memory sector, including libraries, archives and universities involved in related teaching activities. As a result, their focus is predominantly on file preservation. TIMBUS addresses two areas where DPC activities have therefore lacked until now: first, by building our knowledge of process preservation; and second by increasing our contact with, and relevance to, industrial partners. This expands the DPC's network and allows us to reach out to potential new partners to include industry and SMEs.

We have already seen the benefits of our involvement in TIMBUS, with Lloyds Bank becoming the first major commercial institution to join as a full member[72] in January 2014. The presence of Lloyds brings a new dimension to DPC's membership, and supports us in sharing best practice in digital preservation between coalition members. It also strengthens our member network and expands knowledge exchange across sectors. In the final year of TIMBUS we intend to reach new communities with the project outputs. This will offer us further opportunities for networking and identifying new communities for participation.

We are therefore looking to exploit our involvement in TIMBUS to demonstrate our relevance to industrial organisations, and to encourage more businesses to join the DPC and share their own interests in digital preservation. While it is difficult to claim that TIMBUS is directly responsible for new membership applications, the project has enabled us to draw attention to digital preservation issues in wider sectors, and thus increase our profile in these communities. In the long term, the major measure of success will be whether the number of DPC industrial members increases over the next few years. Each member will increase membership revenue by £2,500 to £10,000 per member per annum. This funding enables the DPC to continue to exist and offer the services it does to its members. Table 10, below, references this work.

Table 10: DPC Exploitation Initiative #3: Growing the DPC membership

Exploitation Initiative #3	We will leverage TIMBUS to expand our membership base from mostly memory organisations to incorporate more industrial partners.
Audience(s)	Digital preservation professionals; organisations involved in, or interested in implementing, digital process preservation; higher education; business continuity managers and researchers in business continuity.
Exploitation Goal	We aim to widen our membership base to include more industrial partners, so that we can strengthen our presence in new communities and share digital preservation knowledge across sector.
Expected	The DPC will benefit from this initiative in two ways:

Exploitation Benefit(s)		(1) An increase in the number of members will increase our subscription income and allow us to do more work for our members; and through the benefits accrued from widening our member base to include new audiences with new insights to offer. We are a not-for-profit organisation, and thus extra membership revenue is ploughed back into DPC activities. This allows us to expand our activities, providing further benefits for our members and attracting greater interest in our training and advocacy. (2) Our members stand to benefit from the opportunity to share their interest in digital preservation with representatives from other sectors, and the resultant widening of the DPC's knowledge base.
How to measure the Benefit		We maintain an up-to-date list of our members on the DPC website, which allows us to assess which sectors our membership is drawn from. We can use this information to see whether there is an increase in membership among industrial partners. In addition, we will gather informal feedback about the reasons given by institutions for their decision to join the DPC, in order to assess the role that TIMBUS has played in convincing them to join.
Exploitation Resources		Recruitment of new members is an ongoing DPC activity, and as such it does not require specific TIMBUS resource to be achieved.
Dependencies		This work is a slow process as, by its nature, it relies on taking time to build relationships with candidate members. Some of these will eventually become members but the timing and the actual decision is something which the DPC cannot assure will happen.
Roadmap		
	Steps and actions needed	DPC attendance at industry-related events, and awareness building of the role of the DPC in TIMBUS and allied research activities. This already occurs, but is ongoing to ensure effectiveness.
	Actions taken	The DPC continues to identify and have discussions with new members. This can often be through informal discussions at events, or through direct approaches from organisations. In all cases, the DPC has continued to engage with them to discuss the benefits of membership. Jan 2014: Lloyds Bank joined DPC as full members. 2014: Commissioned to give paper on process preservation at IRMS Conference 2014: Planning of a joint workshop with BAC 2014: Planning of focus group on digital preservation in business Nov 2014: Launch of new Strategic Plan 2015 - 2018
	Current status	New members continue to be recruited from various sectors, and each case is discussed by DPC board members as it is received. Although discussions about membership are inevitably private, we will announce new members as they join.
	Timeline	This initiative is ongoing and DPC will continue to track the increase of new membership in expanded sectors due to the influence of TIMBUS involvement as well as to integrate targeted objectives into the Strategic Plan 2015 – 2018.

9.2.6 DPC Exploitation Initiative #4: Expand our understanding of digital preservation

The DPC supports its members through influencing and advising on relevant standards. Contributing to standards is an important activity for the DPC and TIMBUS allows us to develop our knowledge of process preservation to a point where we can confidently model execution processes for preservation. By creating a sound understanding of the underlying principles of digital preservation we will be empowered to give broadly founded advice and to steer research in novel, innovative and promising directions. The result will be the development of better tools for our membership base. In doing so, we are also contributing to standards development for digital preservation metadata.

We have been involved with the PREMIS (Preservation Metadata: Implementation Strategies) standard throughout the project. PREMIS is an international de-facto standard concerned with developing metadata for use in digital preservation, but it only has a superficially modelled environment model which needs to be validated and further developed. We serve on the PREMIS Editorial Committee and the PREMIS Environment working group, and will continue to do so this year. We ran a preservation metadata briefing day in London on 23rd April 2013 with PREMIS and METS as the main focus. Our members want to learn how to use these standards, and they want us to influence their specification to better support their needs. Because of government open data incentives many of our members also use linked data (RDF, OWL and SKOS). TIMBUS is developing context modelling tools that represent process contexts in Archimate represented in the OWL language. This decision will support reusability of TIMBUS modelling features in members' organisations.

While the benefits of this exploitation initiative are difficult to track and may not be evident by the end of the project, our active involvement with the PREMIS Environment Working Group is likely to manifest itself in enabling our members to capture this kind of process and context information in the long term, using a de-facto standard. Table 11, below, details this work.

Table 11: DPC Exploitation Initiative #4: Expand our understanding of digital preservation

Exploitation Initiative #4	Expand our digital preservation modelling capabilities to incorporate process preservation.
Audience(s)	Digital preservation professionals; organisations involved in, or interested in implementing, digital process preservation; higher education.
Exploitation Goal	The goal is to utilise increased knowledge in process preservation to assist the DPC in its standards activities. In particular, we aim to help to validate the PREMIS environment model and brief members on how to implement these standards.
Expected Exploitation Benefit(s)	The DPC will benefit from its involvement in standards activities in 3 ways: by allowing us to influence standards, and thus underline our position as a trusted source of digital preservation expertise; by assisting our members in implementing these standards in their own work, thus improving member digital preservation activities; and by networking with other organisations and individuals involved in standards. These activities all build on our position as an advocate and catalyst for digital preservation, and increase our ability to influence standards and offer support to our members.
How to measure the Benefit	A metric of success is the degree of increased adoption of the Environment feature in PREMIS which will greatly increase the quality of our members' metadata. This is unfortunately difficult to measure accurately because of a lack of data, but we can undertake interviews and gain anecdotal evidence.

		An additional metric of success is the completeness of the representation information networks (context metadata) archived together with the preservation objects in our member institutions' repositories and the number of preservation objects in their collections that have sufficient context information to understand and diagnose their provenance over time. We do not expect to see significant impact in this regard by the end of the project, but this would be a long-term benefit to our members. Previously, we have seen the completion of a Ph.D. thesis by a DPC staff member on the conceptual modelling of digital preservation, which was informed by the TIMBUS standards and context modelling work. Thus one other measure of success would be to track citations of thesis in the literature.
Exploitation Resources		One member of DPC staff who works on TIMBUS is also involved at board level with the PREMIS Environment Working Group. This is an ongoing commitment for us, which will continue beyond the end of TIMBUS, and represents the primary resource required to achieve this goal. We foresee no problems in relation to the resources necessary to meet this objective.
Dependencies		Access to completed TIMBUS research outputs to ensure relevant knowledge
Roadmap		
	Steps and actions needed	We need to continue our activities in relation to standards, including continuing our existing activities with PREMIS and investigating other opportunities to apply knowledge from TIMBUS to our standards activities.
	Actions taken	2011 – Present: Membership of PREMIS Editorial Committee and PREMIS ENVIRONMENT working group. 2013: Completion of Ph.D. thesis by Angela Dappert, informed by TIMBUS approach. 2014: Provided guidance to the PREMIS Editorial Committee for the review of standards changes, including review and copyediting of a new publication 'New Review of Information Networking' (Dappert, Peyrard, Chou, Delve, 2013), new PREMIS Data Dictionary, and the transformation rules from version 2.2 to version 3 to be released in 2015.
	Current status	DPC staff member Angela Dappert is a current member of the PREMIS Editorial Committee and the PREMIS Environment working group. She represents both TIMBUS and the DPC on these committees and is playing an active role in influencing the relevant standards.
	Timeline	Ongoing – we are unlikely to see significant changes during the lifetime of the TIMBUS project, but we will continue to influence relevant standards in the future.

9.2.7 DPC Exploitation Initiative #5: Update and expand the DPC's research capacity

The DPC wants to ensure that its members remain informed of relevant research on current issues in digital preservation. TIMBUS will allow us to update and expand our research activities, and will feed into our plans through influencing our future research roadmap. The project represents a widening of our research activities and means that we can confidently say that we are actively addressing gaps in knowledge. In doing so, we are ensuring that we meet our members' existing and future research needs.

We aim to take a number of steps to maximise the impact of this initiative. First, we intend to include the lessons and findings of this project into the DPC strategic plan, to necessarily include a roadmap for future research activities. The success of this initiative will be measured by the amount of active progress we make on the DPC research roadmap through subsequent funded projects.

This initiative has already provided benefits. For instance, the DPC is now working with SBA and INESC-ID on a joint FP7 project called 4C, which analyses long-term digital preservation cost models. Additionally, DPC will participate in a study in conjunction with the UK Data Archive in 2015 that certainly will be influenced by the concepts of process preservation and context analysis provided by TIMBUS. The component of the project covered by the DPC examines the digital preservation of inter-relational databases and social media, addressing the challenges of preserving un-fixed, volatile data. Certainly the DPC will utilise methodologies developed by TIMBUS for preserving an entire environment and not just data. Therefore, our involvement in TIMBUS has acted as a springboard to further research activity in the area of process preservation. Table 12, below, details this work.

Table 12: DPC Exploitation Initiative #5: Update and expand the DPC's research capacity

Exploitation Initiative #5		We aim to update and expand the DPC's research capacity through our involvement with TIMBUS.
Partnerships		DPC (William Kilbride), SBA, INESC-ID.
Audience(s)		Internal, digital preservation practitioners, researchers.
Exploitation Goal		We aim to consolidate the multiple tracks of research currently being undertaken, including projects such as TIMBUS, 4C and E-ARK.
Expected Exploitation Benefit(s)		We expect this initiative to help us update and extend the DPC's research capacity, and to identify future areas for research. TIMBUS has already provided benefits to our organisation by expanding our research activities and increasing our knowledge of process preservation, and this initiative will help us to maximise these benefits.
How to measure the Benefit		The benefit will be demonstrated in the creation of a new strategic plan which will include a clear research roadmap informed by our participation in TIMBUS. We expect to complete this strategic plan in 2014, and it will apply to the period from 2015 to 2018.
Exploitation Resources		The strategic plan will require input from other DPC staff and board members, in addition to the two staff members directly responsible for TIMBUS, but we expect this effort to come out of DPC-related activities rather than TIMBUS. In addition, we need to ensure that appropriate capacity is maintained to allow for DPC involvement in future research activities. For instance, 4C requires a commitment of half a full time employee.
Dependencies		Access to completed TIMBUS research outputs to ensure relevant knowledge
Roadmap		
	Steps and actions needed	Internal discussion relating to DPC strategic direction will be needed.
	Actions taken	2011: Discussions to finalise strategic direction of DPC in 2012-2015. These include internal and board-level discussions.

		Dec 2011: DPC Strategic Plan 2012-2015 finalised and released online. Feb 2013: Start of FP7 project: 4C. Aug 2014: New strategic plan drafted and reviewed by DPC Board of Directors and other DPC Staff Nov 2014: Formal adoption of plan by the Board of Directors Jan 2015: Implementation of the Strategic Plan 2015 – 2018
	Current status	The new strategic plan has been formally adopted by the Board of Directors as of November 2014.
	Timeline	M34-36: Internal discussions. Plans for future research and strategic plan taken to DPC board for approval. M36-45: Draft strategic plan and research roadmap. Identify future research opportunities, seek partners and apply for appropriate funding. M45: Release strategic plan for 2015-2018.

9.2.8 DPC Exploitation Initiative #6: Develop framework for aligning DP and risk management

As the TIMBUS Project comes to a close, DPC has had the opportunity to review the project and assess the overall benefits we have reaped as an organisation through our involvement. Though for the most part we have built on initiatives already established in earlier reports, we have also identified an additional initiative that has become possible through the tenure of our experience in the project. Having worked with a number of new research and industry sectors through our work on TIMBUS, DPC has developed a new model for aligning digital preservation and information risk management through a developed understanding of information risk management priorities and renewed ability to cater to those needs through a common vocabulary.

This new model for aligning digital preservation with information risk management will allow DPC to engage more meaningfully with new sectors in industry and business and further promote the importance of planning for digital preservation across multiple disciplines. This alignment will support new relationships with these sectors as well as with different roles within our established base of memory institutions, such as information managers, business managers, and risk management specialists. With continued reliance on our experiences with TIMBUS, DPC hopes to use this new alignment to initiate new collaborations and community outreach activities and also to build our membership to include representatives from these sectors.

Table 13: DPC Exploitation Initiative #6: Develop framework for aligning DP and risk management

Exploitation Initiative #5	We aim to develop a framework for aligning digital preservation and information risk management through a common language with other sectors
Partnerships	DPC
Audience(s)	Business and Industry sectors including Finance, Civil Engineering, eHealth, and the Care sector. Also, cognate functions within current member organisations, such as Records Managers, Chief Information Officers, and other Information governance roles
Exploitation Goal	We aim to engage these new sectors and functions in the importance of digital preservation through developing a framework that aligns digital preservation more closely with the field of information risk management already in place in

		the business sector by using the cross-discipline experiences of TIMBUS.
How to measure the Benefit		The benefit will be demonstrated in joint action with new sectors bodies, speaking directly to businesses, and engaging with new functions within existing member organisations.
Exploitation Resources		The further development of this alignment will provide a means for the business and industry sectors to better access the resources and solutions of digital preservation and will also provide a means for digital preservation researchers, and commercial providers, to communicate with new sectors via risk management.
Dependencies		Continued exposure to business and industry sectors, possibly through connections made during TIMBUS, such as delegates who attended the BCI World Conference and Exhibition in November 2014.
Roadmap		
	Steps and actions needed	2014 and on: embed new approaches and objectives specific to these sectors within the DPC Strategic Plan
	Actions taken	Sept 2014: DP Sustainability at the EU Policy Level, workshop at DL2014 Nov 2014: BCI World Conference and Exhibition Nov 2014: Adoption of new Strategic Plan
	Current status	The new Strategic Plan is currently under review and DPC publicity and outreach has adapted its methods and materials to reflect new objectives
	Timeline	M45: Integrate experience with TIMBUS to support integration of digital preservation in new sectors and functions of exiting member organisation to align with information risk management already in place Past end of project: Build-on and expand alignment with information risk management in other sectors and new functions of existing member organisations based on experience with TIMBUS

9.2.9 DPC Exploitation Conclusion

As discussed in this report, DPC has continued to develop the Exploitation initiatives already established in earlier reports as well as to discover new ways in which TIMBUS has enhanced DPC as an organisation. These initiatives, such as providing value by enhancing membership preservation actions to include processes, increasing our understanding of process preservation in order to develop training materials, and leveraging TIMBUS to expand our membership base, have proved highly beneficial to our core mission throughout the project and will likely continue to demonstrate new benefits as we move forward. The results and lessons learned in TIMBUS, as perceived through the process of dissemination and training, will likely contribute to future research initiatives by DPC as well as to our recommendations to our members in their on-going endeavours to improve and expand their capacity for digital preservation. Overall, DPC's involvement in the TIMBUS Project has resulted in perspective and insight into the direction of digital preservation and summarily improved our ability to offer support and guidance in this critical field.

9.3 IPLS – INTEL Performance Learning Solutions Limited

NOTE: *The content in the Intel exploitation report is classified and not to be distributed outside the terms of any legal agreements in place between Intel, the TIMBUS consortium partner and the representatives of the European Commission.*

9.3.1 Partner Profile

Intel Performance Learning Solutions,
Intel Labs Europe,
Leixlip, Ireland.

Intel Corporation was founded in 1968 and is based in Santa Clara, California. It is the world's largest semiconductor chip maker, with revenue in excess of $50 billion, 100,000 employees worldwide. It develops advanced integrated digital technology products, primarily integrated circuits, for industries such as computing and communications. Intel supplies the computing and communications industries with chips, boards, systems, and software building blocks that are the "ingredients" of computers, servers, networking, and communications products. Intel's business segments are PC Client Group, Data Centre Group, Embedded and Communications Group, Digital Home Group, Ultra-Mobility Group, NAND Solutions Group, Wind River Software Group, Software and Services Group.

Intel Ireland is Intel's centre of manufacturing excellence in Europe. Since 1989, Intel has invested over US$12 billion turning 360 acres of the Collinstown Industrial Park into the most advanced industrial campus in Europe. Over 4,000 people work full time at the Leixlip campus and in addition, there are over 200 people employed at Communications Product Group located at Intel Shannon, Co. Clare and an additional 5000 on construction of a new manufacturing capability, also in Leixlip. The fabs at the Leixlip campus produce 300mm wafers on multiple process technologies and our combined facilities constitute one of Intel's most technologically advanced, high-volume manufacturing sites in the world. These facilities produce leading edge silicon products that power platforms and technology advancements which are essential to the way we learn, live and work today.

Also located at the campus is the Innovation Open Lab – Ireland, which is part of the Intel Labs (iLE) network. The lab is home to a research team who facilitate and engage in open research and innovation opportunities in Europe that can ultimately lead to value-driven technology solutions. The lab is focused on Energy & Sustainability, and Dependable Cloud & Services research. In 2014, the lab has entered a golden period with its research now directly steering Intel's recent IoT announcements, shown below in Figure 42: Intel unveils IoT Strategy (Dec 11th 2014)

and our work is getting wide recognition internally.

Figure 42: Intel unveils IoT Strategy (Dec 11th 2014)

The lab is a member and network leader of Intel Labs Europe which has the goal of expanding the scope of Intel's European R&D activities by coordinating innovation activity and future investments against an Innovation Agenda focused on enabling a Digital Europe.

9.3.2 Exploitation Strategy

A lot has happened in Intel Labs globally in the last 18 months to make this happen and indeed our plans as detailed in the D2.3 deliverable are already bearing fruit. This has happened due to a number of initiatives within the company. Brian Krzanich[74], pictured below in Figure 43, was elected CEO of Intel on May 2nd 2013. Brian, along with Intel President, Renée James has been re-shaping Intel as the corporation faces into a fiercely competitive future. As they begin their tenure as Intel's new leaders, the company faces extremely stiff competition in the mobile market as they attempt to grow a presence in a field in which their competitors dominate. Large cloud service providers such as Facebook, Google, Amazon, Microsoft and others account for a large proportion of Intel's server market and these providers are gaining enough infrastructure mass behind them to consider designing and building their own purpose built servers which may or may not be based on Intel architecture as discussed in a recent internet blogs and news reports[75]. In emerging markets, the Internet of Things looks promising but it is still early days for machine-to-machine and wearable devices, with Intel among one of many vendors competing to add value and differentiate their offerings to potential customers in the market.

Against this backdrop, it is more important than ever that Intel's research wing, namely Intel Labs, is working to position Intel with new ideas and potential products which will help to not only maintain or grow their share of existing markets, but also open up new ones. Intel Labs new Managing Director is Wen-Hang Wang, also pictured below in Figure 43, has begun the process of re-structuring his organisation to meet these new challenges. The main construct is a much more formalised approach to research exploitation within Intel called Mega-Impact Projects, or MIPs.

Figure 43: Brian Krzanich, Renée James, Wen-Hann Wang

The business groups have defined almost a dozen MIP projects in which they have specified requirements and given a commitment that the specified capabilities are items on their roadmaps which they will adopt if they prove feasible but for the present time they are too far into the future to justify a large investment of product development resources in to. The precise details of those MIP projects are confidential. However, this section of the deliverable goes into detail on the parts that TIMBUS is playing in two of the MIP projects.

Intel's motivation for involvement in digital preservation research has many facets to it. At a high level, TIMBUS helps support ILE's strategic imperatives for the lab in Ireland. This labs two research agendas have evolved from last year: (1) Dependable cloud has developed into SDI (Software Defined Infrastructure) and (2) our sustainability research now firmly rooted in IoT development. These two strands are MIP projects and TIMBUS is contributing to both of them. This is quite impressive because the majority of the labs organisation globally are still involved in 'blue sky' research which is not mature enough yet to form part of a MIP, yet TIMBUS is involved in two separate MIPs.

Dependable cloud originally incorporated the concepts of secure, trustworthy execution within the cloud. This extended to TIMBUS through understanding ERM risks to business based on information lifecycles in the cloud. For example, understanding how a business process can be described in terms of its constituent components is a key part of this as it enables cloud based preservation and can assist in avoiding lock-in as it promises the potential to reconstruct an existing service in an alternative cloud provider's environment. The dependable cloud agenda has evolved into SDI. This in line with Intel's market challenges in the data centre. Software Defined Infrastructure is itself an evolving field and is described in any number of online publications. InfoWorld published a comprehensive and easy to understand *Roadmap to Software-Defined Infrastructure*[76] article in November 2013 which was based on an interview with Jamie Thomas of IBM. As explained in that article: *"The goal of a software-defined environment is to enable business users to describe their expectations of IT in a systematic way, which in turn drives automation of the infrastructure. The infrastructure understands application's needs through*

defined policies that control the configuration of compute, storage, and networking, and it optimises application execution. Through this approach, organizations are able to respond in real time to provide improved availability, as well as support for shifting volumes of work." In broad terms, TIMBUS is helping answer questions about how a service can be semantically described in a machine-readable manner. This would allow us to more easily migrate services between cloud providers. The work package 6 development efforts are directly doing this work through the integration of the TIMBUS tools. These tools describe a business process software environment and its supporting hardware.

The sustainability arena of our research has also become much more definitive in the third year of the TIMBUS project. Last year, TIMBUS was informing our research into smart cities and which types of data a smart city may produce, how long they need to be kept for and how they might be preserved over long periods of time. This year, our sustainability labs work has become much more applied as we rolled out an Intel® Galileo® based sensor network in Dublin, London, Liverpool and other parts of the UK.

TIMBUS has worked closely in this deployment to understand the use cases and types of data that are being collected. But in terms of the research, the TIMBUS value is now in understanding how an end-end IoT deployment can be preserved. This work has received very high visibility; it has attracted million dollars of internal Intel funding, forming the basis of the announcement referred to in Figure 42: Intel unveils IoT Strategy (Dec 11th 2014)

. It is very exciting from a research perspective because it is so applied and is being run in a real product development environment. This was detailed fully as part of the Task 6.7 work in TIMBUS deliverable D6.6.

The lab also has many secondary drivers for this particular research topic. These include, but are not necessarily limited to:

- Contributing to Intel's leadership position through informing internal stake holders about the challenges facing our technology consumers so that Intel can use their position to influence the entire technology ecosystem to enrich the lives of people worldwide.
- Internal exploitation through direct or indirect adoption of functional or conceptual aspects of the research to address in-house technology challenges and inform internal strategy. This aspect is detailed in this deliverable.

The best form of exploitation of a research project for a commercial entity such as Intel is of course for it to influence the development of a revenue generating product, somewhere, for someone, ideally for Intel. This is a particularly difficult challenge but as the TIMBUS project comes to an end, the work taking place in Intel's IoT scenario still represents our best vehicle to potentially productise elements of the research which has taken place to date. This section of the deliverable will relate our efforts and our strategy which is continually evolving, being refined and has been getting stronger and stronger throughout TIMBUS' lifetime.

9.3.4 Brief Re-cap of Intel Efforts to date

As stated in the last section, this deliverable will detail all of the strands Intel has been working on. Not all of these have been successful or completed to date, but by knocking on every internal and external door possible we have been doing the upmost to create the potential for the hard work being carried out in TIMBUS to be exploited. To give an example, in total, in the year from March 2014 to December 2014, Intel has hosted or been involved in more than 40 different engagements or meetings with stakeholders which are detailed in Appendix *B: Intel meetings in TIMBUS year 4*) and we feel we have reached out to every possible internal and external avenue for potential exploitation over the four years of the TIMBUS project to date. Intel has been and continues to chase every opportunity; talking about TIMBUS to every possible audience as we never know which conversation may lead to further

opportunity. We have used and still use all opportunities to raise the topic, show any prototypes we have or engage with anyone having difficulties with archival.

In the first year of the TIMBUS project, Intel put a focus on understanding the problem domain. In this vein, we held many meetings and interviews with stakeholders from a very diverse range of industries to identify their digital preservation needs and how they currently address them. The details of all those interviews and our learnings from them were given in deliverable D2.1 in year 1.

In the second year of the TIMBUS project, Intel, with the help of the DPC, reached out to the traditional digital preservation community. In deliverable D2.2, we related our learnings from our engagements with well over a dozen members of PASIG. We took time to detail their activities, profile their work and to understand their businesses and why preservation is important to them. We had meetings and discussions with all of those. This was a very valuable and worthwhile process. We didn't limit ourselves to the organisations we spoke to in year 1. Instead, we merely continued the process, speaking to new organisations and learning about how they are struggling with this problem and what they are going about addressing it. We also raised awareness of the TIMBUS project and in particular Intel's keen interest in this topic by speaking at that event and by chairing one of the panel discussions on archival in the cloud. This approach in year 2 was a deliberate decision and a continuation of what was begun in year 1. Some of the reviewer comments had hoped that contact would be maintained in year 2 with the people we spoke with in year 1. Intel still has all those contacts and the plan has always been to circle back with everyone when the TIMBUS tools are mature enough that we can share them and offer something to them. We have not exhausted the list of organisations we can speak with to raise awareness of the topic and the research. Instead, we have built up a large number of contacts whom we plan to circle back with a status approaching the final learnings of the TIMBUS research. This point in the TIMBUS lifecycle is upon us with the work package 6 tools going online on OpenSourceProjects.eu in M36. This deliverable details those timelines in *Intel Exploitation Initiative #8: Contribution to Open Source Communities*.

All throughout year 1 and 2, we have not just limited ourselves to those external conversations. We have continued to advance our internal engagements, seeking out stakeholders and fellow travellers. In year 1 and 2, the foremost of these has been Phil Mondor's Intel archive rescue project team, Teresa Hill's Engineering Computing group and their customers in the Intel microprocessor and SoC (System on Chip) design teams. In year 3, we added in Rodger Mooney and Gary Dunn's new Intel IT Archival project team and the Intel IoT scenario with its potential to productise some, yet to be identified, elements of the TIMBUS research. Our presentation to Intel IT's *Rough Guide to IT* talk series, as shown below in Figure 44 opened up new contacts between our research and the Intel Shannon IT and design teams.

Figure 44: Mike and Rodger presenting TIMBUS research to Intel IT in Q2 2013

As will be seen in the Intel initiatives in this section of the deliverable, we have worked with internal stakeholder groups, and have been successful in seeking out technology transfers. We have done this by slowly building partnerships over the duration of the TIMBUS project and then working with those partners to put together convincing arguments to be put forward to the potential stakeholders which we jointly identified. A selected excerpt of slides from one of the decks we used throughout year 3 for these meetings is shown below in Figure 45.

Figure 45: Excerpt from Internal Tech Transfer Slide Decks

Intel's exploitation report is intended to be informative, detailed and exciting. As shown in the example below in Figure 46, Intel has brought energy and enthusiasm when promoting the research either internally or externally. Intel is very pleased by the output of this project to date and the continuing potential of the research. It is viewed very positively internally and Intel is very happy to discuss its exploitation plans in further detail if any extra information is lacking or some aspect of our plans or work to date is unclear.

Figure 46: Mike and Perumal presenting TIMBUS Research

(Research@Intel Europe Event in Nice, France, October 2013)

In the last year of the TIMBUS project, Intel, once again with the support of the DPC, reached out to the traditional digital preservation community, attending the twelfth international PASIG meeting in Karlsruhe, Germany from September 16th to September 19th 2014. This was a great opportunity to discuss with members we had met during the previous PASIG event and to engage with other members. We had interesting meetings and discussions with all of those to discuss about their business and understand how they approach digital preservation to deal with the challenges that it brings.

We also raised further awareness of the TIMBUS project, with Angela Dappert providing a presentation on TIMBUS Preservation Business Process. Intel's attendance to this latest PASIG event in year 4 was a deliberate decision and a continuation of what was done in the previous years. It was a great opportunity to engage again with our contacts made previously and provide additional information, updates on TIMBUS and more specifically on the TIMBUS tools as they were now mature enough to be shared. It was also a good opportunity to meet with Ed Fay, Executive Director of OPF to discuss face-to-face about our opportunity of collaboration between OPF and the TIMBUS consortium.

During this final year, Intel continued its effort to raise awareness about TIMBUS within Intel as well; attending internal events whenever possible. This led to further internal engagements.

For instance, in August 2014, Intel Labs opened its doors in both Santa Clara and Portland, US, inviting around 100 projects from their research labs, university collaborations, and summer Interns. These projects aimed at showing how to make future technologies more efficient, connected, secure, and personal, with some of the key topics covering Data Economy Infrastructure (including SDI), the Internet of Things, and Wearables. Perumal Kuppuudaiyar, Software Researcher at Intel Labs Europe (ILE) and Phil Mondor, Intel archive rescue project team member, both TIMBUS members, travelled to Santa Clara, US to attend this Intel Labs Open House. There, they raise awareness about the TIMBUS project and about the importance of digital preservation. Figure 46 below provides a highlight of their presentation.

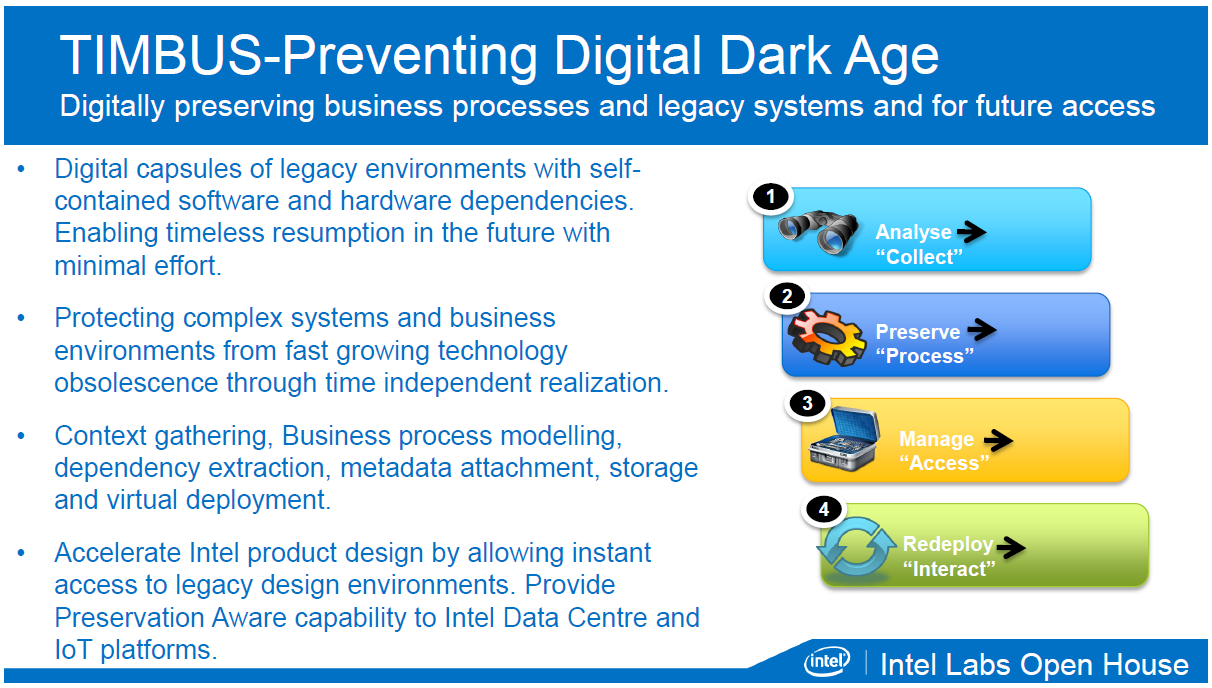


Figure 47: TIMBUS Presentation

(IL Open House in Santa Clara, USA, August 2014)

Although the audience appears to be somehow unaware about process preservation, many, including Intel Vice-President (VP) and Managing Director (MD) of Intel Labs Wen-Hann Wang (Figure 46 below), were very receptive and interested in TIMBUS concepts on preserving an entire environment instead of just data. Keen interest shown by the audiences at the Intel Labs Open House in Santa Clara reflects the innovative and beneficial possibilities of TIMBUS.

Figure 48: Perumal and Phil presenting TIMBUS Intel Labs Managing Director Wen-Hann Wang

(IL Open House in Santa Clara, USA, August 2014)

Finally, during a visit from the Intel CIO, Kim Stevenson, on September 11th 2014, Intel Labs provided a quick presentation on the TIMBUS project and the newly agreed and started POC with the QSD team. The TIMBUS project caught her attention and she shared the following two comments before leaving:

- *"this is the type of work I would like to see more"*
- *"I will be very interested in seeing the results of the PoC"*

She also mentioned that IT has spent about $1.8 million on data retrieval so far this year and she advised us to connect to the team handling this. This further increase the awareness within Intel about the TIMBUS project and demonstrate its potential value.

9.3.5 Intel Exploitation Initiative #1: Technology Transfer to Intel Design Teams

In year 1 of the TIMBUS project, a lot of work was undertaken to discover the internal stakeholders in Intel. Through this effort the CSL lab has had the opportunity to work with Intel IT Engineering Compute division (IT-EC for short) on a joint project. With the PO's approval, IT-EC (specifically, Phil Mondor & Teresa Hill) had gotten agreement to formalise IT-EC's effort in the TIMBUS project where they have been actively engaged for almost two years and in year two have been working on D5.3, 6.4, 6.6 and 6.7.

The Joint Path Finding (JPF) project which is under way between the CSL lab and IT-EC is in the area of preserving Intel's historical tape archives dating back to 1971. The project is expected to run for at least another 18 months to September 2014. In addition to migrating Intel's legacy archives to tape, TIMBUS can help with re-constructing past software environments to render the data. This data is important to preserve because it aids in litigation cases as detailed in deliverable D2.1 in year 1 and additionally it represents a large proportion of Intel's internal know-how which has been built up over time and helps to differentiate Intel as the world's leading semiconductor manufacturer when measured in terms of the

scale and sophistication of their manufacturing processes as well as the products they produce. This JFP project is being led by IT-EC who own the timelines and CSL are working with them to understand how Intel's archival processes can be improved. IT-EC has the ability to roll out improvements to Intel archival processes globally.

The current work that is happening in this area was not anticipated when Intel joined the project and would not have happened without participation in TIMBUS. The chain of events can be summarised as follows:

- Phil Mondor is contributing and now formally reporting part of his time to TIMBUS. He has been working with the CSL lab for over three years informally and had also attended the year 1 review in Ireland. With over 20 years archival experience, Phil is the former head of Intel Archives for IT-EC globally and now acts as a subject matter expert for Intel Legal as part of Intel IT's e-Discovery group, which is part of the larger Intel IT Information Security group. Phil's passion and vision has largely helped to bring the contributors of this work together.
- As a result of that engagement, Phil Mondor, Michael Nolan and Rodger Mooney met with Hong Wang from Intel labs in Santa Clara for a conference call on October 1st 2012. As a result of that meeting, Hong approached Justin Rattner who heads up Intel Labs globally about the need to preserve the Intel archives.
- On November 8th 2012, Brian Quinn (ILE Labs Network Manager) and Justin Rattner (Wen-Hann Wang's predecessor) discussed the issue of Intel's archives with the then Intel CEO Paul Otellini at the Intel Quality Awards (IQA) dinner in the Ritz Carlton Hotel, Half moon bay, CA, USA. Figure 49, below, shows Paul speaking at that event. Paul understood the value of the archives and agreed to fund a $2.4million project to move the tape archives to a more sustainable and accessible solution, part of which is to use TIMBUS to help create an ability to also preserve the software environment as well as just the data.

Figure 49: Intel CEO Paul Otellini speaking at the Intel IQA dinner, Nov 8th 2012.

- Between 11-15th Feb 2013, Michael Nolan and Rodger Mooney from Intel's CSL lab travelled to Folsom, CA, USA and Santa Clara, CA, USA to meet with the following people:
    - *Phil Mondor, Teresa Hill* and *Dave Parker* (all Intel IT). Teresa owns Intel's Engineering Computing archive process globally and has the ability to roll out changes to Intel's archival processes. Dave is project managing the migration of the archives from tape to a disk solution. The current status as of March 2013 is that vendor selection is almost complete and we are ready to move to the next phase of the project which is to ship the tapes to those vendors. The archives reside on over 50,000 tapes most of which fall into 9 different types: 9-Track Reel, 4mm, 8mm, DAT, 3480, Compac Tape I/TK50/TZ30, Compac Tape II/TK70, DLT III and DLT IV – 4000 and an estimated 1.5PB of data resides across those so it is a complex and large undertaking. This restoration process is expected to run through to the end of July 2013.
    - Vivek Aijarapu and Freeman Ratnam manage the IT-EC groups into which Teresa reports. Both of them were supportive of the joint work.
    - On 12th Feb, we had a larger meeting with Hong Wang (Intel Labs), Carol Kasten (head of IT information security group) both of whom we had engaged earlier in the project. At the meeting Jim Brayton (head of IT-EC globally) and Debra Antrobus (reports to Jim. Vivek reports to her) also attended. At that meeting, Hong laid out the steps that TIMBUS needs to perform to offer something that the archives don't have today and the JPF work received the approval of all parties.
    - Subsequent to that, Michael, Rodger and Phil renewed a prior engagement with a product design team in Leixlip (the team are called Clanton and the specific engagements have happened with Noel Murphy who heads up the program, Sarah Frawley who owns the software tool support and Derek Leahy who owns the infrastructure environment). We are currently working with them to execute the next step in this JPF which is to obtain a recent archive of an Intel design project so that we can attempt to re-create the environment manually and prove it works. Phil Mondor's team have done a similar piece of work previously in year 1 for two litigation cases using a virtual machine to host the environment. This environment was from the 1990's and there is little knowledge about the original systems today. This made it more difficult, but it was successful so we are confident that we can also follow the same steps to get this working.
- In TIMBUS year 3 and over the last few months, we have continued this engagement. We have had numerous meetings during the year with stakeholders in Intel design teams at sites in Swindon (UK), Shannon (Ireland) and in Leixlip (Ireland). The details of those meetings are included in *Appendix B: Intel meetings in TIMBUS year 4*.
    - The result of these meetings was a proposed collaboration with the Quark Solutions Division (QSD), also known as the Clanton team, to develop a PoC which implements the TIMBUS processes in a solution bespoke to the Intel Silicon Design environment. The PoC started in August and will run until December 31st 2014. This would involve reviewing both the hardware and software technologies used, the applications utilised in the design process and the types and quantities of data likely to be preserved. Functional copies of the Quark Solutions Design group's environment where backed up to a secure data centre in Folsom, USA. This backup of the design environment comprises of the 'off the shelf' tools, validation tests and design files. The Folsom backup has been modified to be self-contained, it does not rely on any externally mounted applications or configuration files. The PoC will primarily focus on developing a 'one-stop shop' application capable of preserving this backup. The secondary aim will be to investigate and build into design, the foundations of a system to

handle distributed systems where applications are physically hosted on a separate system from the files they work on, where the computation power is hosted on a different system from the RAM and hard drive, etc.

- Future steps pending the findings of the PoC were also discussed, committing to one full-time development resource in 2015 to scale up the PoC and add more features.
- One of the Intel highlights of the TIMBUS project has been the partnership with QSD for running a Proof-of-Concept against a real design environment. This effort took persistent lobbying of our stakeholders over 18 months before eventually QSD (Quark Solutions Group) agreed to provide €20,000 in funding from their own budget toward a 4-month pilot which began at the start of September 2014.
- To realise a PoC for TIMBUS within the QSD group, we required not only political and financial support, but we also needed domain expertise in three areas; Silicon design IT environments, Digital Preservation processes and expertise and Software development skillset. To achieve this, a QSD TIMBUS PoC sub-team was formed to create an Intel specific PoC to demo relevant TIMBUS digital design processes within the Intel Silicon design IT environment. The team comprised of;
  - Sarah Frawley and Derek Leahy – Intel QSD resource who processes expertise and experience in creating, maintaining, validating and manually preserving the Quark Silicon Design development environment. Sarah and Derek are working on an ad-hoc, as needed basis, helping frame the problem statement, educate the team on the development environment collaterals and architecture and general consultation on all things Quark.
  - Phil Mondor and Theresa Hill – Now part of Intel's e-Discovery group, Phil has 20 years' experience in resurrecting archived data on now defunct storage technology using contemporary hardware and software to host the files. Phil and Theresa will be providing general advice on digital preservation processes, tools and use-case centric scenarios.
  - Fearghal O'Hare – Intel IT Flex Services resource who is responsible for designing, developing and testing the PoC to ensure relevant TIMBUS concepts can be utilised to solve Silicon design digital preservation problems. There will be many components to integrate and interact with in this PoC; Quark Solution's Labs, Linux and Windows Servers, networking etc, Fearghal will develop a solution bespoke to the PoC problem statement.
- Because of our successes to date, we have also made contact with a new group called the Intel Reuse Repository (IRR). IRR have increased their scope to now include all legacy IP to enable future re-use and accelerate product development. Phil Mondor is leading a PoC for the archive repository. Sudeep Mehta is our contact point for the IRR group and he has assigned five people to work on this PoC with us.

- On November 6th 2014, Intel Communications published a video explaining how the 1989's i486 design helped create Quark and advertising the importance of archives.
  - In this video, shown below in **Error! Reference source not found.**, Teresa Hill, eDiscovery team member, explains how the design engineers and Intel Labs can take the data from old tapes and "do their magic on it" and reuse it in today's products. This is exactly what they did to create Quark; the brain of the Quark SoC is a tiny, energy-efficient core whose roots are in the i486 processor introduced in 1989. In order to save time and money, Phil Mondor searched through all archives and reverse engineered the obsolete data into modern day

technology and finally found the code needed. Our CIO, Kim Stevenson shared this video during her quarterly update meeting in Q3 2014, highlighted this success story and pointing out that this allowed Intel to save 10 months of work, despite the long effort required to recover and retrieve the data from the old tapes. This success story is now showing the importance of preserving data and Intel is now looking at how it can replicate this with other products.

- This video was very well received and raised a lot of interest within the Intel community, resulting in a lot of discussions with 151 comments. Each comment was a discussion among people replying to an original post. This was a great opportunity for the TIMBUS Intel team, including Phil Mondor and Mike Nolan to raise awareness about the TIMBUS project to an internal audience; pointing out that TIMBUS project's vision is to expand archival beyond just bit preservation to preserving the business process; that is that it includes preserving the environment and tools needed to access and actually use the data far into the future. It also enabled us to increase the profile of our business group within Intel and the work we do.

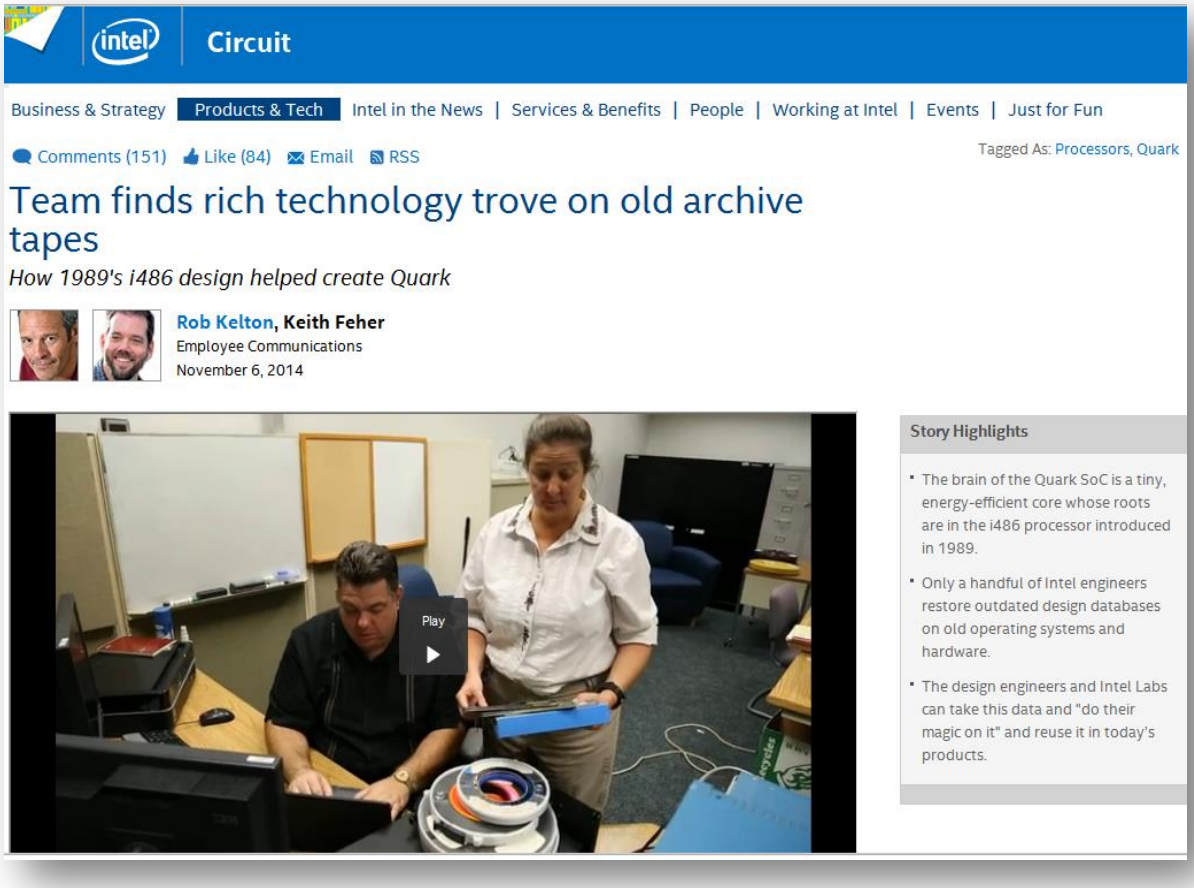


Figure 50: Phil & Teresa star in internal Intel video

- On December 17th 2014, Kim Brown, Senior Manager in Intel IT Flex Services, expressed her interest in TIMBUS and instructed her team in Ireland to drive the TIMBUS exploitation internally within Intel IT, highlighting that other organisations within Intel, such as Automation and Product Design needed. She expressed the fact that she was really excited by the capability and her will to help. The

Intel TIMBUS team will meet with Kim Brown again in January 2015 to discuss and agree on the next steps.

Table 14, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 14: Intel Exploitation Initiative #1: Technology Transfer to Intel Design Teams

Exploitation Initiative #1	Technology Transfer to Intel Design Teams
Partnerships	Intel ITeD (Phil Mondor), Intel Silicon Design Team (Clanton team, Sarah Frawley, et all.)
Audience(s)	Intel IT Engineering Compute (Teresa Hill), all Intel Silicon Design Teams worldwide (these are customers of Intel EC)
Exploitation Goal(s)	The primary goal is to help Intel's design teams to be more productive by enabling simplified IP re-use. This involves: 1. Taking time to build relationships and trust with our stakeholders, namely the Intel Design teams and the Intel IT Engineering Compute team and their management. 2. Developing, and demonstrating a credible TIMBUS-based LTR capability for Intel Silicon design teams. This is a very ambitious goal which is split into milestones.
Expected Exploitation Benefit(s)	Intel has confidential figures around the benefit of this capability to its design teams. The figure is in the region of hundreds of millions of dollars. However, for the TIMBUS team within Intel, a successful outcome will be that we can prove the concept in a design environment and bring this result to the Intel EC management so that they have a decision to make on adopting it as a global service. And we aim to influence that decision but it will ultimately be up to that team to decide if they take further action.
How to measure the Benefit	Intel finance has a mechanism to measure the financial benefit of this work if the exploitation goal is fully met. Each milestone can also be measured. The milestones are below in the roadmap.
Exploitation Resources	The resourcing is multifaceted for this. We have requirements in both headcount and skillsets that are not sufficient to currently meet the objective. However, that is expected as this is proof-of-concept work and we always have the challenge of convincing other business groups to invest resources in adopting a research prototype into a production release. The business groups always have competing priorities which they must balance. 1. The Intel Labs Team: The core team has now increased to 5 resources, with the additional of 2 Intel employees working respectively on the Exploitation work package (Didier Da Costa) and the PoC (Fearghal O'Hare), technically developing the internal Intel PoC described in this document. 2. Our Partners: ITeD have 3 people working on this with us which is

		a fantastic result. 3. Intel Clanton Silicon Design Team: The QSD team have agreed to co-finance an Intel Flex resource (Fearghal O'Hare) until end of 2014 to work on the PoC and have also allocated 2 of their resources to provide support and direction for the PoC. These resources, Sarah Frawley and Derek Leahy, who's domain expertise in the Intel Silicon Design environment, guide the PoC requirements.
Dependencies		Technical: An integrated work package 6 toolset capable of performing end-to-end preservation of a BP is absolutely required. Optional, but desirable, at this point is the ability to re-deploy an environment. Learnings needed from a successful test run against the Intel IoT scenario detailed in deliverable D6.6. This work is dependent on integration of the work package 6 tools and feedback from these tools being run against the TIMBUS use cases. It is expected that work will yield many learnings and improvements to the system. Non-Technical: The resource issues are ultimately subject to management buy-in from other business groups within Intel. We do not control these so have to use our influence and put forward strong arguments to convince the decision makers that this is something they need to resource versus other priorities that they may be working on.
Roadmap		
	Steps and actions needed	Develop the Intel PoC for the Clanton Silicon Design Group, demo to Labs, IIR and Clanton and subsequently review further funding steps
	Actions taken	2011-present: We have built strong relationships with the key stakeholders for this work in the Intel ITeD, Intel EC and Intel Clanton design teams. H1 2013: We met with Intel Shannon and Intel Clanton design teams to discuss their requirements. Intel Clanton engagement is very frequent as they are also based in Leixlip. H2 2013: We have copied the Clanton Design environment to a secured data centre in the US. H2 2014: We have reached agreement with the QSD team on a PoC, which will run till end of 2014. The Clanton TIMBUS PoC will develop a solution based on the use cases developed from this backup.
	Current status	The PoC consultation took 3 weeks, this revealed that currently TIMBUS tools were not suited due to the reliance on Windows and Debian Operating systems where Clanton use the SLES. The current tools code was reviewed and the testbed for the new TIMBUS tool and the TIMBUS tool itself started

		development. Development will continue to Dec 31st 2014 before final review, documentation and demo of the PoC will take place.
	Timeline	M36: work package 6 Prototypes ready to be run against Intel IoT scenario (detailed in D6.6). M36-38: Clanton Design Environment up and running in US. Currently it is copied over but not running as we need assistance from Clanton to do this. M39-40: TIMBUS tools to be run against Clanton Design Environment in US. M41-42: Testing, customer feedback. Generate requirements list for further enhancements and bug fixing. M43-45 (and beyond): PoC successful; seek management approval in IT EC for a global service.

9.3.6 Intel Exploitation Initiative #2: Support of Intel Archive Rescue Project

Very early in the TIMBUS project, the research team based in Leixlip, Ireland began identifying internal stakeholders in our work. Chief among these has been Intel IT's Information Security business group, represented by Phil Mondor and David Parker and supported by Intel IT's Engineering Compute division, primarily represented by Theresa Hill. Phil's team own Intel's microprocessor archive containing data on products dating back to 1971. David Parker had been managing a project to recover this data and make it more easily accessible. Between them, their work represents one of the most complex archive rescue projects ever undertaken by any organisation in the World. Theresa Hill's group own the Global Archival service for Intel microprocessor design teams. This section of the deliverable will detail the work that Phil and his team have done in the third year of the TIMBUS project as well as how it aligns, and is supported by, the work of the TIMBUS research project.

It should be highlighted that the launch of the Quark microprocessor upon which the Intel® Galileo™ and Intel® Edison™ are based has its origins in the Intel Archive Rescue project. The project, as shown below by the media coverage in Figure , was based on IP re-use. The rescue of the old IP from the Intel archives was actually carried out by Phil Mondor. This information is now in the public domain as also showed by the media coverage in Figure .

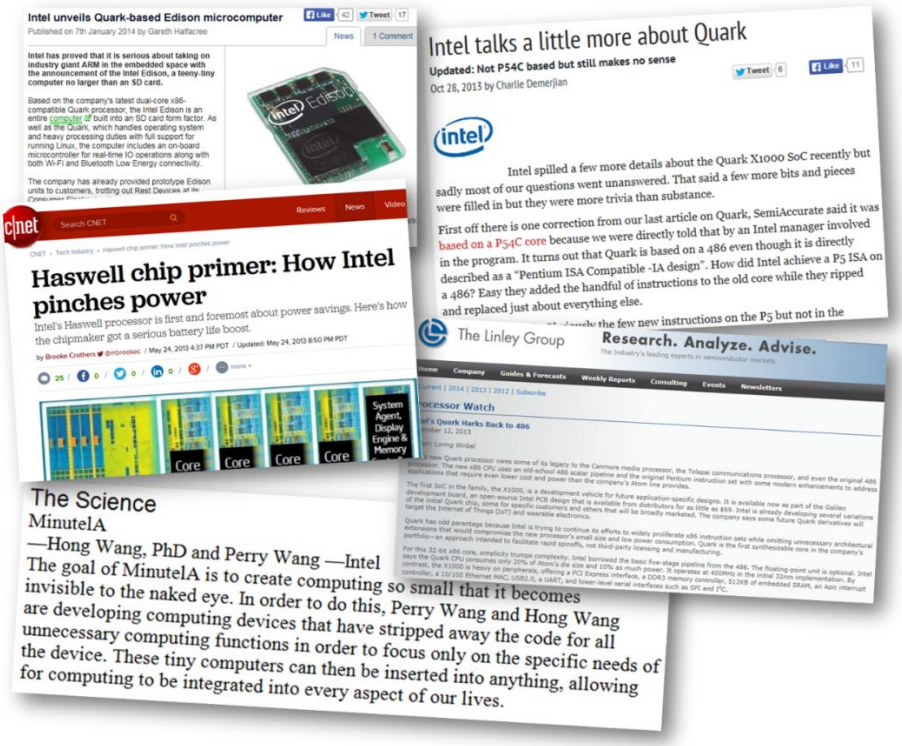


Figure 51: Media Coverage of Quark owing its origin to IP Reuse

Figure 52 shows images from Phil Mondor's visit to Iron Mountain in Feb 2014. Iron Mountain is a storage and information management company, assisting more than 156,000 organisations with storing, protecting and managing their information. Intel has been working with them to carry out the rescue of data from the Intel archives which date back to 1971. These images also show that ovens are used as part of the process to bake some of the tapes to increase the chances of being able to get data off them. This project is a major undertaking and has been described by Iron Mountain, who is one of the world's leading archival specialists, as the most complex project they have ever undertaken with a client.

Figure 52: Phil Mondor visit to Iron Mountain (Hollywood, C.A., USA)

Table 15, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 15: Intel Exploitation Initiative #2: Support of Intel Archive Rescue Project

Exploitation Initiative #2	Support of Intel Archive Rescue Project
Partnerships	Intel and the TIMBUS consortium
Audience(s)	Intel IT InfoSec (Phil Mondor), Intel IT Engineering Computing EC (Teresa Hill)
Exploitation Goal(s)	The goal is to help the Intel Archive Rescue project to be successful in any way we can. This can be broken down in to some sub-goals as follows: 1. Support the Archive Rescue Project politically in Intel. 2. Support the Archive Rescue Project technically in Intel. 3. Create a lasting relationship between Intel Labs Europe and the Intel IT InfoSec and Intel IT business groups
Expected Exploitation Benefit(s)	Exploitation benefits map to the 3 goals in the row above: 1. The Archive Rescue Project, like any other archival project faces still internal competition for financial and people resourcing to keep it alive. The Intel Labs Europe team can support this work politically in Intel by joining forces and sharing our learnings from TIMBUS and assisting in presentations and meetings internally by performing joint proposals, purporting new and strong use cases and supporting the direction that the Archive Rescue Project work is taking. 2. Seek out technology transfer opportunities for the TIMBUS research to be used in the Archive Rescue project. Review and offer advice on the technical solution being used in the Archive Rescue project. This has been a bi-directional process with Intel IT InfoSec and Intel IT Engineering Computing teams providing plenty of insight into the software and hardware issues surrounding the recovery of data from tapes dating back to 1971 and Intel Labs Europe providing our opinion on alternative technical solutions to architecting the infrastructure upon which the Archive Rescue project could be run on. 3. Collaboration is possible on short and longer-term goals. This has so far taken the form of: a. connections between the Archive Rescue team and other research projects (such as amePLM) b. Connections to industry bodies such as SNIA (Storage Network Industry Architecture group), Fugi, EMC, Iron Mountain, etc. These are also 2-way with Intel IT InfoSec & Intel IT Engineering Computing also facilitating these meetings in the reverse direction to help inform the Intel Labs Europe research. c. Connections to other internal Intel archival initiatives. These are also bi-directional with Intel IT InfoSec introducing us to the Intel Strategic Alliance Group and Intel Labs Europe acting

	a as a link between Intel IT InfoSec and the Intel IT Archive team. d. Detailed reviews of TIMBUS work including the legal & risk management aspects which is of particular interest to the Archive Rescue project.
How to measure the Benefit	The benefits can be assessed in this manner: 1. The removal of resource and financial roadblocks so that the Archive Rescue project does not fail due to a political reason. 2. Technical assistance and advice so that the Archive Rescue project does not fail due to a technical reason. 3. Track the number of collaborations and meetings which has taken place where one of the three parties (Intel IT InfoSec, Intel IT EC or Intel Labs Europe) has facilitated a meeting between the other parties and some internal or external business group or entity. This is done in *Appendix B: Intel meetings in TIMBUS year 4*.
Exploitation Resources	The people resourcing required for this is reasonably light and has been able to be met on all three sides through regular meetings and normal business operations. No special allocation of effort on top of what is already there is necessary. Roughly, the effort on the part of the three business groups involved is in the region of 5% of the time of 1 full time person from each group.
Dependencies	Technical: • Credible demonstrators, particularly for the legal and iERM tools help us greatly with these collaborations. • The technical architecture work performed in TIMBUS deliverable D5.3 and continued by the efforts in task T6.7 and by the Intel IT Archive Project team help with feeding in to the roadmap for the technical infrastructure • The ability to re-deploy an environment is very interesting to the IT InfoSec and IT Engineering Computing groups in Intel. They are assisting in building the PoC for this, but we are dependent on support from Intel design teams to make that happen. Non-Technical: Face-to-face funding to allow for detailed collaboration sessions is desirable. This has been difficult in practice with the long distance connections, splits in cost codes for expenses and temporal budget pressures which come and go at different times for the different business groups involved. Up to now, we have always found mechanisms to allow a number of these to take place (only 3 in 3 years; we would like this to be higher). Political support from management has been forthcoming. We need this to continue. Recent high-profile IP re-use projects, such as the one that the Intel® Galileo® is based on have been crucial in just about keeping the Archive Rescue project alive by ensuring that resources, funding and management support has remained in place in the face of stiff competition from other

		internal projects.
Roadmap		
	Steps and actions needed	1. Continue to meet frequently to discuss the objectives of the three groups and how they can help each other to keep their projects alive and to reach their respective goals. 2. Regular technical reviews of each other work. 3. Continue to track meetings and progress towards objectives.
	Actions taken	2011-present: We have built strong relationships with Intel IT InfoSec and Intel IT Engineering computing. Phil Mondor has travelled to Ireland twice and attended the TIMBUS year 1 and year 2 reviews. Mike Nolan and Rodger Mooney have travelled to Folsom and Santa Clara to meet the Intel IT InfoSec and Intel IT Engineering computing management and stakeholder teams. H2 2013: We have jointly supported each other's work. Intel IT InfoSec and Intel IT Engineering Computing (EC) have helped develop strategies to strengthen the tech transfer opportunities for TIMBUS. TIMBUS has strengthened the case being made to keep the Archive Rescue project alive and shown management the potential of a true TIMBUS-like archive. H2 2014: The TIMBUS team continued working closely with Intel IT InfoSec and IT EC, holding frequent meetings and sharing ideas and learnings.
	Current status	This work is still ongoing. We are currently working together on sharing learnings from the Iron Mountain visit where the Archive Rescue work is being carried out as well as developing the argument for dedicated resources in our stakeholder teams for a proof of concept (PoC).
	Timeline	Milestones and plan is as follows: M36: Document learnings from the Iron Mountain visit. Mike and Phil working on this. The nature of these is confidential, but some of the content should be sharable at the year 3 review. M36: Monthly Status update M36: Quarterly Sync between Intel Labs Europe, Intel IT InfoSec, Intel IT Engineering Computing, Intel IT Archival Project. M37-38: Finalisation of slide deck for stakeholder resources for the PoC M37: Monthly Status update M38: Monthly Status update M38-M40: Identification of stakeholder resources for PoC. M39: Quarterly Sync between Intel Labs Europe, Intel IT InfoSec, Intel IT Engineering Computing, Intel IT Archival Project. M39: Monthly Status update M40: Monthly Status update M41: Monthly Status update

		M42: Monthly Status update M42: Quarterly Sync between Intel Labs Europe, Intel IT InfoSec, Intel IT Engineering Computing, Intel IT Archival Project. M43: Monthly Status update M44: Monthly Status update M45: Monthly Status update M45: Quarterly Sync between Intel Labs Europe, Intel IT InfoSec, Intel IT Engineering Computing, Intel IT Archival Project.

9.3.7 Intel Exploitation Initiative #3: Technology Transfer to Intel IT Archival Project Team

Rodger Mooney from Intel IT joined the TIMBUS project January of 2013 as part of a DOT assignment. While on the project, Rodger used his considerable hands on technical experience from the eBaR (enterprise Backup and Recovery) world to contribute to all aspects of Intel's work on TIMBUS, but in particular, to deliverable D5.3. In September of 2013, Rodger's work on TIMBUS was recognised when he interviewed for a permanent position in Intel IT Enterprise Storage team. This role would normally have been filled by an existing employee in one of Intel's US sites, but Rodger's technical background, and in particular his 9 months of research work on the TIMBUS project marked him out as the top candidate in the interview process. Rodger joined the Intel IT Enterprise Storage team and began working on a project lead up by Gary Dunn called the Intel IT Archive Project. The goal of the project is to gather requirements for the deployment of a global archival service within Intel. As part of this process, the team has visited Ireland twice, once in December of 2013 and again in February of 2014. On both occasions, the TIMBUS team helped to host the face-to-face meeting.

The initial face-to-face meeting was a kick-off meeting in which TIMBUS was presented to the team and, with Rodgers support and assistance, TIMBUS has created a fundamental shift in how Gary and his colleagues are now approaching their work. Their process necessarily involves rounds of meetings with external vendors to assess the commercial offerings available as well as generating their own internal requirements. Unfortunately, the details of many of those meetings are confidential as it would include rankings of vendor offerings and publication of internal requirements and designs which Intel is not at liberty to share. However, this does not limit the degree to which the Intel IT Archival Project team and Intel Labs Europe have been able to work together internally and in fact very useful dialogue has been ongoing with valuable benefits in both directions. We can share that the team's remit includes external commercial offerings as well as developing part or even all of the solution in-house. This is very important as that significantly increases the opportunities for collaboration and technology transfer from the TIMBUS project to the Intel IT Archival Project teams work. The sharable aspects of the meetings in which Intel Labs Europe was involved with the Intel IT Archival Project team are also listed in *Appendix B: Intel meetings in TIMBUS year 4*.

At a high level though, the engagement's primary goal would be to affect a technology transfer. In this regard, the work has already been successful as Rodger has continued the development of the reference architecture from TIMBUS. This has been greatly influential in the teams approach. The team have also developed a roadmap which has TIMBUS collaboration on it throughout 2014. The other aspects of the roadmap relate to the desired features that the team would like to see in the solution and when they think these may be implemented so its details are confidential at this time, but it contains the typical aspects you would expect to see in any roadmap, but also the TIMBUS influence can be seen. These aspects include but are not limited to:

- Use case identification, analysis and PoC's
- Policy management, data purging, autodelete
- Data placement, Auto Archiving / Auto tiering
- Offline archival, tape consolidation
- Object storage cost benefit analysis and potential implementation
- Hardware abstraction, metadata capture, index and search
- Legacy environment exhumation

During the last six months of the TIMBUS project, we've resumed our engagement with Rodger, keeping him up-to-date on the progress made with our tools and the TIMBUS project in general. We've also been able to give them some updates on the Clanton POC and share our learnings. This information sharing has been very valuable for Rodger and the Intel IT Archival Project Team. We've also have been able to receive very valuable information, as they shared their experience and challenges they are facing.

Table 16, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 16: Intel Exploitation Initiative #3: Technology Transfer to Intel IT Archival Project Team

Exploitation Initiative #3	Technology Transfer to Intel IT Archival Project Team
Audience(s)	Intel IT Archival Project Team (led by Gary Dunn, of which Rodger Mooney is a member)
Exploitation Goal(s)	Help the Intel IT Archival Project team to be successful in their objectives. More specifically: 1. Perform a technology transfer to the team 2. Inform the Intel IT Archival Project roadmap 3. Help the team to reach their goal of deploying a technical solution in the next 18 months (Jan 2014 - Jun 2015)
Expected Exploitation Benefit(s)	The benefits here align to the items listed in the previous box above: 1. The Intel IT Archival Project roadmap contains some/all of the differentiating elements of the TIMBUS research (iERM, metadata capture, BP re-deployment, legal assessment of digital artefacts). 2. Tech transfer: a. Accelerate Intel IT's Archive Project team deployment schedule. b. The deployed solution incorporates TIMBUS technology concepts/code 3. The Intel IT Archival Project team successfully deploys a solution in the next 18 months (Jan 2014 - Jun 2015)
How to measure the Benefit	The measurements below are based on the three items listed in the previous boxes:

	1. We have seen from the EAB and our interactions with industry partners that raising the awareness of the challenges of long-term archival is an important objective if the issues are to be successfully resolved. We can report out on what features of the TIMBUS research get added to the roadmap as a means of relating how successful we have been at highlighting these and transferring the concepts to an implementation roadmap. 2. Tech Transfer: a. A technical assessment will be carried out with the Intel IT Archival team to quantify the impact to their schedule as a result of this collaboration. b. The deployed solution will either contain TIMBUS technology and code, or it will not. If it does not, we will report on if this is still planned or not in point 2 below. 3. We will report out the status of the Intel IT Archival Project in the M45 deliverables. Regardless of the implementation status, we expect to be in a position to more confidently predict if the June 2015 goal will be met.
Exploitation Resources	The Intel IT Archival team has five people working on this as their primary project (60%+ of their time) and they have support from Intel IT finance to the degree of 20% of one resource's time. The TIMBUS team has had to reduce its support, as the TIMBUS project comes to an end to finalise its work our work package 2 and 6 and the Clanton POC.
Dependencies	Technical: An integrated work package 6 toolset capable of performing end-to-end preservation of a BP is absolutely required. Optional, but desirable, at this point is the ability to re-deploy an environment. Learnings needed from a successful test run against the Intel IoT scenario detailed in deliverable D6.6. This work is dependent on integration of the work package 6 tools and feedback from these tools being run against the TIMBUS use cases. It is expected that work will yield many learnings and improvements to the system. Non-Technical: The effort relies on continued support from Intel IT management. Strong use cases need to be found in the traditional IT customer base to help this effort. This customer base is different to the Intel IT Engineering Compute one which does have strong use cases.
Roadmap	
Steps and actions	Continue the engagements already underway and clarify which technical and conceptual TIMBUS components will be part of the Intel IT Archival project

	needed	team's work. Work with the Intel IT Archival Project team to implement these.
	Actions taken	H2 2012: Rodger Mooney joins the TIMBUS project on a DOT assignment working primarily on D5.3. Feb 2013: Mike and Rodger visit Intel IT sites in Folsom, CA and Santa Clara, CA United States; They link up with IT colleagues on the Storage and Enterprise Backup and Archival teams. March 2013: Rodger completes D5.3 and presents the work at the TIMBUS year 2 reviews in Belfast in May of 2013. August-September 2013: Rodger applies for, and is successful in gaining a position in the Intel IT Enterprise Backup and Recovery team working on a project to implement an IT Archival solution. Q4 2013: Mike and Rodger work with Perumal to understand how to best exploit the TIMBUS research Q4 2013: Intel IT Archival Project Team face-to-face meeting takes place in Intel Ireland's campus in Leixlip. Intel Labs Europe co-host the week-long meeting. Jan 2014: Initial requirements are drafted. This is confidential to Intel but include an infrastructure architecture which is an evolution of the work in TIMBUS deliverable D5.3. Feb 2014: A second week-long Intel IT Archival Project Team meeting takes place in Intel Ireland's campus in Leixlip. Intel Labs Europe co-hosts again. Feb 2014: Review of commercial offerings from vendors. Refined requirements draft completed. Both of these are confidential. H2 2014: Information sharing + updates on TIMBUS and exchange of learnings with Clanton POC
	Current status	A high level roadmap has been produced which includes a TIMBUS partnership and many of the TIMBUS concepts. Refinement of this underway. Areas of collaboration have been identified and are continuing to be worked. These areas include the infrastructure architecture, metadata generation and capture, the building of a testbed for an Intel IT Archival Project proof-of-concept and Intel's work package 6 API's for insertion and management of artefacts in an object based storage implementation.
	Timeline	The exact timelines here are estimated and are under constant review. M36-M40: complete current planning phase. We are expecting to get to the next level of detail in the roadmap and technical implementation plans. M36-M42: Identification of use cases and stakeholders. M36-M42: Stakeholder interviews and requirements gathering. M40-M42: Internal approvals and reviews of latest plans. Likely that these will be strongly scrutinised to determine if they are meeting the requirements and also we expect business decisions at each point to continue the mandate which the Intel IT Archival Project team has. These decisions are not a

		foregone conclusion; Long-term archival projects have been previously tried in Intel and have not progressed to the implementation stage. M42-M44: Budget approvals, if the plans are approved. M42-M44: Hardware procurement, if the plans are approved. M43-M45 onwards: If the plans are approved, we expect a small scale proof-of-concept to be attempted with some identified use cases. The exact timelines and duration of this is to be confirmed. Jan-Jun 2015: Proceed to larger scale deployment with learning made from PoC. Planning will continue throughout 2014 for this.

9.3.8 Intel Exploitation Initiative #4: Influence Intel SIMICS product team

Influencing a product is a very difficult undertaking in any organisations. Product teams will have their own vision for development and limited resources with which to pursue the direction they want to go in. It is very challenging to approach product teams with what seems like a good idea in research and present it in a convincing and compelling way when the product developers are already turning down things that they know will add value and they would like to do but can't due to competing priorities and available resources. It therefore takes time, persistence and skill to convince a product team over time that a research idea actually has a big market and is something that is essential (as opposed to 'nice to have') for them to pursue.

In TIMBUS year 2, Michael Nolan and Finian Rogers met with the following individuals from one of Intel's acquisitions, WindRiver to discuss an Intel emulation product called SIMICS (http://www.windriver.com/products/simics):

- 27th March 2012: Bengt Werner (lead product architect for SIMICS), Yair Lifshitz (ZSIM expert). ZSIM is a binary translator and can perform x86 instruction simulation. It is now built into SIMICs. From this meeting we identified that performing full system emulation, a capability available within SIMICS, was a better pursuit than ZSIM which can only emulate the processor.
- 20th Aug 2012: Stephane Leclercq, head of marketing for WindRiver SIMICS. He informed us that using SIMICS for legacy system emulation was something they were aware of and put us in contact with Guillaume Girard who is another one of the SIMICS product architects.
- On Feb 11th 2013 we met with Guillaume. SIMICS already supports legacy operating systems across the last 30 years through a fairly minimal set of emulated hardware which is included in the software today. However, selling SIMICS as a solution for legacy systems is not where they see the product direction going. SIMICS is a specialist piece of software aimed at a niche, high end market of hardware device designers who want to write code for their new devices and test them prior to the hardware being available to them. However, Guillaume suggested our next step should be to contact Michael Genard who is the VP of tool development at WindRiver to discuss this.

In January 2014, Phil Mondor attended a 2-day SIMICS training class where he met with the SIMICS support team, including some of their developers. Phil took the opportunity to discuss the TIMBUS project with them and our proposed usage model. Although these engineers might not decision makers on the SIMICS roadmap today, Phil made some new contacts for us and we plan to have a follow-up meeting to build more links with the team and grow influence with them toward perhaps marketing SIMICS to the long-term preservation community.

This initiative remains on our exploitation plan, but very little work was done on it over the last 9 months. Due to its low chances of success within the lifetime of the TIMBUS project, lower priority was given to it and we concentrated on other initiatives.

Table 17 below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative. These have not changed since the Year 3 review.

Table 17: Intel Exploitation Initiative #4: Influence Intel SIMICS product team

Exploitation Initiative #4	Influence Intel SIMICS product team
Partnerships	Intel ITeD (Phil Mondor)
Audience(s)	Intel's SIMICS development team (part of WindRiver which was an Intel acquisition and now is part of Intel SSG – software and services group).
Exploitation Goal(s)	Our goals are: 1. Grow new, stronger links between Intel Labs Europe and Intel SSG (WindRiver) 2. Raise awareness of long-term digital preservation challenges in the Intel SSG group (specifically within the WindRiver teams working on SIMICS). 3. Influence the Intel SIMICS product roadmap a. Potentially launch a new SIMICS-like product aimed at the DP market. b. Re-market the existing SIMICS product at the DP market under an alternate licence model which could potentially contain an ESCROW agreement.
Expected Exploitation Benefit(s)	The benefits below relate to the items above: 1. Increased influence for Intel Labs Europe in the larger Intel Corporate network. SSG are a primary exploitation target for all Intel Labs Europe research, not just the TIMBUS project. 2. By keeping the digital preservation topic on the agenda we are keeping the possibility of a successful outcome with this exploitation initiative. 3. Roadmap benefits: a. Increased revenue for Intel due to a new product in the market. b. Increased revenue for Intel due to marketing SIMICS to a new set of target consumers.
How to measure the Benefit	The measurement of the benefits is being done as follows: 1. The number of meetings and contacts that Intel Labs Europe has with SSG/WindRiver is tracked and reported out on in the exploitation deliverables, along with our other meetings, as shown in *Appendix B:*

	Intel meetings in TIMBUS year 4 2. We can keep the digital preservation topic on the agenda by taking every opportunity to meet different members, at different levels within the SIMICS team. 3. The benefit here is dependent on a product being launched or an existing product being re-marketed to a new set of consumers a. If a new product is launched, we can ask for revenue figures from sales or finance. These are likely to be confidential but we won't know that until we ask. b. If the existing product is re-marketed, we can also ask for revenue figures from sales or finance to quantify if the new market has significantly grown the revenue for the existing product. Again, these are likely to be confidential but we won't know that until we ask.
Exploitation Resources	Minimal resources (a few hours a month) are all that is required for this effort given the response we have had so far and the likelihood of success. We have sufficient resources to meet that requirement. If the outlook changes and more significant resources are required, we might struggle to find them and maintain all our other exploitation objectives, but in this event, we will discuss it with management and we would be confident sufficient resources would be assigned to make it successful because exploiting research in the labs is a top priority for our organisation.
Dependencies	Technical: There are no technical dependencies on any of the work in TIMBUS as this is an effort to steer an existing Intel product toward a new market opportunity. Non-Technical: All of the dependencies for this exploitation initiative are non-technical. They include: 1. Successfully influencing the correct tiers of product management within the SSG/WindRiver team. 2. Roadmap decisions being made in favour of the suggested ideas within the SSG/WindRiver team. We can only aspire to put the topic up for decision and influence them so that they give consideration to the idea.
Roadmap	
Steps and actions needed	Continue to meet with and influence this business group at every opportunity.
Actions taken	2011-present: Multiple meetings and engagements with the Intel SSG/WindRiver SIMICS team at various tiers of their organisation Jan 2014: Phil Mondor attended a 2-day SIMICS training event in the US and took the opportunity to speak with the product support and development

		teams.
	Current status	This initiative remains on our exploitation plan but its low chances of success within the lifetime of the TIMBUS project mean that it is lower on our priority list and subsequently fewer resources are being put in to it. However, should that outlook change, we will change that position.
	Timeline	M36-M37: Meet with Phil Mondor training day contacts M39-M45: With the TIMBUS demonstrators in place, circle back with all prior SIMICS contacts before the end of the TIMBUS project as another attempt to influence them. If their position has shifted, we will put more resources into this effort.

9.3.9 Intel Exploitation Initiative #5: Mergers & Acquisitions Scenario

During the visit to Folsom in Feb 2013 Mike, Phil and Rodger met with David Williams from Intel's Mergers and Acquisitions group. David's work reinforced the value of a new use case scenario which Phil Mondor had developed. Namely this is around technology and IP transfer at the time of (1) acquisition and (2) divestiture. The outline of the scenario is that during these processes, a TIMBUS-like solution would be very valuable to provide assurance that the knowledge being acquired or sold at the point of transfer is accessible into the future. Both parties involved in the transfer could sign off on the content with the assurance that the content of the transfer is tangible and accessible. David was impressed with the concepts in the TIMBUS project and subsequently gave an outline of TIMBUS to his manager, Teresa Zawalski who heads up Intel M&A globally.

During their visit to Santa Clara in August 2014 to attend the IL Open House, Perumal Kuppuudaiyar and Phil Mondor met with Dave Williams to give him an update on the progress made on the TIMBUS project. David, once again, expressed his interest in utilizing TIMBUS for M&A activities. David noted the given updates in a view to share them with his team.

On November 28th 2014, Mike Nolan and Didier da Costa met with Lisa Raftery at the Intel site in Leixlip, Ireland. Lisa also works for the Intel's Mergers and Acquisitions group; David and Lisa are actually peers. During our meeting, we gave a short introduction on the TIMBUS project. Lisa, as David did before, expressed her interest in this project. We discussed about what we were doing internally and informed her about the Clanton POC we were running. She said that she would be very interested in finding out what the outcome of this POC would be, in a view to possibly doing a POC with M&A. In fact, she would like to know how such a process could be adopted on a newly acquired company (external) to see how it goes compared to an Intel Org like Clanton. We agreed with Lisa that we would keep the M&A team appraised on the development on the Clanton POC and will setup a follow-up meeting with her in January 2015. Lisa, in turn, will invite us to give presentation to her staff with the view of potentially running a POC with M&A. Table 18, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 18: Intel Exploitation Initiative #5: Mergers & Acquisitions Scenario

Exploitation Initiative #5	Mergers & Acquisitions Scenario
Partnerships	Intel ITeD (Phil Mondor)
Audience(s)	Intel Mergers & Acquisitions Group (David R Williams and Lisa Raftery)

Exploitation Goal(s)	The goals are to 1. Develop a TIMBUS-based LTR capability targeted at preserving the business processes, in particular the intellectual property assets of acquired companies. 2. Develop a TIMBUS-based LTR capability targeted at preserving the business processes, and intellectual property assets of any divestitures that Intel may undertake. 3. Persuade M&A group to run POC on newly acquired company
Expected Exploitation Benefit(s)	Our target audience has said the benefit would be several-fold: 1. Legal assurance that the assets being paid for as part of a merger or divestiture exist and are easily accessible to the party acquiring them. 2. Financial benefits a. Increased ability to sell existing IP in a readily consumable format. b. Potential to exhume an acquired capability years after it is no longer being offered to the market in order to satisfy the demand from a large enough customer(s) who wants the product/service. 3. Reputational benefit: a. Regarding divestures, the purchasing entity would have an increased sense of assurance and confidence in buying IP assets from Intel not readily available from other potential acquisitions that it could have pursued. b. Regarding the ability to exhume an acquired capability years later, any customer taking up on such a service would have an enhanced opinion of doing business with Intel.
How to measure the Benefit	The benefits could be assessed in the following manner: 1. Interviews with legal, financial and technical stakeholders which are involved in the merger or divestiture of intellectual property assets. 2. Financial benefits (any actual figures would be confidential to Intel, but we will ask if the initiative is successful): a. There should be a measurable increase in revenue from this part of Intel's business. We would have to rely on the stakeholders involved to tell us if the TIMBUS-like capability was heavily influential or if it was a 'nice-to-have' during negotiations. b. The revenue from this effort would have to be significant for Intel to consider doing it and in such a case, we could measure the revenue increase. 3. Reputational benefit is hard to measure in financial terms but we would do this based on stakeholder interviews: a. Regarding divestures: by asking the involved individuals in

		Intel how significant the TIMBUS-like capability was in effecting the sale of intellectual property assets. b. Regarding exhumed capabilities, we would again rely on stakeholder interviews with the Intel employees involved as to how significant the TIMBUS-lime ability was in influencing the decision by the 3rd party to buy the service/product.
Exploitation Resources		Minimal resources (a few hours a quarter) are all that is required for this effort given that the likelihood of success is currently low. We have sufficient resources to meet that requirement. If the outlook changes and more significant resources are required, we might struggle to find them and maintain all our other exploitation objectives, but in this event, we will discuss it with management and we would be confident sufficient resources would be assigned to make it successful because exploiting research in the labs is a top priority for our organisation.
Dependencies		Technical: An integrated work package 6 toolset capable of performing end-to-end preservation of a BP is absolutely required. The ability to re-deploy an environment is absolutely required. Learnings needed from a successful test run against the Intel IoT scenario detailed in deliverable D6.6. This work is dependent on integration of the work package 6 tools and feedback from these tools being run against the TIMBUS use cases. It is expected that work will yield many learnings and improvements to the system. A strong demonstrator is required to convince our target audience that the solution is technically feasible. Non-Technical: That we can successfully convince the appropriate layers of management in Intel's M&A (Mergers and Acquisitions) division to adopt a TIMBUS-like capability. That Intel Labs Europe will be able to find sufficient resources in such a case.
Roadmap		
	Steps and actions needed	We need to demonstrate the capability and ask that M&A consider a decision to progress the PoC further with a view to using it in a real acquisition or divesture undertaking in the future.
	Actions taken	Feb 2013: Mike, Rodger and Phil met with David R Williams of Intel's M&A division in Folsom, CA, USA. Q1 2014: Mike drafted the current plan which is dependent on successful TIMBUS demonstrators. Aug 2014: Perumal and Phil met with David R Williams of Intel's M&A division in Folsom, CA, USA at the IL Open House in Santa Clara, CA, USA and provide updated on TIMBUS

		Nov 2014: Mike and Didier met with Lisa Raftery of Intel's M&A division in Leixlip, Ireland to raise further awareness about TIMBUS in M&A division
	Current status	Provided updates about TIMBUS to M&A and discussed about possibility of POC with M&A division, depending on success of Clanton POC.
	Timeline	M40: Assuming we have a strong demonstrator, meet with David R. Williams from Intel's M&A division M40: If they like the demonstrator and are open to a PoC, gather any additional requirements for inclusion in Intel's work package 6 work and potentially in other parts of work package 6. M41-M43: Implementation and testing of features. M44-M45: Small-scale PoC targeted toward supporting an M&A scenario. Q1 2015: Present the results of the TIMBUS project and provide update on Clanton POC to M&A staff with view to start POC; possibility aligning with IT. Q1 2015: Management decision on both sides to continue to support the engagement. Q2 2015: Feedback from the small-scale PoC. Next steps and planning.

9.3.10 Intel Exploitation Initiative #6: Pursuit of new Business Partnerships

Pursuit of new business partnerships is an important part of Intel Labs Europe's work. Just as is the case with the TIMBUS academic and SME partners, creating new business partnerships is an important aspect of Intel's work and Intel is always seeking to create new business networks and nurture new relationships. Throughout the TIMBUS project lifetime, Intel has taken every opportunity to showcase its research, hosting or participating in dozens of meetings, events or conferences each year. In the last 9 months alone, Intel has had 48 meetings with internal and external stakeholders as detailed in *Appendix B: Intel meetings in TIMBUS year 4* of this deliverable. The purpose of these engagements is to grow the reputation of the Intel Labs Europe brand both internally in Intel and externally outside of Intel, but with a particular focus on EU-based engagements.

One of the highlights of this effort occurred in May 2013 when wired.com published a blog titled *We Need to Act to Prevent a Digital 'Dark Age'* [77]. This blog was reported out on at board level in Intel; that is to the CEO, president, senior VPs and VPs as part of a monthly Intel in the media report.

Table 19, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 19: Intel Exploitation Initiative #6: Pursuit of new Business Partnerships

Exploitation Initiative #6	Pursuit of new Business Partnerships
Audience(s)	Internal and external businesses. The exact names have been detailed in the TIMBUS exploitation deliverables to date, including this one. The specific external audiences alone include, but are not limited to: Siemens, EMC, Fugi, Boeing, UK NDA, Microsoft, Tessella, Petroleum Services Group (PSG), R2 Ltd, Airbus, BAE, Oracle, UK Data Archive, Irish National

		Archives, Royal Irish Academy, University College Dublin, Dublin City University, Stanford University, Iron Mountain, IBM, FamilySearch.org, Digital Repository Of Ireland, RTE (Irish national television and radio broadcaster), National University Ireland Maynooth, Russell Library Maynooth NUI, Irish Centre for Manufacturing Research (ICMR), SNIA (Storage Networking Industry Association), Irish Revenue Service, IVI (Innovation Value Institute), Dublin City Council, Wired.com and the list goes on.
Exploitation Goal(s)		1. Showcase Intel research to the world 2. Create collaboration opportunities in areas of mutual interest.
Expected Exploitation Benefit(s)		1. Intel is recognised as a leading industry research organisation. In particular, our engagements in FP projects and with SME's and universities across Europe are singled out. This results in Intel Labs Europe not just continuing to survive as a brand but growing. 2. Establish collaborations with internal or external parties outside of the TIMBUS consortium members.
How to measure the Benefit		1. Without such successes, Intel Labs Europe would not exist. Our continued existence, our growth in employees, our ever increasing exploitation benefits and our expanding portfolio of directed and co-funded EU based research is a direct indicator of success in this objective. This objective is one shared by all activities across Europe and TIMBUS plays in to that. 2. We have already had success with this initiative as indicated by earlier items in the Intel exploitation report. We hope to be able to report out on more before the end of the project.
Exploitation Resources		20% of our exploitation effort is assigned to this work.
Dependencies		Technical: If Intel does not have anything interesting to showcase, or anything interesting to say, then we are wasting our own time and that of our audiences. Therefore, tangible and compelling technical output is the primary raw material required to be successful with this initiative.
Roadmap		
	Steps and actions needed	Continue to meet with new contacts for the remainder of the TIMBUS project. Circle back with all our contacts to date before the end of the project to show case our latest results.
	Actions taken	2011-present: We have met with dozens of internal and external parties.
	Current status	This work is ongoing. We are planning for M38 onwards to circle back with all our contacts to showcase our demonstrators and investigate the possibility of collaboration on this or other areas of mutual interest.
	Timeline	M38: Prototypes are showcased at the TIMBUS year 3 review. M36-M39 onwards: scheduling of meetings with identified audiences. M38-M45 onwards: meeting with all these identified audiences.

		M45: Gather inputs, feedback and thoughts from these engagements and report out on current status at the end of the TIMBUS project.

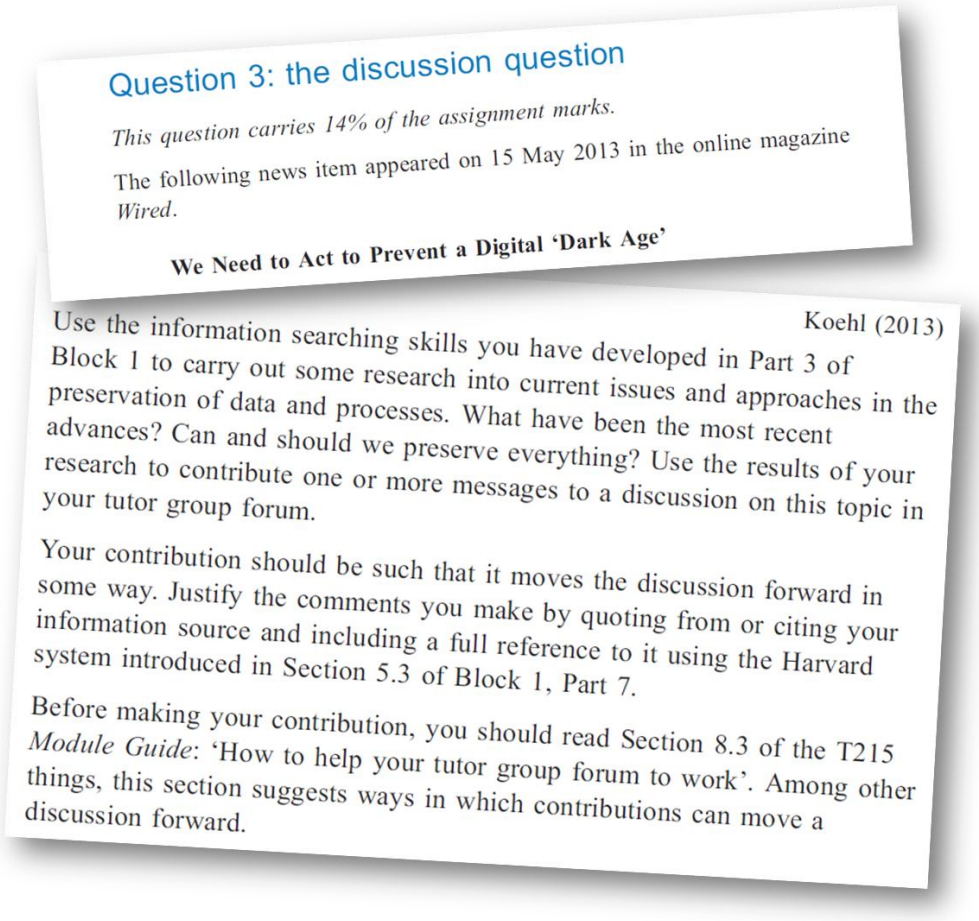
9.3.11 Intel Exploitation Initiative #7: Contribution to Educational Communities

University College Dublin GWAP Assignment

Between September and December 2012 Michael Nolan was undertaking a college project called *Genii* to aid in the digitising of historical records (specifically Irish census records from 1901-1911) that are of public interest. The idea came from a series of TIMBUS meetings between Intel and the Irish National Archives in October 2012 which merged with an MSc course about gamification (solving problems which computers alone cannot easily do). The result was a Tetris-like game which was implemented in python and can be seen on YouTube[78]. The work also provided opportunities to bring knowledge of the TIMBUS project to UCD (Professor Barry Smith), FamilySearch.org (Jason Pierson, senior product manager), Alon Strasman (CIO, national library of Israel), Royal Irish Academy (Bernadette Cunningham) and Paul Hoary (Russell Library, NUIM, working on the preservation of the Morpeth role[79], Paul and the NUIM work on the role was broadcast on RTE national news[34]).

Open University: Computing and IT Course

In November 2013, as a result of the Wired.com article[77], the Open University added an assignment for students on its BSc in Computing and IT course (course code: B62). The particular module was T215 (Communication and information technologies). This was brought to Michael Nolan's attention by one of the course students, Barry Cassells who works in Intel and recognised Michael's name. The specific question posed to the students is shown below in Figure 53 and students were required to participate in an internally hosted blog where they would debate the current issues, investigate approaches being used and make arguments for, or against, these. The assignment required students to research an area of computer science which they were unlikely to have a lot of prior knowledge. For us in TIMBUS, it brought the topic to a new audience and as we have consistently argued, bringing the issues of digital preservation into the mainstream is one of the best ways we can ensure that resources are channelled toward addressing the problems.



Question 3: the discussion question

This question carries 14% of the assignment marks.

The following news item appeared on 15 May 2013 in the online magazine *Wired*.

We Need to Act to Prevent a Digital 'Dark Age'

Koehl (2013)

Use the information searching skills you have developed in Part 3 of Block 1 to carry out some research into current issues and approaches in the preservation of data and processes. What have been the most recent advances? Can and should we preserve everything? Use the results of your research to contribute one or more messages to a discussion on this topic in your tutor group forum.

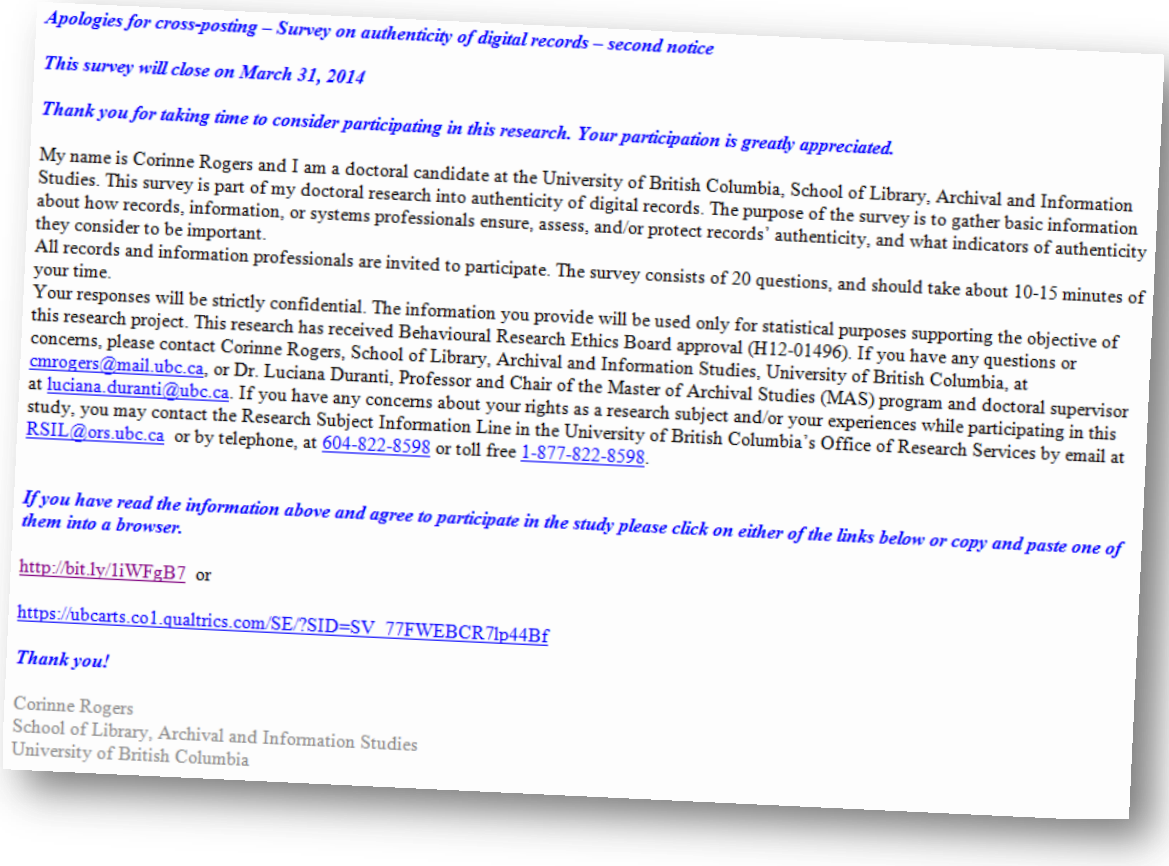
Your contribution should be such that it moves the discussion forward in some way. Justify the comments you make by quoting from or citing your information source and including a full reference to it using the Harvard system introduced in Section 5.3 of Block 1, Part 7.

Before making your contribution, you should read Section 8.3 of the T215 *Module Guide*: 'How to help your tutor group forum to work'. Among other things, this section suggests ways in which contributions can move a discussion forward.

Figure 53: Excerpt from the Open University Course

Survey Contributions:

In March 2014, Corinne Rogers from the School of Library, Archival and Information Studies, University of British Columbia contacted us through the PASIG mailing list to make us aware of a survey, shown below in Figure 54, which she is carrying out relating to the Authenticity of Digital Records. Intel completed the survey and opted to receive the survey results when they are published. This is just one example of how the TIMBUS partners can contribute to related research, become active in the DP community, assist in the pursuit of an academic qualification and in so contributing, we also benefit by getting access to the survey results. Intel carried out a survey itself in the year 1 TIMBUS deliverable and we know from that experience that soliciting such input can be very difficult and that the results are only as good as the number of respondents and their experience so we sincerely hope that Corinne is successful in publishing some interesting findings relating to the authenticity of digital records as part of her PhD research.



Apologies for cross-posting – Survey on authenticity of digital records – second notice

This survey will close on March 31, 2014

Thank you for taking time to consider participating in this research. Your participation is greatly appreciated.

My name is Corinne Rogers and I am a doctoral candidate at the University of British Columbia, School of Library, Archival and Information Studies. This survey is part of my doctoral research into authenticity of digital records. The purpose of the survey is to gather basic information about how records, information, or systems professionals ensure, assess, and/or protect records' authenticity, and what indicators of authenticity they consider to be important.
All records and information professionals are invited to participate. The survey consists of 20 questions, and should take about 10-15 minutes of your time.
Your responses will be strictly confidential. The information you provide will be used only for statistical purposes supporting the objective of this research project. This research has received Behavioural Research Ethics Board approval (H12-01496). If you have any questions or concerns, please contact Corinne Rogers, School of Library, Archival and Information Studies, University of British Columbia, at cmrogers@mail.ubc.ca, or Dr. Luciana Duranti, Professor and Chair of the Master of Archival Studies (MAS) program and doctoral supervisor at luciana.duranti@ubc.ca. If you have any concerns about your rights as a research subject and/or your experiences while participating in this study, you may contact the Research Subject Information Line in the University of British Columbia's Office of Research Services by email at RSIL@ors.ubc.ca or by telephone, at 604-822-8598 or toll free 1-877-822-8598.

If you have read the information above and agree to participate in the study please click on either of the links below or copy and paste one of them into a browser.

http://bit.ly/1iWFgB7 or

https://ubcarts.co1.qualtrics.com/SE/?SID=SV_77FWEBCR7lp44Bf

Thank you!

Corinne Rogers
School of Library, Archival and Information Studies
University of British Columbia

Figure 54: Survey on Authenticity of Digital Records

Table 20, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 20: Intel Exploitation Initiative #7: Contribution to Educational Communities

Exploitation Initiative #7	Contribution to Educational Communities
Partnerships	The other members of the TIMBUS consortium
Audience(s)	Universities (specifically the universities in Ireland, UCD, Trinity, DCU, UL, NUIM, etc). But any university worldwide which we can influence such as the Open University or individual researchers pursing academic qualifications.
Exploitation Goal(s)	Raising awareness of the issue is a key part in ensuring that resources are diverted toward addressing the challenges of long-term preservation. 1. To raise awareness of this issue in universities so that both faculty staff and students gain an appreciation of this often neglected area of computer science. 2. Intel's research credentials and reputation are increased. Graduates have a positive opinion of Intel and of EU-funded research in the event

		that their careers go in either of those directions in the future.
Expected Exploitation Benefit(s)		These are mapped to the two goals above: 1. Increased appreciation of this area of computer science resulting in more focus on it in the organisations where the graduates of such courses start building their careers. 2. Increased numbers of students influenced to follow careers in research, potentially in Intel but equally across the EU in research, SME, academic or industry circles.
How to measure the Benefit		Both of these benefits are long-term and extremely difficult to measure. However, we can attempt to do so by the following: 1. Intel and other partners in the TIMBUS consortium have been very successful in influencing students and university courses. We can conclude that we have been successful in increasing the awareness. 2. Statistics could be sourced (they may already exist) and tracked over a period of years to find out how many university graduates, as a percentage of the total number, end up pursuing careers in research and answer the question on if this trend is increasing. If it is increasing, what are the reasons and do they include the feedback that existing research organisations are providing back into academia.
Exploitation Resources		Minimal resources (much less than 5% of exploitation time) are actively spent on this area by Intel. We therefore don't have a resource issue in continuing to support it for the remainder of the TIMBUS project and beyond.
Dependencies		Technical: If Intel does not have anything interesting to showcase, or anything interesting to say, then we are wasting our own time and that of our audiences. Therefore, tangible and compelling technical output is the primary raw material required to be successful with this initiative. Non-Technical: The resource issues are ultimately subject to management buy-in from other business groups within Intel. We do not control these so have to use our influence and put forward strong arguments to convince the decision makers that this is something they need to resource versus other priorities that they may be working on.
Roadmap		
	Steps and actions needed	Continue to seek out opportunistic chances to contribute to university and educational channels.
	Actions taken	2012: GWAP assignment with UCD and meeting with Russell Library, NUIM. 2013: Open University engagement; a module in one of their courses included a question based on Intel's wired.com article about preventing a digital dark age. 2014: Participated in a research survey as part of a PhD project.

		Sept. 2014: Participated in 12th International PASIG event, engaging and discussing with members about Digital Preservation and providing update on TIMBUS project and more specifically TIMBUS tools… with DPC giving a presentation on TIMBUS Digital Preservation Business Process.
	Current status	The work is ongoing and Intel, and our consortium partners continue to seek out opportunities to contribute to educational channels.
	Timeline	The ad-hoc nature of some of the engagements makes a timeline difficult to plan. Some items will pop up over time, but others can be planned such as circling back round with prior contacts.

9.3.12 Intel Exploitation Initiative #8: Contribution to Open Source Communities

Open Source Approval:

During year 3 of the project, Intel Labs Europe brought the TIMBUS project through Intel's internal open source approval process and we are in a position where code written solely by Intel or in collaboration with the TIMBUS partners can be distributed through opensourceprojects.eu once the code is available for public release.

During year 4 of the TIMBUS project, Intel led the effort to facilitate a partnership with OPF. This resulted in a collaboration between the TIMBUS consortium and OPF. Both are now working closely and are in the process of finalising work plan for sustainability of the TIMBUS Extraction Framework. More details can be found in section 7 (Collaboration with OPF) of this deliverable.

Table 21, below details the planning, partnerships, audience, goals, benefits and timelines for this exploitation initiative.

Table 21: Intel Exploitation Initiative #8: Contribution to Open Source communities

Exploitation Initiative #8	Contribution to Open Source Communities
Partnerships	The other members of the TIMBUS consortium
Audience(s)	Open source communities (specifically the membership of PASIG, the DPC and CMS networks)
Exploitation Goal(s)	1. Provide useful tools to this community which help them address DP issues. 2. Provide tools under a license model which allows for further commercial or non-commercial exploitation of the work.
Expected Exploitation Benefit(s)	These relate to the two previous goals in the row above this one: 1. Relating to providing tools to the community: a. The DP community has tools which tangibly help to address DP issues that they have.

	b. The DP community becomes an advocate of the TIMBUS research, spreading word even further. c. The DP community provides feedback on the TIMBUS tools 2. The DP community, or others, build commercial or open source extensions on top of the TIMBUS tools.
How to measure the Benefit	The goals and benefits can be measured as follows: 1. Relating to the DP community using TIMBUS tools: a. The TIMBUS tools are all released. This is planned and should happen in M36. b. Our dissemination, exploitation and implementation work packages (work package 2, work package 3 and work package 6) should track number of downloads and seek feedback from the community. Gauge the reaction to the tools, is the community spreading the word for us or do we need to push it more actively. c. Gather feedback on the tools through the community via work package 2, 3 or 6. Active engagement with key identified members of the community is a good idea for this. 2. Gather feedback from the community on how they are using the TIMBUS tools. Are they integrating them into other/existing solutions, are they using them as standalone, are they evaluating them or using them in production or are they building other services and features on top of them. Are they planning to release those services and feature extensions and if so, under what type of license model.
Exploitation Resources	Minimal exploitation resourcing has been spent on this to date (< 5%). However, as the tools are released, we anticipate this growing and we will require the assistance of our TIMBUS consortium partners to assist.
Dependencies	Technical: If Intel does not have anything interesting to showcase, or anything interesting to say, then we are wasting our own time and that of our audiences. Therefore, tangible and compelling technical output is the primary raw material required to be successful with this initiative. The quality of the TIMBUS tools developed in work package 6 is probably the most important technical dependency we have. Non-Technical: The resource issues are ultimately subject to buy-in from our TIMBUS partners as well as from the community. We expect to have to make strong arguments to convince community members to even try out the tools. We do not control their decision making processes, so have to use our influence and put forward strong arguments to convince the decision makers that the TIMBUS tools are worth trying out before any further activity is even possible.
Roadmap	

	Steps and actions needed	1. Release the TIMBUS tools 2. More effort needs to be diverted from the TIMBUS consortium partners into dissemination and exploitation for the remainder of the project to work on this initiative. 3. Partnership between work packages 2, 3 and 6 is required. 4. Identification of influential members of the DP community is needed (the DPC can help with this). 5. Meetings with those community members needs to be arranged to showcase the TIMBUS tools, gather feedback and attempt to convince them to try out the tools in their own environments.
	Actions taken	2011-present: work package 6 has been developing the TIMBUS tools. 2013-2014: The TIMBUS consortium and its individual partners have agreed to release the parts of the code that are needed for this under open-source license terms. H2 2014: Collaboration with OPF
	Current status	Release of the work package 6 tools is in progress at present, including the curation of the Extraction Framework and a subset of the accompanying Extractors.
	Timeline	M36: Release the TIMBUS tools M35-M38: More effort needs to be diverted from the TIMBUS consortium partners into dissemination and exploitation for the remainder of the project to work on this initiative. M35-M38: Partnership between work packages 2, 3 and 6 is required. M35-M38: Identification of influential members of the DP community is needed (the DPC can help with this). M39-M45: Meetings with those community members needs to be arranged to showcase the TIMBUS tools, gather feedback and attempt to convince them to try out the tools in their own environments. M39-M45 onwards: Agree on collaboration with OPF and curation of TIMBUS project tools (Extraction Framework and a subset of the accompanying Extractors).

9.4 INESC-ID – Instituto de Engenharia de Sistemas e Computadores - Investigação e Desenvolvimento

9.4.1 INESC-ID Organisational Profile

INESC ID Partner Summary.

INESC-ID is a not for profit, private research institution in the domains of information technology, electronics and telecommunications, with the official status of "utilidade pública" (public interest) recognised by the Portuguese Ministry of Science and Higher Education.

INESC-ID is owned by IST - Instituto Superior Técnico (the engineering school of the Lisbon Technical University) and by INESC- Instituto de Engenharia de Sistemas and Computadores, and integrates more than 60 PhDs and 100 post-graduate students.

INESC-ID is organized into five main groups: computing systems and communication networks, embedded electronic systems, information and decision support systems, interactive intelligent systems, and energy systems. Despite the different competences in each group, all share common objectives:

- To advance the state of art in their fields;
- To support a value generation chain through basic research, applied research and advanced education; and
- To perform technology transfer, namely to provide support for the creation of technology based start-ups.

INESC-ID has strong experience on enterprise architecture and information systems analysis, design and integration, aligned with the state of the art technology and techniques (OMG languages, Zachman's framework, COBIT, ITIL, TOGAF, Archimate, ISO/IEC 42010 - ANSI/IEEE Std 1471, etc.); INESC-ID also has a strong experience in digital libraries, repositories and archives (involving competency and knowledge in TRAC, OAIS, MoReq, etc).

9.4.2 INESC-ID Exploitation Introduction

As a research institute part-owned by a university, INESC-ID exploitation plan focus on two essential pillars: education and research. The former is pursued by having students engaging and participating in our research projects. This collaboration has benefits for both parts since not only it allows students to gather and use knowledge from those projects but also supports the project that acquires valuable feedback from the students. Additionally, it assures the sustainability of the project knowledge through the possibility that students might use the acquired knowledge in their professional career. In the current reporting period, INESC-ID has 2 new MSc students and 4 researchers currently doing a PhD on Information Systems and working/using TIMBUS.

Regarding advancing research, one of our main key performance indicators is publishing papers on international and national research conferences. Also by presenting in high renowned conferences INESC-ID increases its reputation on the specific subjects that are published. In TIMBUS those subjects include mainly digital preservation, risk management and capability engineering. Since the beginning of TIMBUS, INESC-ID has published 24 conference publications which are detailed in the dissemination

deliverable D3.6. In the current reporting period, INESC-ID was able to publish 9 more conference papers and 2 journal articles bringing the total to 33 conference publications and 3 journal articles. On iPRES2014 we were also able to win for the second time consecutively the "Best Paper Award" with the paper entitled "VPlan – Ontology for Collection of Process Verification Data"[80]. The paper describes the verification and validation plan developed in task T4.6 and represents and important achievement on an important output of the last year of the project. The accepted journal articles about risk management were also an important achievement since it allowed us to increase the visibility of the risk assessment tool developed on the project and validates the potential of the approach to other domains and contexts. Additionally, all of the INESC-ID papers were written in collaboration with other TIMBUS partners (e.g. ITM, SQS, SBA, LNEC) strengthening our relation with those organisations.

As reported in the last exploitation deliverable D2.3, TIMBUS allowed INESC-ID to increase its reputation as experts in Information Governance. Consequently, INESC-ID was able to join the consortium of E-ARK[81], a 3-year European research project under the Competitiveness and Innovation Framework Programme (CIP). The primary E-ARK goal is to "create and pilot a pan-European methodology for electronic document archiving, synthesising existing national and international best practices, which will keep records and databases authentic and usable over time". Particularly interesting to TIMBUS is the work on the E-ARK about preservation of records and databases. Due to the fact that preliminary E-ARK results will only appear at the end of TIMBUS it is unlikely that both projects can collaborate. However it might be possible that some of the work on TIMBUS can be adapted and used on E-ARK. At the moment of this report and after approximately 8 months on E-ARK it is already possible to conclude that our experience on developing a risk management tool will be valuable to the project and we will even be able to reuse some tool components.

The risk management tool developed in TIMBUS (see deliverable D6.1 for more details) is an important part of our exploitation. The value of the work and the broad scope of the field allowed us to reuse the tool and the knowledge gained on risk management in other projects. Namely:

- A Metagenomics project (the study of populations of microorganisms, namely metagonems) where risk management is being used as a driver for data management. In more detail, e-Science projects typically require a data management plan that defines how data is managed through the project, i.e., which type of, and how, data is generated, how it is maintained and who has access. This project proposes a risk management plan where risks associated with data are identified and assess how to complement the data management plan. In this way, it is possible to understand if the data management plan successfully controls/mitigates all data risks. One of the journal articles published in this reporting period were the result of the application of the risk tool in this project.
- An internal DP research project with the goal of defining a risk management knowledge base for digital preservation and curation.
- The 4C[82] project, where the tool is being used for defining a risk management process, based on ISO 31000, for digital curation. The goal is to define the activities, inputs, and outputs of the process and identify which risk management techniques are best suitable for digital curation. This collaboration allows us to create synergies between projects.

For the remaining months of the project, INESC-ID plans to continue focus on our strengths and pursue the following goals:

- Improve or extend consultation services related to TIMBUS, especially regarding risk management were we are already getting results. Please see section 0 of this deliverable for more details on this.

- Promote the use of TIMBUS knowledge in MSc and PhD student's works in their pursuit of academic qualifications. Continue to encourage PhD students working on TIMBUS to pursue TIMBUS related-topic. By doing so, INESC-ID is arming future workers, researchers and academics with needed skills for being successful in their careers. Please see section 0 of this deliverable for more details on this.
- Disseminate and use TIMBUS knowledge and developments to strength our position as experts in the field of digital preservation, risk management, business processes management, Enterprise Architecture and System Engineering. This should be mainly done by publishing results in national and international conferences. Please see section 0 of this deliverable for more details on this.

9.4.3 INESC-ID Exploitation Initiative #1: Open Source developments for risk management

Apart from research, INESC-ID also pursues development of open source software. Within TIMBUS, INESC-ID is responsible for developing a risk management component to evaluate, treat and communicate risks. We took the opportunity to develop a holistic tool that can be used through all the risk management phases (identification, assessment, treatment, management and communication) and in other domains apart from digital preservation. Our goal is to pursue the use of the tool in different projects and increase our reputation as risk management experts. This can support several exploitation goals since by increasing our reputation we may gain additional consultancy services, new research funding, advance the state of the art in risk management and/or educate students on risk management. Table 22, below details the current status and planned actions for this initiative.

Table 22: INESC-ID Exploitation Initiative #1: Open Source developments for risk management

Exploitation Initiative #1	Open Source developments for risk management
Audience(s)	Risk Management practitioners and researchers.
Exploitation Goal	The goal is to develop and improve open source software for risk management. The software should be holistic, i.e., it is usable in different domains and contexts, and should support the integration or mapping between those different domains.
Expected Exploitation Benefit(s)	The primary expected benefit is the adoption of the open source software tool in different industries. Additionally, that adoption can support other goals such as winning consultancy services, gaining research funding, advance the state of the art in risk management and/or educate students on best and emerging practices in risk management.
How to measure the Benefit	Benefit is measured through number of features, known bugs, cross-comparison with other risk management tools and market value. Previous criteria are largely increased by the adoption of the tool in other projects. Additionally all exploitation benefits (see above) achieved through that adoption can be used to measure the success of the exploitation initiative.
Exploitation Resources	INESC-ID has two developers working on the tool. Additionally 3 researchers are responsible for defining the roadmap of the tool. Apart from that, by the utilization of the tool in other projects, the team in charge receive several feedback. The researchers in question are responsible for managing new

		requirements that arise from the adoption of the tool in research projects or consultancy services. This involves, identify requirements, communication and negotiating them with stakeholders.
Dependencies		As a research centre, the development of the tool is dependent on the requirements and funding of the research projects or consultancy services that are using it;
Roadmap		
	Steps and actions needed	Continuously development and dissemination of the tool. It needs to be demonstrated that the tool can support a risk management process with clear benefits to the users
	Actions taken	2012-present: We have developed the tool to the point that it fulfils TIMBUS requirements. The tool is available on opensourceprojects.eu together with the other TIMBUS tool. For more details on the requirements that were developed please refer to TIMBUS deliverable D6.1. Q1 2013: 3 MsC students (see section 0 for more details) are using the tool in their thesis. New requirements have arisen from that usage. Q2 2013: The new requirements were developed. Further information on those requirements are presented on deliverable D6.8 (to be submitted at M45). Q3-Q4 2013: The tool raised interest in a research project (MetaGen-FRAME). INESC-ID followed that interest and was able to collaborate with MetaGen-FRAME. Q1-Q2 2014: The use of the tool in MetaGen-FRAME led to the publication of 4 conference papers and 1 journal article. Q3 2014: We have developed a sustainability plan for the tool. Q3-Q4 2014: New requirements from other projects led to several changes in the core of the tool. A second version of the tool is expected to be released in mid-December. The second version allows the use of risk management in other domains apart from digital preservation. Risk assessments data collected in TIMBUS are going to be migrated to the new version after the end of the project.
	Current status	The tool was used in the MetaGen-Frame research project successfully validating our preposition that the tool can be used in different domains. The tool is now able to efficient and effectively perform a risk assessment for the purpose of digital preservation. However, to explore other contexts and reach other communities the tool still requires further development.
	Timeline	Through the use of the tool in other projects we concluded that the tool has untapped potential. To explore that potential we needed to change some of the developed features and added additional ones. In the end it is expected that the tool is able to perform risk management assessments independently of its context. The tool is expected to be used in European project 4C and as part of PhD and MsC thesis ensuring its sustainability past the project.

9.4.4 INESC-ID Exploitation Initiative #2: Academic Qualifications through TIMBUS

Due to the close collaboration with the Technical University of Lisbon, INESC-ID is able to offer to students the opportunity of working and using knowledge gathered by existing projects. The collaboration allows us to motivate students to pursue academic and/or professional excellence in the fields of those projects. At the same time, projects benefit from the feedback students can provide. Table 23, below, details the work in this initiative.

Table 23: INESC-ID Exploitation Initiative #2: Academic Qualifications through TIMBUS

Exploitation Initiative #2		Academic Qualifications through TIMBUS
Audience(s)		Students from the Technical University of Lisbon especially from Computer Science and Engineering.
Exploitation Goal		Educate students by exposing them to the problems and solutions of TIMBUS. Support the project by receiving input from the students. The students were involved in some deliverables of TIMBUS, namely deliverables D6.1, D6.8, D8.1 and D9.1. Their names appear on the authors of those deliverables. This provides students with an exciting and rare opportunity not readily available in other Universities to contribute to EC research.
Expected Exploitation Benefit(s)		1. TIMBUS can be recognized as advancing the state of the art; 2. Students can successfully achieve their academic qualifications; 3. Students can use TIMBUS knowledge in their future professional careers.
How to measure the Benefit		Number of students interested in TIMBUS; Number of students that successfully used TIMBUS knowledge in their thesis and work;
Exploitation Resources		Due to the collaboration between INESC-ID and the Technical University of Lisbon the majority of researchers in INESC-ID also work in the university. Professors can present the work being done at INESC-ID or propose thesis related to research projects in order to engage students.
Dependencies		Students need to be interested in engaging the project. The INESC-ID staff, need to be interested in coordinating student effort and harnessing their energies and ideas into furthering the research agenda and the students own knowledge.
Roadmap		
	Steps and actions needed	Continuously promote TIMBUS work at the University; Propose MSc and PhD thesis related to TIMBUS.
	Actions taken	2012-present: INESC-ID had 2 MsC students (Ricardo Freitas e Diogo Fernandes) working and using TIMBUS knowledge on their MSc Theses. Both Thesis are related with Digital Preservation and use as application and validation the industrial cases of LNEC (WP8) and LIP (WP9) described in the project. INESC-ID has 4 researchers (Ricardo Vieira, Gonçalo Antunes, Diogo

		Proença and Marzieh Bakhshandeh) currently doing a PhD on Information Systems and involved in TIMBUS that can, if they see fit, use TIMBUS knowledge/work on their Theses. 2013/2014: INESC-ID had 1 MsC student (Filipe Ferreira) that used and adapted the risk management tool developed on TIMBUS on his thesis. The student successfully completed his degree. 2014/2015: INESC-ID proposed 2 MsC thesis in the field of risk management.
	Current status	INESC-ID has currently 1 MsC student working closely with TIMBUS on the field of risk management. Additionally 2 other students will start their thesis on the second semester (February 2015). Due to the end of the project they will not be able to participate and collaborate but it is likely they will used TIMBUS knowledge in their thesis. Gonçalo Antunes is doing a PhD on the subject of system capabilities that is strongly related to WP7 tasks and is planning to finish in January 2015. Diogo Proença is doing a PhD on Information Governance Maturity Models that is also strongly connected to the work in WP7. Marzieh Bakhshandeh work focus on Ontology Integration and has been using and helping the implementation of the TIMBUS context model. Finally, Ricardo Vieira is doing a PhD on Information Governance and Risk Management and was able to bring, and take, valuable feedback especially from the risk management tasks in the project.
	Timeline	After project: Diogo, Marzieh and Ricardo will only complete their PhD studies after the end of the project so they will ensure the continued development and exploitation of TIMBUS knowledge.

9.4.5 INESC-ID Exploitation Initiative #3: Scientific Excellence

As a research centre one of our main key performance indicators regarding advancing state-of-the art in the field is publishing papers on international and national research conferences. Table 24, below details this initiative.

Table 24: INESC-ID Exploitation Initiative #3: Scientific Excellence

Exploitation Initiative #3	Scientific Excellence
Audience(s)	Mainly Researchers. Potentially industry practitioners that pursue innovation through research and development.
Exploitation Goal	Promote and use TIMBUS work in other projects to create synergies; By this we mean future 2-way activities that happen as a result of promoting the TIMBUS work. Promote TIMBUS work in conferences, journals and other dissemination events to increase visibility of our work and consequently increase recognition among the scientific community.

Expected Exploitation Benefit(s)		Increase reputation as experts in the field; Pursue new collaboration opportunities in the scientific community such as new research funding options and/or new research projects.
How to measure the Benefit		Number of accepted papers and journal articles and participation in dissemination events (workshops, meetings, etc.). Particularly, the number of citations is a good indicator that reputation is increasing. Consequently new collaboration opportunities can be measured by the arrangements made in those dissemination events.
Exploitation Resources		Researches of INESC-ID are required to regularly publish results of their work and encouraged to pursue new collaboration opportunities when presenting it
Dependencies		Publications are typically dependent on the quality of work and quality of the event. Conferences and journals demand quality so it is necessary that researchers are able to produce work that is considered good. Additionally the quality of the events influences the quality of the audience that may correspond to more or less opportunities to pursue new collaborations.
Roadmap		
	Steps and actions needed	Write and publish about the work being done. Pursue new collaboration opportunities when presenting it.
	Actions taken	2012-present: INESC-ID has published 23 conference publications and 1 journal article. End of 2013: INESC-ID defined a publication roadmap that consisted of 10 new conference publications and 1 new journal article. Q1-Q2 2014: INESC-ID was able to publish 3 more conference papers and 1 journal article. Oct 2014: Together with our colleagues at SBA and LNEC, INESC-ID was able to receive the best paper award of a paper entitled “VPlan – Ontology for Collection of Process Verification Data” at IPRES2014. Q3-Q4 2014: INESC-ID was able to publish 6 more conference papers and 1 more journal article.
	Current status	INESC-ID accomplished the goals defined on the publication roadmap defined in the end of 2013. The roadmap still predicts the publication of 3 more conference papers. INESC-ID was able to publish 33 conference papers and 2 journal articles in the project levering its reputation as experts on the various fields explored in TIMBUS.
	Timeline	After project: Continue to submit proposals at workshops, conferences, journals, etc.

9.5 ITM – Institute for Information, Telecommunication and Media Law

9.5.1 ITM Organisation Profile

ITM Partner Summary.
Leonardo-Campus 9
48149 Münster, Germany.

The ITM is the national center of excellence (NRW) in information, telecommunications and media law and a member of the Law Faculty of the Westfälische Wilhelms University (WWU) in Münster.

It is divided in a civil law and public law department. Issues of cross-cutting Information Law can therefore be handled optimally, a concept that is unique in Germany since the founding of the Institute in 1998.

The research of the organisation has focused particularly on the field of information law. Due to the interdisciplinary approach, ITM is member of the European Research Centre for Information Systems (ERCIS) and also works closely with the Departments of Communication Studies an Information Systems to fall back on appropriate technical know-how.

Further the Civil Division of the Institute has an extensive expertise in handling and managing of externally funded projects. The following projects were funded by the European Commission under the Framework Program and carried out at the ITM in the past: CONSENT (Consumer sentiment regarding privacy on user-generated content services in the digital economy) and Lapsi (Legal Aspects of Public Sector Information). The institute also maintained numerous grants, such as the Federal Ministry of Education and Research sponsored project 'Network Economics and hybridity' as well as 'Big Data Management'.

In addition, the Research Centre of law in the German research network of the 'DFN-Verein' and its members are supported on all legal issues associated with the operation of the German Research Network (DFN) and the use of information and communication services.

The institution has its own extensive library, which also includes international books. Currently in the civil division 18 faculty members and 21 student assistants are employed.

9.5.2 ITM Exploitation Introduction

At the beginning of TIMBUS, ITM developed diverse ideas and approaches. Especially, ITM planned to publish a book. This book should answer all relevant questions which appear with regard to legal aspects of digital preservation. In December 2013, the book 'Legal Aspects of Digital Preservation' by Thomas Hoeren et al was finally published by Edward Elgar Publishing Limited. Concerning this initiative, we now focus on the marketing of the book. The book 'Legal Aspects of Digital Preservation' by Thomas Hoeren et al is only one example how ITM has realized its plans. Another example are the online training modules. During the last years, ITM has developed online training modules. Each module covers topics which are important with regard to digital preservation, e.g. IT contracting, Software Escrow and Protection of Databases. The users are provided with relevant information. They can improve their knowledge with regard to digital preservation, its legal problems and requirements. Furthermore, their legal understanding is strengthened. The online training modules are addressed to students and any person who is interested in digital preservation, e.g. companies.

ITM has developed a legal ontology for the field of digital preservation. This is one of the initiatives that was not planned at the beginning but the idea was developed during the project. This legal ontology aims to improve the legal understanding of the legal concepts which underlie digital preservation. The

relationships between the different concepts are explained. For the development of the legal ontology, ITM has used the results which were collected during the analysis of the different use cases.

This shows that former ideas and approaches have been developed further and completed during the TIMBUS project. In M37-45, ITM has focussed on the completion and exploitation of the different initiatives.

Furthermore, ITM has been working on the legal analysis of a variety of use cases: PHAIDRA (Permanent Hosting, Archiving and Indexing of Digital Resources and Assets) repository of the University of Vienna (https://phaidra.univie.ac.at), RCAAP (Portuguese Open Access Scientific Repository) repository (both WP7), Civil Engineering Infrastructure (WP8) and Medical Databases (WP9). Our TIMBUS project partners have investigated which information are worth to be preserved and how this could be carried out technically. ITM has analysed which legal requirements must be fulfilled. We have examined the legal permissibility of the application of the tools developed in the given scenarios and of storing and/or copying of the information collected within the scope of the different use cases. Under the lead of SQS, ITM has contributed to the pilot studies of the use cases of WP7, WP8 and WP9. During the project, ITM has defined the legal requirements that must be fulfilled and during testing, ITM will answer the question if the requirements are fulfilled.

ITM draws the attention of the legal research community to the specific characteristics of permanent preservation. We never tire of emphasizing how permanent storage is inevitably linked to IT contracting. Therefore, we stress the importance of watching newly emerging technologies and of being prepared to adapt present contracts to upcoming innovations.

As already mentioned, our book 'Legal Aspects of Digital Preservation', which contains our initial and fundamental research results, was published in December 2013.

The unique Legalities Lifecycle Management (LLM) tool has been refined and completed. This is a decision support tool which is intended to serve as a legal guidance for its users, e.g. companies' planning to use a digital preservation system or those users who are simply interested in digital preservation. To make the content easily accessible for non-lawyers, introductory guidelines which accompany our LLM tool were created. The content of the LLM is open for all interested parties and offered under a Creative Common License.

The LLM tool, the legal ontology and the online training modules we have developed will be made available online until the end of M45. Students as well as external users will have access.

As a part of the WWU, the ITM offers lectures, legal trainings (specific and general) and study pro-grams. Within this teaching activities, the ITM covers legal areas regarding IT Law, e.g. Copyright Law, IT contracting, Data Protection Law and Information Law.

Participating in TIMBUS allows us to implement the results of our digital preservation legal analyses in training services for lawyers and law students. Accordingly, the insights gained in TIMBUS are used in our lectures. We want to influence the scientific discourse regarding legal aspects of digital preservation, business products and services of companies. It gives us the opportunity to make suggestions regarding legislative projects. Using TIMBUS results has also opened up a new area of legal research in other legal research projects.

In the further course, we will continue to distribute the research results we have collected during the TIMBUS project.

9.5.3 ITM Exploitation Initiative #1: Book Publication '*Legal Aspects of Digital Preservation*'

In M37-45, ITM has focused on drawing the attention towards our book 'Legal Aspects of Digital Preservation'. For example, ITM uses the book with regard to its teaching activities and recommends it

to our students as well as our partner Universities. Our objective is to create awareness of the importance of digital preservation and the existing legal problems.

The ability to preserve data and the reuse in the future is influenced by legal requirements. All aspects of digital preservation are affected: business constraints, process descriptions, computational environments and their mutual dependencies, digital assets that are produced and consumed by the processes, roles of individuals and organisations as well as dependencies on third-party products and services. Our research in TIMBUS is a significant effort considering the legal implications of executing various digital preservation strategies in various use case scenarios. Our book 'Legal Aspects of Digital Preservation' adopts this comprehensive view. It should help legal practitioners and non-specialists to understand the legal issues to be considered in preparing digital preservation strategies. Table 25, below details this initiative.

Table 25: ITM Exploitation Initiative #1: Book Publication '*Legal Aspects of Digital Preservation*'

	Exploitation Initiative 1#	Book Publication '*Legal Aspects of Digital Preservation'* 
	Exploitation Goal	This book presents our fundamental research results in the legal area of digital preservation.
	Audiences	The book serves as legal assistance for our project partners. As general introduction into legal aspects of digital preservation, it serves any person interested in digital preservation. Furthermore, it functions as a guideline for those who might digitally preserve their business processes. In particular: - Researchers in the area of archiving and digital preservation who need information about legally permitted and recommendable technical actions and management strategies; - Researchers in the field of migration, porting and emulation of software to whom the legal permissibility of these actions needs to be explained to; - Developers of digital preservation systems who want to be aware of the legal situation of their products; - Companies who digitally preserve their work; - Companies offering digital preservation as a service and hence need extensive legal support with its planning and execution.
	How to	Procedures have been adapted with regard to the content collected and

	measure the benefit	preserved. The risk of litigation for all project members has been reduced and project partners have profited from the research of ITM in general. The book offers a new approach to digital preservation: Publications already exist regarding technical and management issues of digital preservation. Our work is written from the legal point of view. The book is unique because it does not concentrate on specific issues in the preservation domain but offers an overview and focuses on the preservation of an entire business process. Solutions for practitioners are offered. Furthermore, the book contains analyses of licenses and contracts and their benefits for digital preservation, e.g. software escrow agreements.
	Exploitation Resources	Thomas Hoeren is a law professor and head of the Institute for Information, Telecommunication and Media Law of the University of Muenster; Barbara Kolany-Raiser works as a postdoctoral research fellow at the Institute for Information, Telecommunication and Media Law; Silviya Yankova is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; Martin Hecheltjen is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; Konstantin Hobel holds a research position at Secure Business Austria; as well as two student assistants.
	Actions taken	ITM has focused on legal requirements in the field of Intellectual Property Rights, Data Protection and IT-Contracting. The book was published by Edward Elgar Publishing Ltd. in the United Kingdom and the United States of America in October 2014. In the rest of Europe, it was already published in December 2013.
	Current status	The book is available in print version and electronically. Edward Elgar Publishing Ltd. has announced the publishing of the book on their website. It offers the introduction as free sample on its website. The book was also announced on the TIMBUS website as well as on the ITM TIMBUS website. Review copies were sent to main journals. The book is recommended in all our online training materials, on the TIMBUS blog and in the TIMBUS newsletter. Furthermore, the book is presented during conferences concerning TIMBUS, namely: PASIG, iPRES, ICOLD. The book is available on amazon.com. With regard to the ITM teaching activities, the book is recommended to our students. Furthermore, our partner universities use the book, too. The book is promoted on the ITM website and the online training modules contain references.
	Timeline	➢ Publication: December 2013 (Europe, except for United Kingdom), October 2014 (United States of America, United Kingdom);

		➢ M33-36: review copies were sent to main journals by Edward Elgar Publishing Ltd.: - IIC - International Review of Intellectual Property and Competition Law; - GRUR-Int (Gewerblicher Rechtsschutz und Urheberrecht, Internationaler Teil) - The international part of the journal of the German Association for the Protection of Intellectual Property, concerning mainly European and International Intellectual Property Law; - MMR (Multimedia und Recht) - German law journal focusing on Information and Media Law; - CR (Computer und Recht) - German law journal focusing on Information and Computer Law; - DuD (Datenschutz und Datensicherheit) - German law journal focusing on Data Protection. - Several other law journals publishing articles on IP Rights, Data Protection, Information and Media Law, e.g. Kommunikation & Recht (K&R), Zeitschrift für Medien- und Kommunikationsrecht (AfP), Zeitschrift für Urheber- und Medienrecht (ZUM); - jusIT, Zeitschrift für IT-Recht, Rechtsinformation und Datenschutz (LexisNexis); - Jusletter IT, Zeitschrift für IT und Recht (Editions Weblaw, Bern); Compliance Praxis (LexisNexis Austria). ➢ M40: Recommendation of the book on the ITM-website; ➢ 08.11.2014: Presentation of the book at the yearly ITM Friends' Association Conference at the ITM.

9.5.4 ITM Exploitation Initiative #2: Legalities Lifecycle Management Tool

During the last years, we have developed the Legalities Lifecycle Management (LLM) tool in order to raise awareness for the legal aspects of digital preservation. In cooperation with SQS and DPC, the LLM tool will be made available online. In M37-45, we all have focused on the realization of this plan. In the upcoming months, the LLM tool will be available on the TIMBUS website as well as on the ITM TIMBUS website. The user will have the possibility to download a virtual machine to be able to use the tool. ITM has already announced the making available of the LLM tool at its partner universities.

The LLM tool serves as a decision support tool. Therefore, it covers a variety of possible scenarios companies who wants to digitally preserve their business processes are confronted with. To begin with, the LLM tool deals with the preservation of third party material, especially software, databases, text documents or pictures. Furthermore, data protection issues are covered. For example, the user is provided with relevant information with regard to the question which differences arise if client information should be stored and the digital preservation system is inside or outside the European Union. Sector and non-sector specific obligations to preserve data are presented. By taking into account different scenarios which can occur, a legal questionnaire was developed which contains relevant legal information. The tool is diversely applicable. It is accessible to a wider range of users on basis of a Creative Common License. Table 26, below details this initiative.

Table 26: ITM Exploitation Initiative #2: Legalities Lifecycle Management Tool

Exploitation Initiative 2#	Legalities Lifecycle Management Tool (LLM)
Exploitation Goal	Goal is to develop a decision support tool to function as a guideline for any person interested in digital preservation or companies and users of digital preservation systems
Audiences	The LLM is open for all interested parties, esp. any employee who must assume the responsibility of digital preservation in his company and who needs legal advice for the specific preservation situation during the planning, installation and execution of the preservation system itself. The LLM Tool is provided on basis of a creative common license
Expected Exploitation Benefits	ITM aims to assist all users with the LLM Tool and profit from their feedback and recommendations in return. The idea is that users might improve the version and free it up on basis of a creative common license in return.
How to measure the benefit	The advantage of our LLM Tool can be deduced by its popularity and by feedback of satisfied users, which might be measured by e.g. the number of "digitally granted licenses" meaning the number of clicks and downloads and in particular by the amount of improved versions which are offered for their part.
Exploitation Resources	Thomas Hoeren is a law professor and dean of the law faculty at the University of Muenster as well as head of the Institute for Information, Telecommunication and Media Law. Barbara Kolany-Raiser works as a postdoctoral research fellow at the Institute for Information, Telecommunication and Media Law. Silviya Yankova is a lawyer and works as a research fellow at the Institute for Information, Telecommunication and Media Law. Martin Hecheltjen is a lawyer and works as a research fellow at the Institute for Information, Telecommunication and Media Law.
Actions taken	The questionnaire was refined and edited, by ITM. In year 3 we have extended the existing queries by adding questioner regarding sector specific monitoring obligations for Medical Data as well as Medical Products where we added not only the specifications given by European legislation but also different national legislation or jurisprudence. The questionnaire was also improved regarding its language by an external native speaker who worked as an editor and whose help we got thanks of DPC. Guidelines explaining the content and giving a short overview were written.
Current status	The prototype of the tool is implemented and uploaded to the platform for European Projects (http://opensourceprojects.eu/p/timbus/). As soon as the LLM tool is finally implemented and announced on the TIMBUS

	website, we will do so on our ITM TIMBUS website. We will recommend the LLM tool to our students. In September 2014, SQS and ITM have entered into negotiations with an operator planning to take the LLM tool after the TIMBUS project has ended.
Timeline	➢ M36-45: Publication of the tool under the Apache License and publication of the content under a Creative Commons License. M45: Presenting the tool on the TIMBUS website running on a virtual machine. Then, making available of the tool running on a virtual machine on the ITM TIMBUS website in order to allow access of our students to the tool.

9.5.5 ITM Exploitation Initiative #3: Digital Preservation Legal Ontology

Ontologies are necessary to visualize complex relationships, also with regard to the legal domain. Nevertheless, there has hardly been a legal ontology for the digital preservation domain. ITM and our partners have developed a legal ontology for digital preservation in order to close this gap. Our legal and technical research results are presented in a paper titled 'Towards a Legal Ontology for the Digital Preservation Domain'.

In M37-45, we tried together with INESC ID to draw more attention to our legal ontology. In October 2014, INESC ID has presented our joint work in a poster at iPres 2014 in Melbourne (Australia) and we have presented the legal ontology at the KEOD International Conference in Rome (Italy). In Rome, we were able to make new contacts. We have awoken the interest of many conference participants.

Consequently, ITM has come to the decision to make the c-map available on the ITM TIMBUS website. The plan will be realized in the upcoming months to create a better understanding about the legal concepts and their relations for people without legal knowledge.

This section of the deliverable details the initiative. Table 27, below details this initiative.

Table 27: ITM Exploitation Initiative #3: Digital Preservation Legal Ontology

Exploitation initiative 3#	Digital preservation legal ontology
Partnerships	INESC-ID and KIT
Exploitation Goal	The aim is to develop a legal ontology for the digital preservation domain.
Audience	The ontology is addressed to our project partners and their partners who are involved in the preservation process. The ontology shall improve the understanding between the technology community and the community of legal practitioners.
Expected Exploitation Benefit	In the paper, results are presented which were collected during the work on the different use cases, especially PHAIDRA (Permanent Hosting, Archiving and Indexing of Digital Resources and Assets) repository of the University of Vienna (https://phaidra.univie.ac.at.), RCAAP (Portuguese Open Access

	Scientific Repository) repository (both WP7), Civil Engineering Infrastructure (WP8) as well as Medical Database (WP9). The ITM has analysed the use cases with regard to their legal permissibility. The legal understanding and security of our project members should be increased. Besides from the benefit with regard to the specific use cases, any person can profit from the legal ontology and consequently improve its legal understanding and security if the given use cases are used as pattern for related scenarios. Furthermore, any person willing to represent complex legal structures might use the ideas towards the development of a legal ontology as examples.
How to measure the benefit	The legal ontology was developed on the basis of two components. First, our project partners have decided which business processes they want to collect and how this could be carried out technically. Second, we have investigated how these plans correspond to legal requirements, have foreseen legal issues and have solved them. As a result, our partners profit from legal compliance. On the basis of use cases, it is shown how digital preservation can be carried out practically.
Exploitation Resources	Thomas Hoeren is a law professor and head of the Institute for Information, Telecommunication and Media Law of the University of Muenster; Barbara Kolany-Raiser works as a postdoctoral research fellow at the Institute for Information, Telecommunication and Media Law; Silviya Yankova is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; Martin Hecheltjen is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; as well as two student assistants.
Actions taken	The paper was presented at ICT Law 2013 and published in the conference proceedings book. The ontology was extended.
Current status	The paper was at KEOD, 6th International Conference on Knowledge Engineering and Ontology Development, October 21-24, 2014, Rome (Italy). We have also been accepted to present a poster at iPRES in October 2014. We will further present the ontology, especially to legal practitioners who are connected to the ITM. Furthermore, we will make the c-map available on our ITM TIMBUS website.
Timeline	➢ M36-45: Publication/Extension of the ontology M43: Presentation of the legal ontology at KEOD, 6th International Conference on Knowledge Engineering and Ontology Development, October 21-24, 2014, Rome (Italy) and presentation of our joint work in a poster at iPres 2014 in Melbourne (Australia).

9.5.6 ITM Exploitation Initiative #4: Legal Training and Teaching Courses

As informational freedom is one of our fundamental principles, members of the ITM have always aimed to pass the benefit earned from their research to students and others by offering a variety of teaching activities. Concerning digital preservation, the TIMBUS research is implemented in different courses. It has shown how far the technological progress is related to legal challenges. The TIMBUS scenarios are used as teaching examples. By means of the use cases, the students can apply the law to unfamiliar fields of technology. This is one of the core qualifications a law graduate should have.

In M37-45, we have again increased the use of the results we have gained during the TIMBUS project in our teaching activities. Both lecturer and students benefit. Table 28 below details this initiative.

Table 28: ITM Exploitation Initiative #4: Legal Training and Teaching Courses

Exploitation initiative #4	Legal Training and Teaching Courses
Exploitation Goal	Influencing legal standards and research discourse in the field of digital preservation
Expected Exploitation Benefit	Influencing legal standards, e.g. general legal views in literature and science; hereby indirectly influencing national and European legislation. With our work we want to create awareness of the importance of digital preservation. The limits of existing regulations must be revealed to show the need for clearer regulations. The aim is to increase the legal understanding and security of the parties concerned and thereby to minimize the risk of litigation.
How to measure the benefit	To influence legal standards is a slow and tedious process, which takes a lot of time and continuous work on legal research, publications and teaching activities. We play an active part in current science programs to enlarge the scope of knowledge within scientific research. We transport this new knowledge to students. Moreover, ITM influences the general discussion in literature and science by publications of ITM researchers and ITM PhDs. Furthermore, Prof. Hoeren and Prof. Boehm are often asked to write down their legal opinion concerning a specific issue, e.g. a law or draft law. Their expert opinions are taken into account and therefore influence legal standards.
Exploitation Resources	Thomas Hoeren is a law professor and head of the Institute for Information, Telecommunication and Media Law of the University of Muenster; Franziska Boehm is a junior law professor at the University of Muenster; Barbara Kolany-Raiser works as a postdoctoral research fellow at the Institute for Information, Telecommunication and Media Law; Silviya Yankova is a lawyer and has worked as a research fellow at the Institute

	for Information, Telecommunication and Media Law; Martin Hecheltjen is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; as well as the scientific staff of the ITM (at the moment 15 research fellows).
Actions taken	April 2013- October 2014. Course on Information Management, Muenster 2013, directed by Prof. Hoeren, approx. 30 participants (graduates/ undergraduates); Course on Cloud Computing with University of Zurich, Muenster-Zurich 2013; Course on Data Protection Law with University of Luxembourg, Muenster-Luxembourg 2013, directed by Prof. Boehm and Prof. Cole (University of Luxembourg), approx. 25 participants (undergraduates); Course on Library Law, Muenster 2013, directed by Prof. Hoeren, approx. 10 undergraduates as participants (presenting their theses in the field of copyright law as part of university graduation exams), staff from the University's library (audience/attendees to the ensuing discussion); Course on Media Law, Muenster 2013, directed by Prof. Hoeren, approx. 25 participants (undergraduates/ agents from the music industry (audience/ participants to the ensuing discussion)); Course on Journalism and Law (specialisation course), Muenster 2013, directed by Prof. Hoeren, approx. 30 participants (graduates/undergraduates); Lecture on International Media Business Law, Muenster 2013, held by Prof. Hoeren, attended by undergraduates and graduates; Lecture on Intellectual Property Law, Muenster 2013, held by Prof. Hoeren, attended by undergraduates and graduates; Lecture on Data Protection Law, Muenster 2013, held by Prof. Hoeren, attended by undergraduates and graduates; Lecture on Information Law, Muenster 2013, held by Prof. Hoeren, attended by undergraduates and graduates; Lecture on Copyright Law, Muenster 2014, held by Prof. Boehm, attended by undergraduates and graduates; Course on the Legal and Technical Aspects of Information Security, Muenster 2014, held by Prof. Boehm, undergraduates as participants; Course on Media Private Law, Muenster 2014, directed by Prof. Hoeren and Mr. Schaefer, undergraduates as participants.
Current status	Course on Journalism and Law (specialisation course), Muenster 2014/2015, directed by Prof. Hoeren, approx. 30 participants (graduates/ undergraduates);

	Course on Information Law (Media Criminal Law), Muenster 2014/2015, directed by Prof. Hoeren and Prof. Heghmanns, undergraduates as participants; Lecture on Information Law, Muenster 2014, held by Prof. Hoeren, attended by undergraduates and graduates; Lecture on Data Protection Law, Muenster 2014/2015, held by Prof. Boehm, attended by undergraduates and graduates; Course on E-Commerce, Muenster 2014/2015, directed by Prof. Boehm, undergraduates as participants.
Timeline	ITM will carry on its teaching activities. We will continue to include the research results gained in the TIMBUS Project. The book "Legal Aspects of Digital Preservation" is on the list of recommended reading material and the online training materials as well as the LLM-tool are also integrated in the teaching activities.

9.5.7 ITM Exploitation Initiative #5: Online Training Modules

We have developed online training modules which cover relevant topics with regard to digital preservation, e.g. IT-Contracting, Software Escrow and Protection of Databases. These online trainings modules contain relevant information which can improve the legal understanding and legal security of the users concerning digital preservation.

The online training modules will be made available online. Furthermore, we have recommended our work not only to our students but also to our partner universities. Consequently, the online training modules will gain more and more attention. Table 29 below details this initiative.

Table 29: ITM Exploitation Initiative #4: Online Training Modules

Exploitation Initiative	Online Training Modules
Exploitation Goal	The aim was to develop online training modules to improve the legal understanding and legal security of any person interested in digital preservation. The relevant topics which regard to digital preservation are covered and illustrated.
Audience	The online training modules are useful to a wide range of persons, e.g. companies using digital preservation (employers and employees), students.
Exploitation Benefits	The online training modules provide relevant information with regard to digital preservation. They offer a great overview. Furthermore, the online training modules contain all necessary information. The different topics, legal problems and requirements are explained in detail. The online training modules exist of two components. First, the user is provided with slides.

	Second, a native speaker read out these slides.
How To Measure The Benefit	The audience can increase its legal understanding and security in the field of digital preservation. For example, companies who are interested in digital preservation are made aware of legal problems and requirements which must be taken into account.
Exploitation Resources	Thomas Hoeren is a law professor and head of the Institute for Information, Telecommunication and Media Law of the University of Muenster; Barbara Kolany-Raiser works as a postdoctoral research fellow at the Institute for Information, Telecommunication and Media Law; Silviya Yankova is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; Martin Hecheltjen is a lawyer and has worked as a research fellow at the Institute for Information, Telecommunication and Media Law; as well as two student assistants.
Actions Taken	ITM has developed the content of the online training modules, including text and slides. The following online training modules were developed: - IT-Contracting: License Agreements – Software Contracts between Software Producer and DP User; - Protection of Databases and Digital Preservation; - Copyright Protection of Software and Digital Preservation; - Software Escrow; - Digital Libraries: Copyright Protection of Text Documents, Orphan works, etc.
Current Status	A native English speaker (Sara Day, DPC) is editing the online training modules with regard to linguistic issues. Furthermore, the slides are read out and recorded. ITM will implement the online training modules in their teaching activities. The online trainings will be made freely available. As soon as the online trainings are finalised and published on the TIMBUS website, we will publish it on our ITM TIMBUS website. We will recommend the online trainings to our students.
Timeline	➢ Until M45: Online training modules freely available.

9.5.8 ITM Conclusion

During the TIMBUS project, different plans and initiatives have been realized. The work during the last years was very interesting because of the diversity of the different tasks we were working in and the different exploitation initiative that were developed in the course of the project.

Each initiative has posed its own challenges. For example, on the one hand, the development of the legal ontology was something completely new and we have benefit a lot from the joint work with INESC ID and their great knowledge in this field. On the other, the publication of the book 'Legal Aspects of Digital Preservation' by Thomas Hoeren et al proceeded smoothly.

The results of each initiative give a great insight into the legal aspects of digital preservation. Furthermore, the different initiatives show how important legal support is in the field of digital preservation. Only if the technical and legal domain work together, the best results can be achieved.

During the TIMBUS project, a great network was established. ITM has benefited from the great cooperation with the TIMBUS project partners which has led to the great results we have achieved.

In the upcoming months, ITM will focus on the further dissemination of our results, especially with regard to the book 'Legal Aspects of Digital Preservation', the LLM tool, the legal ontology, the online training modules and our teaching activities. Furthermore, we are planning to use the gained results in future projects.

9.6 KIT – Karlsruhe Institute of Technology

9.6.1 KIT Partner Profile

Karlsruhe Institute of Technology,
Karlsruhe, Germany
KIT IT Partner Summary

Karlsruher Institut für Technologie (KIT) combines the mission of a university (University of Karlsruhe) with that of a large-scale Research Centre of the Helmholtz Association in the Federal Republic of Germany. With over 8,000 employees and an annual budget of nearly €650m, KIT is one of the largest research and education institutions worldwide.

The TECO of the KIT is a well-renowned research group in Pervasive & Ubiquitous Computing, Human Computer Interaction, and Wireless Sensor Networks. TECO has significant experience in the areas of Knowledge-Based Reasoning in Context-Sensitive Systems and Intelligent Distributed Context-Aware Systems. TECO proposed and developed a Context Model along with methods for identifying and capturing of contextual information and business process dependencies for TIMBUS. The underlying concepts of this meta-model were founded on architecture for monitoring of context-aware systems which had been previously developed at TECO. Based on this model tools for context extraction, integration and analysis were developed.

9.6.2 KIT Exploitation Introduction

As the TIMBUS project reaches a conclusion, KIT has not expected to see major changes in that approach at this point. As was the case in the year 3 review, the general exploitation plans and strategies of KIT and TECO remain to be targeted at both academia and industry. It is, however, still the case that KIT's industrial partnerships would continue growing as TIMBUS software tools and usable technologies have been developed. KIT has continually revised and updated their exploitation plan radically based on a reassessment of current opportunities that support current emerging technology. In this, our final report in the TIMBUS project, we update the status and milestones of the previously communicated initiatives from year 3 and we have added a fourth in the final months of the TIMBUS project which we are very excited about as it feeds into the overall TECO research agenda.

As research institute KIT has been following multiple exploitation strategies that focus on research, innovation and technology transfer. These have not changed since our year 3 report and they can be summarised as follows:

1. TECO as an active research group at KIT has been contributing to dissemination of TIMBUS results, both in academia and industry, in the form of announcements and website notifications, as well as publishing research articles. We plan on publishing in new domains where process preservation is a key issue. TECO will continue to attend other workshops and conferences as well, to strengthen its position as a key player in the Ubiquitous and Mobile Computing and Internet of Things scientific community. TECO also has an excellent track record for scientific publications at leading conferences, filling editorial roles (e.g. Journal of Personal and Ubiquitous Computing, Ambient Technology, and Special Issues in IEEE) and committee roles at major international and European conferences (e.g. program chair of HUC/Ubiquitous Computing/Pervasive, ARCS). Academically TECO has further successfully applied the Context Mining technology that has partially been developed in the scope of TIMBUS in the activity recognition and smart energy systems domain.

2. KIT puts strong emphasis on training and engagement of young researchers, especially by developing research staff through doctoral and postdoctoral training. At present, our staff on the TIMBUS project includes two Ph.D. students and one Postdoctoral research fellow. By introducing new courses into the master curriculum, KIT has provided new possibilities to postgraduate students. The "praxis of research" master course provides master students with opportunities to actively engage in research projects such as TIMBUS. In 2013, the "practical software engineering" course (http://pcs.tm.kit.edu/teachingss2013_394.php) was directly working with the TIMBUS extractor tools. In the winter (2013/2014) and summer terms (2013, 2014), TIMBUS-related topics were also discussed in the context of the bachelor and master seminar (http://pcs.tm.kit.edu/teachingsws2013_407.php, http://pcs.tm.kit.edu/teachingsss2014_452.php). The newly created "Internet of Things and Mobile Computing" lecture (winter term 2013, 2014) already includes results from TIMBUS in our bachelor degree courses. For the first time in this year's summer term we also included results from the TIMBUS project into the Context Sensitive System lecture (summer term 2013).
3. Our partner-specific goal is, essentially, to advance the research on autonomous monitoring of business processes. The focus is on modelling the contexts of business processes and their dependencies on other software and services .This enables subsequent decision-making. The design techniques in the Civil Engineering use-case preserve the entire monitoring processes for large infrastructures, such as the WP8 Portuguese water dam. These are being applied to other applications in this domain. Furthermore increasing demand for similar technologies comes from the area of Internet of Things, Cyber-physical Systems and Big Data Analytics. KIT has initiated different activities to exploit TIMBUS results in those areas. The Smart Data Innovation Lab and projects with-in the Software Campus as described below have especially high potential for the application of TIMBUS results.
4. KIT and TECO have continuously been using project synergies in existing efforts in other application domains that are partially related to controlling theoretical perspectives in energy markets, distributed energy market modelling, and new business models such as the BMBF Software Campus VDAR project. An interesting new synergy has emerged from the newly started Prosperity4All Project that assists in building a Global Public Inclusive Infrastructure. TECO is particularly responsible for designing the developer space and coordinates the delivery of personalization components. The modelling of dependencies and other context's as developed in TIMBUS has high relevance to this topic with high relevance to society. KIT and TECO will continue disseminate knowledge about TIMBUS results in all projects it is involved in.

Changes from Y3 include:

- Ad 1: Recent developments within the SDIL project (see below) have shown particular need in for preserving Smart Data Analysis tool chains and methods. Another application is the Internet of Things. The research that has been published within the IoT 2014 conference, regarding the documentation of smart environments, is currently merged with TIMBUS research on context extraction. This year TECO again co-organized the Workshop on "Workshop on IoT Apps and Value Creation for Industry" with ABB that was held the second time, this October at MIT in Boston. Data lifecycles and preservation was one of the topics discussed.
- Ad 2: Teaching activities were successfully continued, updated and improved.
- Ad 3: See details below.

9.6.3 KIT Exploitation Initiative #1: Support to configure CPS tools

This initiative was previously reported on in our year 3 deliverable. Its objective remains the same which is to create a vendor independent platform to collect, represent and share configuration relevant knowledge for complex heterogeneous tools and tool chains in the lifecycle of Cyber Physical Systems. This platform improves customization quality, avoids customization errors, accelerates customisation, reduces customization costs via functionalities to represent and identify related configuration data for given tasks. Additionally this system delivers the preconditions to get to automated configurations and parameterisation. The final status of the activity is shown in Table 30, below where our ambition remains to pursue research opportunities which support our agenda of sustainable development of cyber physical systems. TIMBUS has been highly helpful in augmenting our work in this area and KIT feels that its project proposals have been stronger as a result of our participation in the project.

Table 30: KIT Exploitation Initiative #1: Support to configure CPS tools

Exploitation Initiative #1	Sustainable Development of Cyber Physical Systems
Partnerships	MST SW (http://www.microtec-suedwest.de/en/), EIT ICT Labs (http://www.eitictlabs.eu/)
Audience(s)	SME companies within the MST cluster that produce components (smart systems, communication component), and companies like Siemens that provide development and planning tools for the Cyber-Physical Systems in industry (CPS)
Exploitation Goal	Application of Context Capturing, Dependency and Risk Analysis to complex systems of systems in the domain. Adaption of tools and methodologies for industrial application.
Expected Exploitation Benefit(s)	KIT has been contacted by Siemens and MST BW that are members of the above mentioned organizations. Two concrete opportunities are discussed in detail: 1. The use of TIMBUS tools to ensure the preservation of design tools for complex CPS and there configuration (e.g. Plant management tools based on Siemens COMOS) 2. The preservation of complex cyber-physical systems (CPS, e.g. used for diagnosis and maintenance of industrial machinery). • EIT ICT Labs Partner Event (Paris, 17-18 April 2013) • EIT CPS Workshop Munich at Fortiss GmbH (Munich, May 7 2013) • Follow-up Meeting with OCE, Siemens (Venlo, May 13 2014) • Phone conferences By capturing the run-time environment of successful deployments and preservation of complex systems and their configurations, the risk of employing complex CPS that are not solely based on standards is mitigated. Manufacturing is one of the driving forces of the European economy, contributing over 6 500 billion Euro in GDP and providing more than 30 million jobs. It covers more than 25 different industrial sectors, largely dominated by SMEs, and generates

	annually 1 500 billion Euro of value added. (Source: EU Research & Innovation, Industrial Technologies). The global industrial automation market is forecast to reach more than $200 billion by 2015 (Source: IMS Research).
How to measure the Benefit	Support to ease the configuration and parameterization of industrial IT systems and the integration of IT tools into tool chains used in the live cycle of CPS. - 60000 jobs (1 % in configuration and parameterization of IT-tools) - 6 mio jobs (20 % in development, engineering and lifecycle of CPS) 5% Market size and share in 2016 (EU): - 25.000.000 €
Exploitation Resources	Within EIT planned allocated budget was 548 200 €. The whole budget is requested from EIT and relates solely to personal costs. The complementary funding is 2 360 183 €. The following resources were proposed for 2014: - 0.25 FTE years Project Leader: 40 k€ (160 k€/yr) - 1.25 FTE years Researchers: 200 k€ (160 k€/yr) - 1.35 FTE years Researchers: 150 k€ (111 k€/yr) - 1.00 FTE years Researchers: 88.2 k€ (88.2 k€/yr) - 1.00 FTE years Researchers: 70 k€ (70 k€/yr) The proposal was finally rejected in the EIT business plan 2014. To follow up on those activities additional funding is needed in a national or international context. For transferring the technology for the above mentioned use cases we expect at least one person year effort. To provide this service as consulting to external partner's further resources are needed. KIT proposed currently funding opportunities within H2020 are explored. In 2014 already 1PM at KIT was put into acquiring new funds.
Dependencies	Technical: This work is dependent on integration of the work package 6 tools and feedback from these tools being run against the TIMBUS use cases. It is expected that work will yield many learnings and improvements to the system. Especially the capability to preserve real world business processes like in the WP8 Sensor use case is needed. Particularly interesting is the preservation of the reading infrastructure and the description of the sensing system. Non-Technical: As an academic partner KIT has no direct way to generate revenue on the existing tools , other funding possibilities need to be explored: e.g. in the context of a pan-European virtual application center: a competence centre formed by 6+ CPS SME clusters within Europe (Mikrosystemtechnik Baden-Württemberg e.V, Pôle des microtechniques, MinacNed, Micro-tech

		Innovation, CSEM, distrettohtmb). The idea is to offer CPS services within a common framework.
Roadmap		
	Steps and actions needed	Proposal within the context of EIT (European Institute of Innovation and Technology) Catalyst activities or H2020 innovation action.
	Actions taken	2013: We have pitched the work within the EIT ICT Labs CPS workshops in Paris and Munich in 2013. We got very good feedback. H1 2013: A proposal for catalyst funding within the EIT was submitted together with Siemens research, which was rejected in H2 2013. The proposal for technology transfer activities was not included into the 2014 Business Plan of EIT. Therefore we are currently evaluating other funding opportunities to mature and adapt the technology. Q1 2014: Approach new funding possibilities. The work is part of our technology offering to create a network of design centres for the "smart everywhere society" within the H2020 framework program. M41: A new industry funding proposal (led by Zeiss 3D) was submitted to the BmBF (national). KIT spend 0,5PM into the preparations of the proposal.
	Current status	Currently strategically no new proposal is planned within the H2020 framework. Focus remains on national or bilateral funding building on the MSTBW Cluster.
	Timeline	M35: The proposal was submitted to the H2020 ICT 1 call. The proposal was led by KIT. M42: The EU proposal was rejected by the EC. New EU Calls like FoF-9 and ICT-30 were explored and contact to industry partners and commissioners was established M45: Notification of acceptance for national funding

9.6.4 KIT Exploitation Initiative #2: Global Public Inclusive Infrastructure (GPII)

The purpose of the Global Public Inclusive Infrastructure (GPII) is to ensure that everyone who faces accessibility barriers due to disability, literacy, digital literacy, or aging, regardless of economic resources, can access and use Internet technology to access information, communities, things and services for education, employment, daily living, civic participation, health and safety.

Since the last report the project was successfully started and first actions have been taken to establish a common infrastructure. As integration is slightly delayed the application of TIMBUS technology is also delayed and is planned for the beginning of the next year.

Table 31, below details the next KIT exploitation initiative, plans and timeline.

Table 31: KIT Exploitation Initiative #2: Global Public Inclusive Infrastructure (GPII)

Exploitation Initiative #2	Context and Dependency Modelling for the GPII
Partnerships	Raising the Floor Initiative (http://raisingthefloor.org/)
Audience(s)	Implementers that want to make their Software more accessible and inclusive. Prosperity4All is creating an ecosystem in which everyone will benefit, matching user needs with product and service developers. This particularly includes members of the Raising the Floor Initiative (raisingthefloor.org) such as: • FUNDACION ONCE PARA LA COOPERACION E INCLUSION SOCIAL DE PERSONAS CON DISCAPACIDAD FONCE, Spain • AGE PLATFORM EUROPE AISBL AGE, Belgium • NATIONAL COUNCIL FOR THE BLIND OF IRELAND NCBI, Ireland • CONSORCIO PARA EL DESARROLLO DE POLITICAS EN MATERIA DE SOCIEDAD DE LA INFORMACION Y EL CONOCIMIENTO EN ANDALUCIA FERNANDO DE LOS RIOS GUADAL, Spain • OPENDIRECTIVE LTD OpenDir, United Kingdom • LIFETOOL GEMEINNUTZIGE GMBH LFTL, Austria • MLS MULTIMEDIA AE MLS, Greece • Clevercherry.com Ltd CC, United Kingdom
Exploitation Goal	Modelling of software dependencies and redeployment of processing tool-chains for multi-model user input.
Expected Exploitation Benefit(s)	One of the major problems of redeploying accessibility support in real world applications is that the systems require complex interactions for input and output. Those systems cannot be indefinitely maintained into the future because of reducing demand over time. By providing a repository for (re-) deploying existing solutions on a per demand basis we meet very specialised needs for end users that otherwise are not fulfillable by standardised or generic software. By identifying similar successful deployment and redeploying them, the setup cost will be reduced drastically.
How to measure the Benefit	The success will be measured by concrete redeployments on a per case basis by including the redeployment and preservation mechanisms in the GPII. The tools will be included for public benefit and as public domain. Reduction of time required by implementers for developing/adapting/modifying an At applications, using the tools = at least 15% reduction reported for developers knowledgeable on how to make an application accessible, and at least 30% reduction reported by developers with little experience in accessibility issues. (Mean-value over all project evaluations with developers in all iterations). At least 65% of the above stakeholders (notably companies), Project Collaborators and other external stakeholders report that mechanisms

		proposed address their needs and could be adopted by them.
Exploitation Resources		The effort is funded via the *Prosperity4All* project. Depending on the maturity of the TIMBUS tools we expect to spend 1PM on including the (open source) TIMBUS redeployment tools into the GPII. (The project works in an agile way and resource usage and timing will depend on concrete user demand).
Dependencies		Technical: The completion of the TIMBUS redeployment tools and the possibility to especially capture concrete hardware dependencies on fine granular level. Non-Technical: The inclusion into the GPII will depend on the internal evaluation of the suitability of the TIMBUS tools.
Roadmap		
	Steps and actions needed	Evaluation of the suitability of the TIMBUS tools based on concrete implementation needs within the GPII
	Actions taken	H1 2014: Project kick-off and discussion of exploitation opportunities with technical GPII leads. M42: Run of TIMBUS tools on GPII development environment with mixed success.
	Current status	This will set up the work to happen once the TIMBUS redeployment tools are ready. Delays in both the delivery of TIMBUS tools and within the P4A lead towards delay.
	Timeline	M45: work package 6 Prototypes ready to be ran against a GPII scenario M45+3: Integration into the GPII upon success.

9.6.5 KIT Exploitation Initiative #3: Smart Data Innovation Lab

Structuring Big Data results in information (called “Smart Data”) which in turn leads to knowledge advantages which can be used to support decision-making processes. In order to be able to make fast use of this competitive edge for Europe, partners from industry and research have set themselves the goal to bring to life the Smart Data Innovation Lab (http://sdil/de/). The close cooperation between industry and science is intended to improve the conditions for cutting-edge research in the area of Data Engineering / Smart Data.

Since Year 3 this initiative has taken up considerable speed and since September also acquired considerable funds. As KIT is confirmed as the operator of the SDIL via the consortium agreement, TIMBUS results can be directly implemented in the operation of the SDIL. The project was officially presented at the German IT-Gipfel as part of the core national IT strategy. Changes in the exploitation plan only consider slight delays in the implementation. Table 32 below details the next KIT initiative.

Table 32: KIT Exploitation Initiative #3: Smart Data Innovation Lab

Exploitation Initiative #3	Smart Data Innovation Lab
Partnerships	Ministry of Science and Education (Germany and Baden-Württemberg) Smart Data Innovation Lab (http://www.sdil.de/partner/)
Audience(s)	German companies having need for large scale data analytics particularly partners of the initiative, that use the infrastructure provide by KIT: ABB AG Forschungszentrum BASF SE Bayer Technology Services GmbH Blue Yonder GmbH & Co. KG BOGEN Electronic GmbH Robert Bosch GmbH CAS Software AG EBID Service AG echobot Media Technologies GmbH econda GmbH EnBW Energie Baden-Württemberg AG Hitachi Data Systems GmbH Infineon Technologies AG LeserAuskunft GmbH Microsoft Deutschland GmbH PTV GROUP - PTV Planung Transport Verkehr AG SAP AG Siemens Aktiengesellschaft SOFTWARE AG Stratosphere TRUMPF Werkzeugmaschinen GmbH + Co. KG
Exploitation Goal	Inclusion of the tools developed for the mathematical simulation and sensor use case in TIMBUS WP8 in the context of the Smart Data Innovation Lab (SDIL).
Expected Exploitation Benefit(s)	The SDIL KIT provides the expert knowledge and computing resources to develop novel data analytics based on big data algorithms. As companies provide data only temporarily (i.e. it has to be deleted by terms of the contract), any algorithms and experiments done on the data need to be preserved. The infrastructure is shared so that redeployments will be a common task. Research institutions will bid for platform resources and data source usage. A committee will select about 20 parallel projects that will share

		the infrastructure. After execution of experiments only the tools and the outcome will be preserved. For scientific validity the process of creating the result with the tools needs to be recorded.
How to measure the Benefit		Funding will be provided on a per project basis (analytics task) and KIT will be rewarded for both deploying and documenting the analysis system by the funding agency that supports the individual projects (executed by third parties on KIT computing infrastructure). We expect to reduce costs for preserving and redeploying analysis workflows with the TIMBUS systems. Currently no concrete claims can be made since the cost structure inside KIT is under discussion.
Exploitation Resources		Currently we are planning for between one and a half to three people over a period of 3 years (+2 if milestones are reached) for providing the infrastructure support for the SDIL, which the preservation tasks will be a considerable part of. First batch of funding (48x1.5PM) was acquired in M41.
Dependencies		Technical: An integrated work package 6 toolset capable of performing end-to-end preservation of a BP is absolutely required. Especially a positive evaluation within the mathematical simulation use case is a precondition. Optional, but desirable, at this point is the ability to re-deploy an environment. Non-Technical: The general effort is planned but still depends on the final budget approval by the local responsible ministry that is supervising KIT.
Roadmap		
	Steps and actions needed	Procedures and operation models for the SDIL need to be worked out concretely.
	Actions taken	H1 2014: The SDIL was founded and procedures are designed for performing concrete projects. M41: Funding acquired (48x 1,5PM) from the local government M42: Installation of the first infrastructure
	Current status	The hardware was successfully installed. Currently the hardware of is tested and multi-tenant operation is prepared. A first trial pilot was successfully run on the HANA systems. IBM Watson and SAG Terracotta systems are currently installed.
	Timeline	M44: Lab evaluation of TIMBUS technologies M47: First projects will be run on top of the SDIL

9.6.6 KIT Exploitation Initiative 4: Software Campus

While the previous initiatives were started before, KIT has used concrete opportunities to exploit tools developed within TIMBUS in the scope of new projects.

Evaluating mobile application in the wild instead of a laboratory raises challenges. Experts are not able to supervise the subject and their behaviour permanently. In addition, classic evaluating measures such as user experience questionnaires might not be applicable as the user cannot answer them simultaneously to using the application.

COGPHY, Real-time Analysis of Cognitive Stress through mobile Sensors, a subproject of the Software Campus, aims at tackling these challenges. The developed framework is supposed to supervise the interaction of the user and the device and gather relevant sensor information without intrusion. Additionally, this framework might be combined with experience sampling methods (ESM) to query the user sentiment.

Another subproject, MARC², shifts the focus to user profiling and context recognition. This project also aims at intrusion-free gathering of relevant sensor information from the user.

Collected information can then be analysed and evaluated by the expert and provide user experience feedback. Thereby, the mobile device serves as a supervisor of the user in a field study similar to an expert in a laboratory one. Table 30 below details this initiative.

Table 33: KIT Exploitation Initiative #4: Software Campus

Exploitation Initiative #3	Software Campus
Partnerships	German Federal Ministry of Education and Research (BMBF)
Audience(s)	Companies having need for analysing and annotating time-series data, but especially: DATEV eG SAP AG Siemens
Exploitation Goal	Inclusion of the time-series analysis tool (TACET) developed for the mathematical simulation and sensor use case in TIMBUS WP8 in the context of the Software Campus projects with DATEC and SAP. Context integration utility used for documentation generation with Siemens.
Expected Exploitation Benefit(s)	During monitoring the subjects and smartphone users, sensor measurements are gathered that need to be evaluated. This evaluation will benefit from the TIMBUS tool in terms of analysis. The new integration framework will be the basis for a workflow to integrate resources relevant for the documentation of CPS and CPS design tools.
How to measure the Benefit	We expect to reduce evaluation effort and improve the analysis of time-series data. The proposed experience evaluation methods favours higher user experience. Reuse of (parts) the TIMBUS tools outside of their original scope reduces

		development cost and increases the tool quality.
Exploitation Resources		Currently we are planning 1+1 PM for adapting the tool to the new use case and for introducing it to the audiences.
Dependencies		Technical: Functionality of the time-series annotation tool developed in WP6. Non-Technical: Acceptance of the tool by the project partners and acceptance of the new experience evaluation methods by the users.
Roadmap		
	Steps and actions needed	Evaluation of the suitability of the TIMBUS tool based on concrete implementation needs.
	Actions taken	Consultation of the project partners and agreement of the realization. Implementation of accessing methods that will yield the sensor data to be analysed using the TIMBUS tool.
	Current status	Further implementation effort for realizing the user experience evaluation.
	Timeline	M44: Adaption of the tool for the Software Campus use cases. M45: First evaluation using the TIMBUS tool.

9.7 LNEC – Laboratório Nacional de Engenharia Civil

9.7.1 LNEC Organisational Profile

The Laboratório Nacional de Engenharia Civil
LNEC (National Laboratory for Civil Engineering) ,
Lisbon, Portugal.
LNEC Partner Summary.

LNEC is a state owned research and development institution founded in 1946. It works in the various domains of civil engineering, giving it a unique multidisciplinary perspective in this field. The main goals of the LNEC are to carry out innovative research and development and to contribute to the best practices in civil engineering. LNEC also plays a key role in advising the government in technical and scientific matters of civil engineering, as an unbiased and independent body.

The Laboratory has, at present, 556 staff, of which 46% hold a university degree and 27% are researchers with a PhD or equivalent qualification. It also has about 140 science research fellows with grants awarded by LNEC. Around 47% of the LNEC's annual budget is funded from its own revenue through scientific and technology contracts, with the balance coming from the National Budget and other sources of income.

Among other activities, LNEC carries out business processes on data acquisition, validation and transformation, as well as safety assessment through statistic and deterministic models. The main contribution of LNEC in TIMBUS is to provide concrete business processes and requirements for digital preservation, limited to large civil engineering structures, bringing technical and scientific advances to preserve business processes and data that are crucial to the civil engineering domain. Both knowledge and developed solutions will then be applied to other activities and processes performed by LNEC, following the research and development strategy of this unbiased and independent body.

9.7.2 LNEC Exploitation Introduction

The LNEC organisation vertically structures the civil engineering subjects in specific departments, namely: hydraulics and environment, concrete dams, buildings, materials, transportation, geotechnics and structures. The research vertically undertaken in civil engineering is supported by horizontal services (e.g., human resources), but also by horizontal research in the domain of information technology and scientific instrumentation.

The main goal of those horizontal research lines is to support the specific civil engineering research, but also to exploit new opportunities and solutions that can be adapted to the multiple domains of civil engineering. This is the example of TIMBUS, which is a project internally coordinated by the horizontal IT research line, aiming at applying the developed methods and tools to the full scope of the civil engineering challenges where LNEC is involved.

Consequently, LNEC sees TIMBUS as a very important part of its strategic development that will enhance its ability to compete in new markets by offering an enhanced portfolio of capabilities not readily available in the industry today. The LNEC exploitation plan mainly covers four dimensions. The first dimension is related to the GestBarragens information system, which was initially designed to manage information related to the structural safety of concrete dams (this information system supports the execution of business processes for the civil engineering domain work package.

Second, since civil engineering covers multiple domains, the LNEC internal exploitation plan addresses other civil engineering domains apart from concrete dams, such as bridges.

Third, as a public laboratory with a scientific mission, LNEC also has a scientific exploitation plan.

Finally, as an external exploitation plan, LNEC intends to address other civil engineering laboratories and companies.

9.7.3 Exploitation initiative #1: *GestBarragens* information system

Within the scope of TIMBUS, LNEC is providing the industrial scenario on civil engineering business processes related to the structural safety of large dams. Currently, LNEC is monitoring 120 concrete dams and 39 embankment dams[83]. This is happening in work-package 8 - Industrial Project 2: Civil Engineering Infrastructures and its status has been reported out in TIMBUS deliverables D8.1 - Use Case Definition and Digital Preservation Requirements, D8.2 - Use Case Specific Risks and D8.4 - Digitally Preserving CAD/CAM Business Processes. For this specific case, the main business processes are split in three sub-scenarios, namely:

- the monitoring of large civil engineering structures, i.e., the use of sensor networks to determine the actual state of the structure;
- the use of CAD/CAM information in business processes used as a daily-basis activity;
- large mathematical simulation processes that run on the scope of a cluster infrastructure, where the goal is to mathematically simulate the dynamic behaviour of a full dam through time

The use of such sensor networks also aligns with Intel's new end-to-end internet-of-things scenario which is detailed in deliverable D6.6 and also referred to in the Intel exploitation report in this document and LNEC and Intel have agreed to share any interesting research results in these areas.

The relevance of business processes in the scope of large civil engineering structures is related to the fact that the design, operation and maintenance of these structures is a matter of public safety and TIMBUS can offer an enhanced capability to provide an additional level of assurance in a way that is not available today.

At LNEC, business processes related to the dam monitoring are supported by an information system, called *gestBarragens. gestBarragens* uses an Oracle 10g database and runs on a Microsoft Internet Information Server (IIS) using the MS .NET framework 4.0. Through our work with the TIMBUS consortium, LNEC is learning how to preserve business processes such as the ones supported by the *gestBarragens* information system.

As reported in D8.2 - Use Case Specific Risks, a risk assessment was performed[84] to determine the main risks that can affect the supported business processes, considering the current systems. As a result of this analysis, several strategic, legal and operational risks were analysed, and potential control through digital preservation was evaluated in order to improve the longevity of business processes for this domain. Note that the preservation of business processes related to the monitoring of civil engineering structures is highly important to ensure:

1. Trust on previous executions and produced results.
2. Correction of executed processes with new or updated parameters.
3. Reanalysis using new references
4. Continuity with new data due to the long time span of these structures.

Since *gestBarragens* is a dynamic system that is being continuously improved, LNEC identified a set of requirements in (resulting from the research reported in deliverables D8.1 and D8.2) to reduce the dependencies from external components and also the complexity of the *gestBarragens* components, conducting a restructuring of the core application. Since *gestBarragens* is a web-application based on the ASP.NET, HTML and CSS, it was critical to restructure the application in order to fulfil with new

programming paradigms and supporting technologies, with the main goal of centralising similar functionalities in one component. Thus, instead of having multiple pages with similar behaviour, the components were isolated and reused across the application (e.g., tables with sort, filter, export capabilities are isolated in one single component that is further reused by other pages). That fact simplifies the longevity of this business processes, as well as reduce the costs of maintenance and further developments.

Before the TIMBUS began, *gestBarragens* was used to support the business processes related to the monitoring of concrete dams (LNEC concrete dams Department. As a direct result of what we have learned from TIMBUS, and the consequent restructuring of the core application, its usage was extended to the embankment dams (LNEC geotechnical Department) and is being also extended to other types of structures, such as bridges and large buildings.

Business process digital preservation capabilities improve the quality of the provided service by maintaining the functional capabilities, but improving non-functional properties that directly affect the trust of end-users. Process preservation also increases the estimated time that these supporting services can be exploited, i.e., by ensuring that the business processes and supporting activities are preserved, we can also ensure the continuity on the services supported by those business processes. Table 34, below details this initiative.

Table 34: LNEC Exploitation Initiative #1: GestBarragens information system

Exploitation Initiative #1	Improving the *GestBarragens information system*
Audience(s)	LNEC concrete dams department; LNEC geotechnical department; LNEC structures department; Dam safety authority (Water Institute); Dam owners, including EDP (the major electricity operator in Portugal) and EDIA (the owner of the Alqueva dam);
Exploitation Goal	The goal is to continuously improve the information system used to support the activities related to large civil engineering structures safety, including monitoring and long term analysis. This improvement allows the adoption of this system in different domains, as well as the potential to be exploited as a service provided to other institutions outside Portugal. Finally, we should remark that during last year, the gestBarragens system was extended to fully support Multilanguage capabilities. This goal improved the exploitation capability.
Expected Exploitation Benefit(s)	The primary expected benefit is related to the assurance of critical business processes undertaken in the scope of multiple activities that are performed to guarantee the structural behaviour of critical structures. This can only be done if the information system is behaving as determined through a long time span. On the other hand, it is also required that this system has “replay” capabilities in order to correct/verify/inspect any past anomaly or distinct behaviour. On the technical side, the TIMBUS methods and techniques affect several non-functional dimensions of the current systems, improving its scalability,

		maintainability. Additionally, indirect goals such as consultancy services, research funding, commercial funding can occur. Due to the new Multilanguage capability, the system is already being tested by Algerian users on a large bridge currently under construction.
How to measure the Benefit		Benefit is measured through number of features; known bugs; maintenance costs; market value; corrective maintenance costs; deployment costs; development costs per functionality.
Exploitation Resources		LNEC has an IT unit responsible for the technical aspects of the gestBarragens information system. This includes 2 full-time developers and a project manager. Several specific activities are performed through the responsibility of specialised resources (e.g., algorithm parallelisation). As a common information system, gestBarragens has several stakeholders related to the business domain. This aspect involves technicians and researchers from the concrete dams department, geotechnical department and structures department. Also, users from structure owners are involved in the design process. Therefore, we have no concerns around the people resourcing at present.
Dependencies		As a public laboratory, LNEC activities directly depend on the Portuguese state and on research and contract funding. Should this funding be reduced, we would struggle to be successful with this exploitation initiative but that would depend on the level of reduction and the decisions of LNEC management as to which activities would be fully pursued, which might be reduced and which might, regretfully, need to be eliminated for financial reasons. This is unlikely, but it is never the less a consideration.
Roadmap		
	Steps and actions needed	Continuous development and improvement of the information system. Multilanguage support and translation to other languages. Extend the system to be used by EDP Brazil, which owns several dams in Brazil. This is a considerable market, especially if we consider both federal and state. Exploit similar technologies in other markets. LNEC is currently involved in projects with Brazil and Mozambique, to design and develop systems related to civil engineering. Both systems will take advantage from digital preservation and long term requirements.
	Actions taken	gestBarragens was already in production when TIMBUS started. Until now, the main exploitation actions that resulted from project results and developments were: • Adoption of gestBarragens by the geotechnical department to monitor the structural behaviour of embankment dams; • Adoption of gestBarragens by the structures department to monitor the structural behaviour of bridges and large buildings • Demonstration of gestBarragens to stakeholders in Brazil and

		Mozambique; • Kick-off of projects related to structural safety, but not using directly *gestBarragens*; • Full Multilanguage support; • System already translated to French and English; • System being tested by Algerian users.
	Current status	Currently, we are capable of preserving and "replaying" the sensor monitoring processes that are supported by gestBarragens. We also developed methods to improve the capability to emulate sensors (tasks T8.3 and T8.4), preserve CAD/CAM business processes (task T8.5) and the capability to preserve large scale simulations (task T8.7). The system is now fully capable to support multiple languages.
	Timeline	M36 – M45: improve the already achieved results, by improving the service quality. M36 – M45: as a direct result of TIMBUS tasks, the sensor emulation, CAD/CAM preservation and large scale simulations will be achieved in test scenarios. After M45, we plan to generalise and put under production all the above mentioned capabilities.

9.7.4 Exploitation initiative #2: Other civil engineering domains

As an internal exploitation strategy, the validated and produced knowledge and technologies is being exploited to address digital preservation challenges and requirements in other civil engineering domains such as buildings, structures, geo-techniques, hydraulics, environment, materials and transportation. This will raise the awareness for digital preservation by other LNEC stakeholders (departments that address other civil engineering domains). The LNEC TIMBUS team can support them to improve their current processes and supporting systems

Currently, all LNEC departments have to deal with heterogeneous data sets, using internal and specific formats, and several distinct tools to support the execution of data generation (e.g., data gathered from sensors in real structures or in scaled physical models) and analysis business processes. This heterogeneity has several impacts, where some processes can only run in specific technology environments. It can also be the case where only a limited set of people possesses the knowledge required to be able to execute these processes. These departments also do research by contract, where the intellectual property produced in the scope of this contract must be packaged and delivered to the external organisations, involving preservation requirements during the life-span of these contracts. Table 35, below details this initiative.

Table 35: LNEC Exploitation Initiative #2: Other civil engineering domains

Exploitation Initiative #2	*Other civil engineering domains*
Audience(s)	LNEC internal departments that address problems that are not related to large dams.

Exploitation Goal		The goal is to make critical and valuable processes digitally preserved for the LNEC overall organisation, including other civil engineering domains, such as transportation, buildings, material or seismic.
Expected Exploitation Benefit(s)		Apply information management and digital preservation methods and best practices horizontally to LNEC processes and projects. This has the potential to reduce the operational costs of running services, especially those that have strong dependencies on people and/or technology, as well as reducing the risks of being unable to reuse a valuable process, or loosing information that must be delivered to an external organisation.
How to measure the Benefit		The spreading of digital preservation will be mainly measured by the ease to reuse information and processes, both in the same unit, but also across multiple units. It is also expected that it will create new projects and collaborations (both internal and with external organisations).
Exploitation Resources		The LNEC IT unit is responsible to horizontally spread the digital preservation achievements accomplished in TIMBUS to other units.
Dependencies		As a public laboratory, LNEC activities directly depend on the Portuguese state and on research and contract funding. From a technical perspective, it also depends on the completion of tools, techniques and methods as well as their application to the LNEC use case in dam safety.
Roadmap		
	Steps and actions needed	Continuous application of TIMBUS methods in LNEC use cases in the scope of large concrete dams; Internal dissemination and training to other units and departments; Creation of an internal and horizontal competence centre to provide internal consultancy on digital preservation, information management and information systems in general.
	Actions taken	The problem of digital preservation and the TIMBUS approach was disseminated to the other departments. Currently, the IT unit is being consulted by several departments to provide consultancy in multiple systems. Also, the IT unit is being requested to elaborate project proposals (for H2020 or other contracts) designing systems and solutions where digital preservation is seen as a common concern in long-term systems such as those related to long-lasting civil engineering structures. To support the internal exploitation, a new collaboration IT committee was created, including one researcher from each of the vertical civil engineering departments (hydraulics and environment, concrete dams, buildings, materials, transportation, geotechnics and structures) that act as contact point, along with the researchers from the IT unit. The goal is to actively seek for opportunities related to information management and digital preservation.
	Current status	Currently, the information system that is driving the TIMBUS WP8 use case was extended to other internal departments. We are involved in several project proposals where digital preservation can make the difference for an accepted proposal.

		From the last reporting period, two additional relevant actions were achieved: • Special project on Building Information Modelling (BIM), where LNEC is driving the standardization of BIM in Portuguese public constructions. This involves multiple processes and multiples actors, from architects and engineers to constructors; Nacional Cloud Initiative Pilot: the Portuguese National Scientific Foundation is driving a Cloud pilot that intends to create a national cloud infrastructure for the scientific community. The goal is to create a hybrid cloud IaaS, where multiple types of applications and processes can run. LNEC is contributing with multiple case studies. On the other hand, after this national pilot, our goal is to extend the scientific infrastructure with preservation capabilities for both data and processes.
	Timeline	M36 – M45: improving the service quality and normalise systems, processes and procedures to be used by multiple departments. M36 – M45: we have a huge expectation on the results of the preservation of mathematical simulations, as this is a process where we are facing several preservation problems and is widely used across LNEC departments. M45 – after: we have strong expectations on exploitation results that might be achieved in collaboration with the two new initiatives, namely on the BIM standardization and on the scientific cloud pilot.

9.7.5 Exploitation initiative #3: Scientific exploitation

Since the main mission of LNEC is to carry out innovative research and development in the civil engineering field, the scientific results produced in the scope of TIMBUS constitute an important asset for the organisation. The work carried out in TIMBUS can be further exploited to support the internal research programme producing new and updated knowledge in the scope of new PhD Theses and internal researchers work.

During Year 2, a LNEC TIMBUS team member completed his PhD, where digital preservation was addressed as a risk management problem. During Year 3, another member completed his PhD applying techniques to process data gathered from the sensor monitoring systems.

As a follow-up of TIMBUS, we plan to have a full time researcher and a PhD student directly exploiting digital preservation in the scope of civil engineering. However, considering the current budget limitations, we did not achieve yet this goal. The hiring of such resources is depending on external funding that can be achieved through the exploitation initiatives #1 and #2.

The expected impact is being disseminated in scientific journals and conferences (e.g., International Commission on Large Dams meeting, Journal of Computing in Civil Engineering) and, eventually, on new funded projects that could exploit digital preservation in a European civil engineering network. Table 36, below details this initiative.

Table 36: LNEC Exploitation Initiative #3: Scientific exploitation

Exploitation Initiative #3	Scientific exploitation

Audience(s)		Research community, especially the civil engineering practitioners that pursue innovation through research and development. The ICOLD (International Commission on Large Dams) is an important group that aggregates several practitioners in the domain of large dams to share knowledge amongst specialists.
Exploitation Goal		Promote and use TIMBUS work and collaborations in other projects or research activities; Promote research undertaken in TIMBUS in conferences, journals and other dissemination events.
Expected Exploitation Benefit(s)		Increase reputation as experts in multiple fields; Pursue new collaboration opportunities among the scientific and industry communities, including new research funding options and/or new research projects.
How to measure the Benefit		Number of accepted publications; Participation in dissemination events. New research and industry funded projects.
Exploitation Resources		All LNEC researches are required to regularly publish results of their work and encouraged to pursue new collaboration opportunities (these factors constitute and important part of the internal evaluation process which directly impacts the researchers' career).
Dependencies		The publications mainly depend on the quality of the research work, the relevance of the subject and the quality of the event/journal. Additionally the quality of the event influences the quality of the audience that may correspond to more or less opportunities to pursue new collaborations.
Roadmap		
	Steps and actions needed	Write and publish about the work being done. Pursue new collaboration opportunities when presenting it.
	Actions taken	Since the beginning of TIMBUS, LNEC has: • published 17 scientific papers with peer-review; • published 1 technical report; • finish 2 PhD thesis In collaboration with our colleagues from SBA and INESC-ID, LNEC was able to receive the best paper award of a paper entitled "VPlan – Ontology for Collection of Process Verification Data" at IPRES2014.
	Current status	LNEC was able to accomplish a significant set of scientific publications, especially those in collaboration with other TIMBUS partners. Dissemination to the civil engineering community was not as we would like, and should be our target for future publications.
	Timeline	M36 – M45: Submit new publications and present at scientific events, especially at civil engineering meetings.

9.7.6 Exploitation initiative #4: Other civil engineering laboratories and companies

LNEC is working to disseminate digital preservation knowledge, technologies and best practices across organisation in the civil engineering domain, especially into European and African laboratories, as well as construction and instrumentation companies. LNEC's involvement in TIMBUS is enabling it to provide improved digital preservation services enhancing its ability to compete for and win new clients.

From the TIMBUS consortium and the specific collaboration with SAP, LNEC is involved in the FP7 iWidget (Improved Water efficiency through ICT technologies for integrated supply-Demand side management) project, which intends to advance knowledge and understanding about smart metering technologies in order to develop novel, robust, practical and cost-effective methodologies and tools to manage urban water demand in households across Europe, by reducing wastage, improving utility understanding of end-user demand and reducing customer water and energy costs. Moreover, LNEC is involved in three information systems with external organisations, where TIMBUS methods can potentially be exploited[85]:

- Collaborating with the World Bank in a project to manage risk information about all dams in Brazil (approximately 11.000 dams). The design of this system was completed during the last year review. The project is currently on the software development stage.
- Design and implementation of a dam information system to manage the dams in Mozambique. The system was fully developed by LNEC during the last year. The Mozambique water authority is currently testing it. The system should go into production shortly.
- Monitoring of a large bridge in Algeria. During the last year, the system was adapted to support the Algerian bridge processes. Also it was extended with Multilanguage capability to support, for this specific case, the French language.

Table 37, below, details this initiative.

Table 37: LNEC Exploitation Initiative #4: Other civil engineering laboratories and companies

Exploitation Initiative #4	Other civil engineering laboratories and companies
Audience(s)	External companies, research laboratories and universities (in Portugal and worldwide). Including, but not limited to the World Bank in Brazil; The National Environment Agency; the Technical University of Lisbon, the Oporto Faculty of Engineering; the Engineering Laboratory of Angola, the Engineering Laboratory of Mozambique; the Brazilian National Water Agency, EDP (Portuguese electricity company, which also operates outside Portugal), The Brazilian water authority and the Mozambique water authority..
Exploitation Goal	Promote and use the LNEC research, especially including the results of the TIMBUS work and collaborations, in other projects or research activities;
Expected Exploitation Benefit(s)	New projects and collaborations with external companies, laboratories and universities.
How to measure the Benefit	Numbers of new projects and/or collaborations that directly or indirectly result from the research carried out in TIMBUS.
Exploitation Resources	Mainly the LNEC TIMBUS team, but also the full set of LNEC workers that can create channels to exploit our work.

Dependencies		The main dependencies to externally exploit our work are, indeed, the quality of the produced work and the proof of concepts achieved in the materialised scenarios in work-package 8.
Roadmap		
	Steps and actions needed	Continuously seek for new opportunities; completion of current projects and collaborations with external partners.
	Actions taken	Since the beginning of TIMBUS, LNEC has: • Started a FP7 project (iWidget) that in the hydraulics domains, where SAP is also a member of the consortium; • Started a project to design the national information system for dam safety to the Brazilian Agency of Water, in collaboration with the World Bank; The system analysis and design was finished during the last year. The system is currently under development by a software house. • Design and development of the Mozambique information system to manage the national dams. The Mozambique water authority is testing it. • Started developing the mechanisms to support the sensor acquisition processes in a bridge in Algeria. Currently, the system supports the French language, supports all processes for the sensors installed on that bridge and is able to send all sensor data to LNEC systems.
	Current status	LNEC is currently involved on the projects mentioned in the “Actions taken”.
	Timeline	Continue its involvement in the above mentioned projects: • iWidget project until 2015; • Design the national information system for dam safety to the Brazilian Agency of Water. Initially, the collaboration with the World Bank, was planned until December 2014, but we received several requests to continue our collaboration with new initiatives. • Development of the Mozambique information system to manage the national dams. The system is under test and evaluation by tee end users since October 2014. The new phases should start on January, 2015 • Mechanisms to support the sensor acquisition processes in a bridge in Algeria. The first deployment phase was in May 2014. The system is being continuously extended to support a continuous monitoring service for the next years on an annual contract basis. Note that this service is called “service engineering”, as LNEC provides the technical systems, but also the structural safety engineering procedures on top of processes supported by our systems.

9.8 SAP – Systems Applications and Products

9.8.1 SAP Organisational Profile

SAP Research CEC Belfast,
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As market leader in enterprise application software, SAP (NYSE: SAP) helps companies of all sizes and industries run better. Founded in 1972, SAP (which stands for "Systems, Applications and Products in Data Processing") has a rich history of innovation and growth as a true industry leader. Today, SAP has sales and development locations in more than 50 countries worldwide. SAP applications and services enable more than 183,000 customers worldwide to operate profitably, adapt continuously and grow sustainably.

From back office to boardroom, warehouse to storefront, desktop to mobile device, SAP empowers people and organisations to work together more efficiently and use business insight more effectively to stay ahead of the competition. We do this by extending the availability of software across on premise installations, on-demand deployments and mobile devices.

SAP is the world's largest inter-enterprise software company and the world's third-largest independent software supplier, overall. SAP employs about 48,000 people in more than 50 countries. SAP Research is responsible for identifying, researching, understanding, developing and evaluating new and emerging technologies, processes and e-business solutions that strategically influence the future of SAP business applications.

9.8.2 SAP Exploitation Introduction

SAP offers solutions like enterprise resource planning (ERP), financials (FIN), human capital management (HCM), customer relationship management (CRM), supplier relationship management (SRM), supply chain management (SCM). The target market is organizations of every size, from the largest companies, to small businesses and midsize enterprises (SME). The major goal of SAP is to enable best run businesses for its customers and ensure optimized businesses with business continuity.

However, in order to ensure continuity for the business processes, developing an understanding of the business processes executing within an enterprise is the first immediate and crucial challenge. Once this challenge is addressed, the next step is to analyse the business processes from the risk perspective to make sure that the business processes are best run, and there are business continuity plans in place, to ensure continuity for all critical business activities, resources and services, needed for the efficient execution of business processes. However, business processes are either not documented or poorly documented within organizations. Even if documented, the abstraction level is too coarse-grained, and is mainly targeted towards human understanding. The actual execution of business processes and all the exceptions happening in the execution are not reflected in the modelled or documented business processes. The documented or modelled business processes are, therefore, not accurate enough to be used as information sources in a decision support system. A risk management solution, based on documented business processes, is unable to offer any real benefits. Dependence on third party service providers further complicates the picture by exposing enterprises to additional risks inherent within

such scenarios, including third party services becoming incompatible, service providers going bankrupt or technical failures, etc.

The major focus of SAP research team within TIMBUS project has, therefore, been on the development of business process oriented intelligent risk management solution. This included the design and implementation of the iERM solution as well as the integration of the different enterprise data sources including IT landscape data, risk data, process logs, etc. with the risk management solution to automate the risk management process. SAP TIMBUS team has further developed static and dynamic business process extractors in order to automate the import or business process models into the iERM solution eliminating the need to manually model the process models into the iERM solution. Digital preservation is made available as an integrated risk mitigation strategy within the iERM solution, to cater with the long-term availability requirement of certain resources.

A successful exploitation of a research project with in SAP research is generally measured in terms of the technology transfer projects carried out in order to transfer valuable research outputs either into SAP existing products to enhance them or to drive completely new products. A realization of these transfer projects is itself a very challenging process itself. This includes presenting research results at various SAP internal venues such as SAP Development Kick-Off Meetings (DKOM), SAP TechEd, SAP Annual Research Day, etc. These events are attended by a very large audience from all over SAP including middle and higher management people from development and product groups. These events are further streamed live within SAP, and put in an internal media share repository so that everybody within SAP is able to watch. Due to the high visibly these events offer there is a strong competition from all over SAP to have the novel work selected and presented in such events. The project visibility increases significantly when the projects results are presented in such events. Then, people from different development and product groups, who identify the work as interesting and relevant for their products, approach to set up collaborations in the form of technology transfer projects. The technology transfer projects involve either integration of the research results into the existing products as proof-of-concepts (PoC's) if possible, or preparing more matured standalone PoCs to drive completely new solutions that address customer's pain points. After this stage the next step is the formal productisation of the research results, which is a formal internal process within SAP involving allocation of resources from within SAP and executing the work with the rigor of a product development project.

As stated earlier, SAP's major output in the TIMBUS project has been an intelligent risk management and business continuity solution. SAP research team has been leveraging the results achieved in the research areas of intelligent Enterprise Risk Management (iERM) and business continuity to drive a novel stand-alone Business Continuity Management (BCM) solution, and also to enhance existing business process management solutions with the business continuity perspective. SAP research team has carried out numerous technology transfer projects with internal SAP product groups to enhance existing business management platforms with business continuity support, and to drive also a standalone solution that automates all the manual business continuity activities to simplify the process and offer better results. This work is already being pushed to be productized by the TIMBUS team together with SAP IT team.

The second significant output for SAP has been the development of business process extractors within the Context Model work, particularly for business process discovery from the process logs, and to mine performance and resource information from the process logs. This information is then used by the risk management solution in carrying out a process oriented risk management. The context extractor work within TIMBUS is, therefore, being leveraged to enable process-centric decision support for SAP business execution and management platforms.

Another important contribution from SAP to the TIMBUS project is to provide a use case so that the tools and technology developed in the project can be evaluated in the context of the use case. Since SAP is not allowed to share its or its customer's business processes with the TIMBUS partners, the SAP

Research team has implemented a prototype eHealth use case to share with the TIMBUS consortium. This use case is realising a service-oriented Decision Support System (DSS) for assisting in a drug prescription scenario called DrugFusion. DrugFusion aims to help doctors and pharmacists to make the most effective choice of treatment for each individual patient's condition. This use case has a potential to become a base for the future eHealth related projects.

9.8.3 SAP Exploitation Initiative #1: iERM

In the start of the project, SAP TIMBUS team defined two major exploitation initiatives, and has made noticeable success in achieving these two initiatives. SAP TIMBUS team has worked very closely with the relevant internal SAP development and product groups, particularly in the areas of iERM (Business Continuity Management) and Process-oriented decision support systems. SAP TIMBUS team has the thought leadership in these two areas within SAP. The following tables provide more concrete information about the initiatives, the partnerships, the specific goals, and the roadmap to achieve the initiatives. Table 38 below details this initiative.

Table 38: SAP Exploitation Initiative #1: iERM

Exploitation Initiative #1	iERM for business process centric risk management and business continuity management (Confidential)
Partnerships	SAP IT Security and Risk
Audience(s)	SAP internal product groups, External SAP Customers, Business Continuity community
Exploitation Goal	The goal is to develop an iERM based operational risk management and business continuity solution to be rolled out for internal usage as well as to offer to SAP customers.
Expected Exploitation Benefit(s)	A successful outcome will be a favourable evaluation of the iERM workbench in the context of TIMBUS industrial use cases as well as SAP internal use cases. Work with the internal SAP groups to transfer the knowledge and expertise that we have gained from within TIMBUS project to help drive a business continuity solution. Our research is expected to accelerate our product development groups and form part of a larger overall product offering.
How to measure the Benefit	Number of demonstrations within SAP Feedback from the internal and external product and development groups Internal technology transfer projects
Exploitation Resources	The resources available within SAP TIMBUS team were appropriate to produce a research prototype solution for intelligent enterprise risk management, which is able to reflect the novelties in this approach, and is able to demonstrate the added value in terms of improved risk management. However, the proper productisation of iERM would follow a specific and formalised process. Once the work goes through the productisation phase, a proper development team will be allocated that would take the research prototype and transform into product with support from SAP Research TIMBUS team, according to SAP standards and development guidelines and quality standards.

Dependencies		There are technical dependencies in terms of reliance on other TIMBUS tools for different tasks, such as risk prioritisation, digital preservation, etc. Additional resource specific dependency is the availability of enough resources for the productisation process.
Roadmap		
	Steps and actions needed	Establishment of technology transfer projects and push towards productisation.
	Actions taken	SAP Research team has been very successful in identifying and connecting with the relevant SAP internal stakeholders (product and development groups) and in establishing transfer projects with these groups in order to transfer the TIMBUS technology into existing products and to drive new solutions. Following is the list of internal SAP groups that were established as stakeholders for the iERM work, and with whom transfer projects were carried out: ▪ SAP Business Continuity Management ▪ SAP GRC – Security and Risk ▪ SAP NetWeaver BPM – SAP Operational Process Intelligence ▪ SAP Process and Governance The SAP TIMBUS team has successfully completed nine technology transfer projects with different product / development groups within SAP. These projects involved transferring parts of the research novelties into PoCs which have been presented to the high level management for formal productisation. The internal perception of research within TIMBUS is already very positive. The following table provides concrete information about the different technology transfer projects that we have been carried out, along with the names of the internal product and development groups:

Year	Project Name	SAP Internal Group
2014	Business Continuity Management Solution for SAP IT – POC for SAP Cloud Solution Offering	SAP IT Security and Risk
2013	Business Continuity Management Solution for SAP IT III	SAP IT Security and Risk
2013	Simulations for Business Suite Powered by HANA II (OpInt Project)	SAP HANA Plat I/O BPM
2012	BizInsight – Business Decisions with Insight	Thought Leadership Project
2012	Simulations for Business Suite Powered by HANA I (OpInt Pro-ject)	HANA Plat I/O BPM

2012	Business Continuity Management Solution for SAP IT I	SAP IT Security and Risk
2011	Real-time Analytics and Predictions for NetWeaver BPM	SAP TIP CORE I/O BPM
2011	Business Continuity Management Solution for NetWeaver BPM	SAP TIP CORE I/O BPM
2011	BCM Tooling for Business Impact Assessment	SAP IT Security & Risk

SAP TIMBUS team has further demonstrated the iERM solution in the following internal and external venues:

- Business Continuity World Conference 2014
- Presentation to SAP IT for productisation 2014
- Presentation to the SAP Process Governance Head 2014
- Presentation to SAP Process Maps Team 2014
- SAP DKOM 2013
- Northern Ireland Business Continuity Institute Workshop November 2012
- Presentation to SAP Research Head – March 2012, July 2012
- Presentation to SAP Pre Sales team – Nov 2012
- SAP DKOM 2011, 2012
- SAP Research Day 2011
- SAP Critical Process Owners Workshop - 2011

We have already implemented PoCs, where we have integrated the iERM work with SAP existing solutions including SAP NetWeaver BPM. The BCM solution is planned to be employed by SAP Business Continuity Team first for internal work, and once evaluated internally, the solution will be productized and available to external customers as well.

SAP TIMBUS team has further attended a number of external events to provide training, education about the iERM solution. Some of the events that were:

- QUEENS University / Tutorial
- Lancaster University - Lecture + Demo
- PASIG - Demo
- BCM World Conference 2012
- BCM World Conference 2014

In 2014, we demonstrated the iERM solution in the BCI World Conference &

		Exhibition in London. This conference was attended mainly by the Business Continuity professionals from around the world and from many different large companies. This conference provided us an ideal platform to connect to the business continuity professionals and we demonstrated them the value of the research work. The feedback from the business continuity professionals was excellent with most of them confirming that iERM was the only solutions they have come across that offers end-to-end business continuity solution and they would be waiting for it to become available as a product in the market.
	Current status	We still have ongoing transfer projects with SAP IT and SAP BPM where we are integrating additional data sources with the iERM solution including Signavio Process Maps and SISM (infrastructure) database, etc.
	Timeline	M36: iERM integrated with the Process Mining extractors to get all the process related information automatically from SAP business process management platform into the iERM environment. M40: iERM integrated with SAP CMDB database to extract IT level dependencies M43: Integration work to connect to SAP Cloud solution logs and additional data sources for providing business continuity solution for cloud-based applications. M44: Demonstration to provide business continuity analyses service for SAP HANA Enterprise Cloud solutions. M45: PoC successful; seek management approval for productisation.

9.8.4 SAP Exploitation Initiative #2: Business Process Extractors

This second exploitation initiative concerns with the transfer of our Process Extractors research output into internal products that are designed for enabling process-oriented decision support. Table 39, below details this initiative.

Table 39: SAP Exploitation Initiative #2: Business Process Extractors

Exploitation Initiative #2	Business Process Extractors for SAP Business platforms for Process-oriented decision support (Confidential)
Partnerships	SAP NetWeaver BPM – SAP Operational Process Intelligence, SAP IT Security and Risk
Audience(s)	SAP internal product groups, External Customers
Exploitation Goal	The goal is to enhance existing business management platforms (that is, SAP product offerings in the market today) with process-oriented decision support systems and process-oriented risk management.
Expected Exploitation Benefit(s)	A successful outcome will be the favourable evaluation of the process mining extractors in the context of the TIMBUS industrial use cases as well as SAP internal use cases.

		Work with the internal SAP groups to transfer the knowledge and expertise that we have gained from within TIMBUS project to help drive a process-oriented decision support solution.
How to measure the Benefit		Number of demonstrations within SAP Feedback from the internal and external product and development groups Internal technology transfer projects
Exploitation Resources		The resources available within SAP TIMBUS team are appropriate to produce a research prototype solution for process-oriented performance and risk management. However, the proper productisation of process-oriented decision support solution would require allocation of additional internal resources (team of developers) that will take the research prototype and transform into product with support from SAP Research TIMBUS team.
Dependencies		There are technical dependencies in terms of different business management platforms, customers providing different log formats. This will always necessitate customisation work, which would mean transformation of available logs first into the extractor's specific format before the processes could be mined out of them. Additional resource specific dependency is the availability of enough resources for the productisation process.
Roadmap		
	Steps and actions needed	Establishment of technology transfer projects and push towards productisation.
	Actions taken	SAP TIMBUS team has carried out a number of technology transfer projects with different product and development groups within SAP. Following is the list of internal SAP groups that were identified as stakeholders and with whom technology transfer projects were carried out: ▪ SAP Business Continuity Management ▪ SAP GRC – Security and Risk ▪ SAP NetWeaver BPM – SAP Operational Process Intelligence ▪ SAP Process and Governance We have further demonstrated the Process-Oriented Performance and Risk management work in various internal and external venues. ▪ SAP DKOM 2011, 2012, 2013 ▪ Presentation to SAP Research Head – March 2012, July 2012 ▪ Presentation to SAP Pre Sales team – Nov 2012 ▪ SAP Research Day 2011 ▪ SAP Critical Process Owners Workshop - 2011 We have already implemented PoCs, where we have integrated the Process mining extractors with SAP existing solutions including SAP Business Suite and SAP NetWeaver BPM. We have finished one PoC this year, which showed the end-to-end solution of starting with the logs, running the simulations and then

		identifying the bottlenecks in the business process from the performance and risk perspective. This work is planned to be productised in 2015.
	Current status	We have finished one transfer project with SAP BPM last year where we integrated the process-oriented decision support with the SAP Business Suite. The results were shown by the Chief Product Owner within SAP as well as to SAP customers for further feedback.
	Timeline	M36: Process mining extractors integrated with iERM. M40: Process mining extractors working for real time business processes M44: End-to-End performance based decision support based on process, performance and resource extraction. M45: PoC successful; seek management approval in SAP for productisation.

9.9 SBA – Secure Business Austria

9.9.1 SBA Organisation Profile

Secure Business Austria
Vienna,
Austria.

Secure Business Austria is an industrial research centre for information security and was founded in 2006 by three universities: the Vienna University of Technology, the Graz University of Technology and the University of Vienna. In its second research phase from 2010 to 2017, the Vienna University of Economics and Business and the University of Applied Science St. Pölten joined the centre as a full academic partners. SBA brings together these Austrian universities and bundles their research activities in the field of information security. SBA currently employs more than 100 researchers and is located in Vienna.

SBA's main aim is to perform basic research with a clear heading towards a practical usage by industrial partners or general use. SBA has four main areas of research:

(1) Governance, Risk and Compliance

(2) Data Security and Privacy, including Digital Preservation

(3) Secure Coding and Code Analysis

(4) Hardware and Network Security

9.9.2 SBA Exploitation Introduction

As a research centre our key success indicator for advancing research in Digital Preservation is publishing papers at international research conferences. In the current reporting period we were able to publish new research findings within ten conference publications. We were able to do that on conferences such as iPres 2014, EDOC'14, and IEEE eScience 2014. SBA won the "Best Paper Award" for one of our publications at iPres 2013. We again won the "Best Paper Award" on iPres 2014. Additionally, we built on the strengthened collaboration with our partners of the TIMBUS consortium from the previous year, in particular, INESC-ID, ITM, SQS, and LNEC, by publishing together.

As we are still involved in the APARSEN project and in the 4C project, we were able to sustain our links and synergies within both for the research work done. We also actively participated in the Data Citation Working Group within the Research Data Alliance network, with Andreas Rauber being one of the chairs of said working group. The TIMBUS project allowed us to establish and strengthen our research portfolio with respect to digital preservation, data and process management. Proposals for new and follow-up projects were done because of our engagement in TIMBUS. We were able to convince new partners and businesses of our expertise on the field of processes management in order to bring together a consortium for new projects on the topic of preserving data analysis processes in the e-Health sector. And we strengthened our collaboration with established partners like SQS and CMS and were able to bring our knowledge to other areas like the mobile security domain, for which we submitted a project proposal together.

Members of SBA were also attending conferences and workshops where we used the opportunity to present work done in TIMBUS and get into contact with other scientific representatives from inside and outside of Europe. At the "Digital Preservation – Advanced Practitioner Training" in Vienna in July 2014, we presented work done on the context model and data citation, which were well received by the

audience. A context related tutorial was also given at the iPres 2014, as well as at the Digital Libraries (Joint JCDL and TPDL conferences) 2014, from which we both received overall positive feedback. The latter two tutorials were held in conjunction with partners from the WF4Ever project, thanks to our close cooperation with them.

Through the involvement in research projects such as TIMBUS we were able to maintain our organisations highly influential position in the global Digital Preservation community. Thus we chaired for instance events like DPRMA 2013, which was co-located with the DASPOS 2013 workshop at the JCDL 2013 in Indianapolis, USA. We held a workshop there together with the WF4Ever project on TIMBUS results.

We further presented our work to a broad spectrum of events and conferences, where process preservation is an issue, such as computer science, process management plans, e-Science, and research infrastructures. The TIMBUS work was presented at INFORMATIK 2014, e-Science 2014, IEEE Big Data 2013, DATA 2014, IEEE EDOC 2014, iPRES2014, EDOC 2014 and iiWAS2014.

The open research challenges identified in WP5 of TIMBUS showed a number of research topic that were initially invested. SBA will take on some of the topic identify and further investigate the topics and potential application within other research projects with a focus on the area of e-science in particular data citation, process management plans and the context model. The work within TIMBUS shows the potential of the topics and the investigated approaches, more research work is required to improve the maturity of the solutions and to evaluate their fitness for other domains.

The TIMBUS project allowed us to strengthen our position as key player in the Digital Preservation scientific community. This will support us in continuing our research after TIMBUS and be involved in follow-up research and industry projects. Moreover we were able to further establish SBA as a competence centre for Digital Preservation. Through work done in scientific projects in the DP domain we were able to strengthen our core capabilities and plan on continuing this and broaden our competences.

Staff members at SBA finished their TIMBUS related Master theses, e.g. on resilient web services and process virtualisation. In connection with the Technical University of Vienna we offer Bachelor and Master Theses, e.g., on the topic of citable data bases. Within the project duration we held lectures of three Digital Preservation course each summer term at the Technical University of Vienna, where TIMBUS topics were presented to the students. The Digital preservation laboratory course were held in and small projects on TIMBUS related topics were implemented with students. Overall we received positive feedback from the students attending the lecture and lab course, which resulted in further participation through theses in the Digital Preservation field. We will continue contributing to the Digital Preservation courses after the TIMBUS project. Presenting the final results of our TIMBUS work will keep the awareness for long term process preservation, which we see as one of the largest challenges in this domain.

SBA's portfolio includes research as well as the development of software. The release of open source software from within the TIMBUS project has therefore strengthen a key business position for our company. Thus we set our focus on expanding our software development to reach established and new groups of prospective customers with our tools. Yet we were able to develop and contribute various software developments. For instance, our converter extracts Taverna workflows and converts them to Archimate models, a tedious task if done manually. We developed a Protégé visualiser for a visual representation of DSOs and an Archi to OWL converter, which transforms Archimate models to OWL files. We also developed a technical framework to support the quality assessment for software development artefacts that can be used by Software Escrow agents in their contract preparation. Further prototypes were developed in regards with the "Open research challenges" task, for example on

data citation. The feedback for the software tools was very positive and SBA has a vital interest in maintaining the developed tools within their software portfolio.

Interest on Digital Preservation is growing in the domain of data security. Our aim is to contribute the findings of TIMBUS to the security domain and establish SBA as a competence centre for this knowledge. To this end we will contribute in research projects as key player to enhance research in this area.

The TIMBUS project allowed SBA to acquire detailed expertise in process management for the long term. The project has strengthen our position as high quality research center. While the gained expertise through the TIMBUS project increases our research portfolio ensuring competitive application for research projects. The findings of TIMBUS will be further used in other research projects of SBA.

9.9.3 SBA Exploitation Initiative #1: Training

Increasingly the awareness for preserving business processes rises in the Digital Preservation community. To exploit the results of TIMBUS and offer the expertise we gained in the project so far, workshops and other training are needed to bring the gathered knowledge to the community for exploitation. Table 40, below details this initiative.

Table 40: SBA Exploitation Initiative #1: Training

Exploitation Initiative #1	Training new and experienced participants at business process preservation workshops
Partnerships	DPC, WF4Ever partners (Oxford e-Research Centre, Poznan Supercomputing and Networking Center, Universidad Politecnica de Madrid), SCAP partner (Science and Technology Facilities Council STFC)
Audience(s)	Business process preservation manager. The audience is made up of the different attendees at training events and is therefore open to whoever decides to attend our various events.
Exploitation Goal	The goals of this initiative are as follows: (1) Offer workshops and training on results of TIMBUS to experienced and new researchers and customers. (2) Expand the palette of existing training (3) Create additional exploitation opportunities within the Digital Preservation community and domains outside of the core DP community, e.g. research infrastructures. For the previous reporting period we presented TIMBUS and its results at conferences and workshops inside and outside of Europe: in Glasgow, at iPres 2013, the TPDL, and the DPRMA.
Expected Exploitation Benefit(s)	(1) Increase the awareness for preserving business processes (2) Exploit directly the results of TIMBUS findings by offering our expertise to interested audiences
How to measure the Benefit	(1) Increased number of workshops being run on this topic compared to the years before (2) New business contacts from training events
Exploitation	The resources needed for training are SBA's employees and training events. At

Resources		present we are working together with other TIMBUS partners when doing training, and we want to enhance this approach. As each employee is able to present his own area of expertise a lack of resources (i.e. a staff member not able to do a training course) is not anticipated. In order to reach a critical mass of listeners we submit proposals to different events interested in the topic. As the topics of TIMBUS we are dealing with are expanding, more and more events are suitable for our trainings.
Dependencies		The training material presents the outcome of our work in the work packages. The high quality and range of topics addressed in the project help us to provide interesting training events and workshops for various audiences. If the work there is not preceding we have to fall back to already presented material and thus will probably loose audience.
Roadmap		
	Steps and actions needed	Extract new training material from the findings of the final reporting period.
	Actions taken	2011-present: By working on different TIMBUS tasks we successfully developed input for several training events.
	Current status	We have delivered trainings on context modelling, data citation and, as well as process preservation in general, on the following events: • Digital Preservation – Advanced Practitioner Training, July 2013, Glasgow, UK • iPRES 2013 Conference, September 2013, Lisbon, Portugal, in collaboration with WF4ever • TPDL 2013 Conference, September 2013, Malta, in collaboration with WF4ever • Digital Preservation – Advanced Practitioner Training, July 2014, Vienna, Austria • Digital Libraries 2014 Conference, September 2014, London, UK, in collaboration with WF4ever • iPRES 2014 Conference, October 2014, Melbourne, Australia, in collaboration with WF4ever
	Timeline	M30-M38: Identification of audience as we need to define specific targets for the training. These may be organisations, who are members of bodies such as the DPC, or they may be associated with the university, or they may be leading SME's in Austria, or elsewhere, whom we have a business relationship with. M36-M38: Submitting proposals to new training events M36-M38: Developing training materials M38-M43: Doing training at different events M38-M43: Gather and analyse feedback from events

		M38-M43: Feedback cycle based on event evaluations. Tweak or alter training materials. M44-M45: Final summary and evaluation of training events held in which SBA participated.

9.9.4 SBA Exploitation Initiative #2: Advance Research in Digital Preservation

As a research center as well as a competence center on IT security, SBA tries to advance the research on security in Digital Preservation especially with respect to business processes. SBA's portfolio includes research as well as the development of software, which is why the release of open source software from within the TIMBUS project can strengthen a key business position for our company. Table 41, below details this initiative.

Table 41: SBA Exploitation Initiative #2: Advance Research in Digital Preservation

Exploitation Initiative #2		Advancing the development of open source software projects for business process management.
Partnerships		The TIMBUS consortium members. No external partners are involved in this.
Audience(s)		Organisations and companies need for process management addressing capturing, analysis, and preservation of business processes
Exploitation Goal		Advancing the SOTA research in digital preservation especially with the focus on business processes. Establishing SBA as a software development provider who can contribute this highly valuable and unique combination of security and digital preservation. Development of software tools supports the research work. Bear in mind that is it not SBA's intention to launch a software product, but we want to establish our product development skills in order to work with companies in commercial projects in the future.
Expected Exploitation Benefit(s)		Software development projects and open source software tools. SBA is targeting 2 to 4 new projects with focus on development and customisation of tools for customers.
How to measure the Benefit		(1) Utilisation of software in other projects, by partners, by customers. (2) The number of new development projects that launch with SBA involved in them.
Exploitation Resources		Developers are needed to produce the tools, as well as researchers and experts with the required knowledge and expertise. Funding of the researchers and experts as well as management support is needed as well.
Dependencies		The tools are dependent on research results from TIMBUS work, professional staff, and suited skillsets.
Roadmap		
	Steps and actions needed	Adapt existing tools to current TIMBUS results and develop new software based on the results of the new deliverables.

	Actions taken	2011-present: During the TIMBUS project we have developed a range of software tools needed for process preservation. The tools include a Taverna to Archimate converter, a Protégé visualiser, an ontology comparator, a process migration framework and a technical framework for software escrow.
	Current status	At present we are testing, adapting and developing software mentioned above, for deliverables D5.6 and D6.9. The tools are published on the Open Source Projects Europe Website for the public.
	Timeline	M30-M38: Identification of target audience and potential customers for development projects within the DP community, medium and large enterprises in Austria and existing SBA business contacts M36-M38: test tools with use case partners From M38: going public with open source software, publishing, and advertising amongst target audience M38-M42: Discussions with identified organisations in the field, including demonstrations of the tools. These discussions are effectively stakeholder meetings where SBA will get feedback but also explore potential opportunities for collaboration on projects. M42-M45: Refinement of implementation according to feedback

9.9.5 SBA Exploitation Initiative #3: Educating students

As a research centre that is well connected to the Vienna University of Technology as well as the Vienna University, we work closely with students on various projects and theses (master and PhD). By educating them with the results of TIMBUS and providing feedback of the students into TIMBUS we create a learning circle that helps us promote and use the results of TIMBUS as well as reflect on the research. Table 42, below details this initiative.

Table 42: SBA Exploitation Initiative #3: Educating students

Exploitation Initiative #3	Educating students in cooperation with Vienna University of Technology
Partnerships	Vienna Technical University
Audience(s)	Student of Viennese Universities
Exploitation Goal(s)	(1) Get feedback on TIMBUS research and act on the feedback where appropriate. (2) Provide TIMBUS knowledge to students, thus educating future industry leaders on the issues and the importance of digital preservation for businesses. There are two ongoing MSc theses and four ongoing PhD theses on TIMBUS related topics at SBA. Additionally we offered TIMBUS related exercises for a university course on DP and an associated lab course. The topics comprised legal aspects of DP, software escrow and emulation.
Expected Exploitation	Education and lectures on the field of Digital Preservation, as this is the key

Benefit(s)		performance indicator of a research and competence centre.
How to measure the Benefit		As SBA's relationship to the Vienna Technical University is very strong, because it is based on a long track record of involvement in academic affairs and the future of that strategically important relationship rests on doing a good educational job, additional bachelor and master theses, PhD theses, additional students attending the courses are an important benefit measure.
Exploitation Resources		Teaching staff. As each employee is able to present his own area of expertise a lack of resources (i.e. a staff member not able to do a training course) is not anticipated.
Dependencies		The content of the training is dependent on the outcome of our work done in different work packages. If the work there is not proceeding we are not able to present new material. Time and effort to prepare materials and give lectures.
Roadmap		
	Steps and actions needed	Extract new teaching material from the findings of the final reporting period.
	Actions taken	2011-present: By working on different TIMBUS tasks we developed input for the courses at the university. H1 2013: We held the course and lab course on Digital Preservation in the summer term of 2013. H1 2014: We held the course and lab course on Digital Preservation in the summer term of 2014.
	Current status	Topics that are direct research output of TIMBUS have been successfully integrated in the Digital Preservation Course, and practical Lab examples are held using some of the Tools developed by SBA. We will continue holding course and lab course on Digital preservation. We are preparing the final findings of the project for the upcoming summer term courses. Sustained integration of TIMBUS outputs in the Digital Preservation course is ensured by staff working at the Vienna University of Technology (Andreas Rauber).
	Timeline	M40-M45: revise the structure according to the feedback

9.9.6 SBA Exploitation Initiative #4: Scientific excellence

As a research centre our key performance indicator is publishing the results of our research and presenting it to an international audience. Table 43, below details this initiative.

Table 43: SBA Exploitation Initiative #4: Scientific excellence

Exploitation Initiative #4	Scientific excellence
Partnerships	The TIMBUS consortium members. No external partners are involved in this.

Audience(s)		Researchers and experts worldwide in the domain of business process managements and digital preservation. This initiative targets research publications, thus it is not possible to pinpoint the audience, as everybody interested in the domain will read and use our work.
Exploitation Goal(s)		(1) Use international cooperations and the projects we are working on to generate new and interesting scientific results. (2) In order to call the attention of an audience to our work, we publish our findings on national and international conferences or in journals and present them with the goal of forming international relationships. (3) Increase the awareness of business process preservation
Expected Exploitation Benefit(s)		(1) Establishment of SBA as a key competence centre for business preservation (2) Find new partners and cooperation opportunities like research projects
How to measure the Benefit		(1) New research opportunities as an outcome of TIMBUS (2) Scientific publications presenting the TIMBUS results
Exploitation Resources		Researchers involved in TIMBUS at SBA, who are publishing within their area of expertise
Dependencies		The content of the publications is dependent on the outcome of our work done in different work packages. If the work there is not proceeding we are not able to present new material. The ownership of this is with the TIMBUS consortium, namely the work package 6 lead, CMS and the PCC in the event of their being issues that cannot be resolved within the work package. We also have dependencies on the tools being developed in the use case work packages, namely WP7, 8, 9. With regards to issues within these WP's, the WP owner has primary responsibility, with the PCC able to assist if further escalation is necessary.
Roadmap		
	Steps and actions needed	Extract new material from the findings of the previous reporting period (year 3 of TIMBUS).
	Actions taken	2011-present: By working on different TIMBUS tasks we worked on developing input for different publications in our areas of expertise. H1 2013: We presented TIMBUS results on the DATA 2013 and the workshop DPRMA 2103. H2 2013: We presented TIMBUS results on the iPres 2013, the IEEE Big Data 2013, and the TPDL 2013. H1 2014: We presented TIMBUS results on the AES 2014 and IDCC 2014 conferences. H2 2014: We presented TIMBUS results on the DATA 2014, iPres 2014, the IEEE eScience 2014, and the EDOC 2014 conferences.
	Current	At present we are preparing the findings of the previous year for upcoming

	status	conferences.
	Timeline	M36-M40: Identification of appropriate conferences. This will be an ongoing task. M36-M40: writing papers and submitting them to identified conferences. M38-M43: presenting paper results on conferences M38-M43: gathering feedback, output from conferences M38-M45 onwards: Pursue conversations and networking opportunities at conferences and events with the purpose of establishing further research projects and collaborations in areas of mutual interest in support of our exploitation goal and expected benefits earlier in this table. M36-M44: writing journal papers

9.10 SQS – Software Quality Systems

9.10.1 SQS Organisational Profile

Software Quality Systems
Cologne, Germany.
SQS Partner Summary.

The SQS Group (SQS) is the world's leading specialist for software quality. This position and its expertise stem from over 30 years of successful consultancy operation.

The company's main competitive advantage is its strong methodology, based on decades of project experience. Over this period of time, the company has also developed extensive specialist knowledge in many vertical markets. With more than 7,000 completed projects under its belt, SQS has a strong customer base, including half of the DAX 30 companies, almost one third of the STOXX-50 companies and 20 FTSE-100-companies. Among the clients, there are names like Allianz, Beazley, BP, Centrica, Daimler, Deutsche Post, Generali, JP Morgan, Meteor, Reuters and Volkswagen.

SQS was founded in Cologne, Germany, in 1982. Our workforce has grown from 2,200 when the TIMBUS project began to stand currently at 4000 employees who are based across Europe, Asia, North America and Africa. SQS has a strong presence in Germany and the UK and offices in Austria, Egypt, Finland, France, India, Ireland, the Netherlands, Norway, South Africa, Sweden, Switzerland, and the United States.

In 2013, the group achieved revenues of €225.8 million. This is also strong growth from the €189.1 million in 2011 when the TIMBUS project began. SQS is listed on the London Stock Exchange (AIM) and has a second listing on the Open Market on Deutsche Börse, Frankfurt.

9.10.2 SQS Exploitation Introduction

As the TIMBUS project reaches its conclusion, this section of the SQS report takes a look back over our previously communicated exploitation objectives and updates them where appropriate since the year 3 review.

In 2012, SQS has been restructured internally and SQS Research has been merged with SQS senior subject matter experts to form the "Special Experience Team" (SET). SET acts as a task force supporting the SQS consultancy organisation when launching projects or managing projects with a high profile. SET set-up also facilitates the internal knowledge transfer from research initiatives and service development to the delivery organisation. The focus of SET is on developing methods and services for the assessment and management of IT Quality and Testing.

In the end of the year 3 of TIMBUS, we have deployed the methods and techniques learnt from TIMBUS as improvements to our special expertise consulting services, in particular with regards to

- Enterprise Risk Management (applying ISO 31000 in our projects)
- Business and IT Service Continuity Management (as a tool for consultants when structuring and facilitating discussions in this field)
- Enterprise Architecture (e.g., utilising TOGAF in client projects)
- Holistic Quality Management approaches (e.g., taking into account aspects such as web services, backup and restore of business systems)

Since its establishment in 2012, SQS SET has successfully deployed the methods and techniques developed in TIMBUS mentioned above as to contribute to a better and more holistic understanding of business processes and it's supporting IT assets allowing SQS to focus on quality aspects early in the IT development life cycle.

SQS SET has identified a number of operational as well as mid-term strategic opportunities in the results of TIMBUS. Together with SQS Service Management, the results from TIMBUS have been used to improve the existing quality assets. In particular, more internal employees have been introduced to TIMBUS methods and techniques in order to broaden the internal spread of knowledge. In 2014 we co-allocated 3 consultants from operational units to benefit from their practical knowledge and to train them TIMBUS methods on the job.

SQS SET has communicated and exchanged results from TIMBUS with the SQS Service Management team, which integrated the results from TIMBUS into SQS' services. In addition, SQS SET members have been co-allocated to projects of the SQS operational units and support daily business in the role of subject matter experts. Our identified business opportunities have not changed greatly during the last months of the project and as previously reported in past exploitation deliverables, these are explained quite nicely below in **Error! Reference source not found.**.

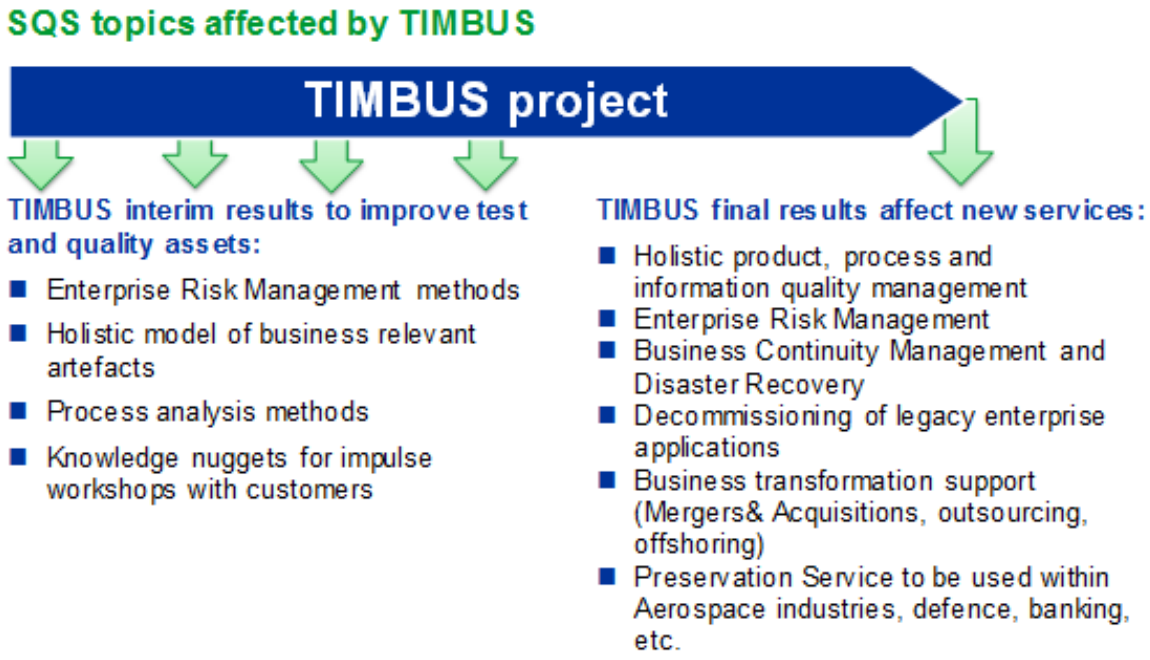

Figure 55: SQS business topics and TIMBUS results

As depicted in **Error! Reference source not found.**, the methods developed in TIMBUS helped SQS to provide their clients with improved methods with regards to transitioning testing activities from clients' site to SQS Test Centres.

In particular, and as shown in Figure 56, with the methods applied in DP as a background, our consultants worked in client projects throughout the course of the TIMBUS project to provide answers to questions in the carve-out phase such as:

- What projects or programmes can be delivered as Managed Testing Services?
- What processes and test assets are in place and to be transferred from client to SQS?
- What processes and test assets are in scope to be transferred from client to SQS?

- What resources are required in the testing activities?
- What resource interfaces need to be established for testing?
- What cost models can be applied for a sustainable client-provider relationship?

Queries such as these can be answered with authority by making use of e.g., dependency models from TIMBUS. Dependency models developed in TIMBUS provide a complete picture of "what" needs to be taken into account when transferring testing processes. Context models (as developed in TIMBUS) help us not only to identify the underlying IT but also the necessary "collaterals", e.g., people, documentation, contracts, security constraints, legal considerations and many more.

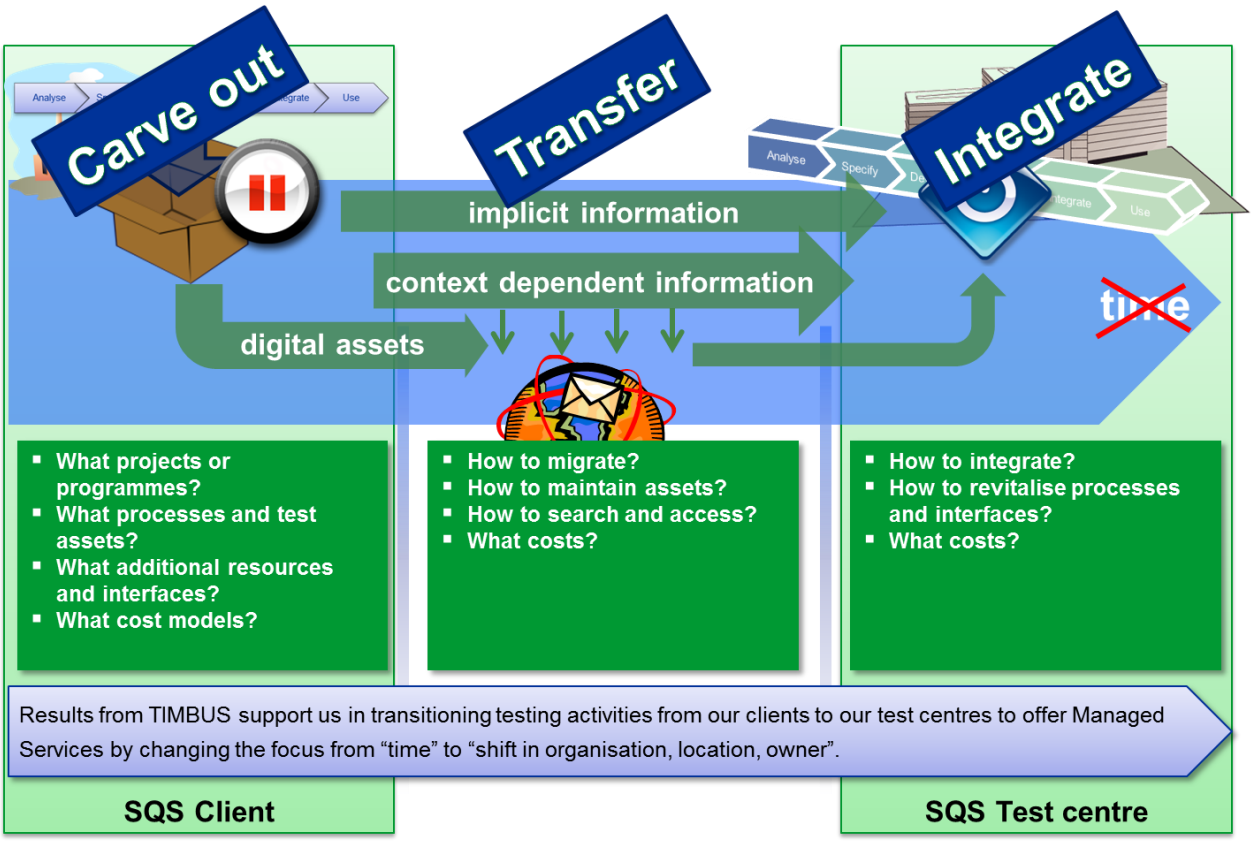

Figure 56: SQS client Q&A's generated from TIMBUS methods for Managed Testing Services

For transferring activities from our clients to SQS's test centres, SQS needs information that is also addressed by TIMBUS research, e.g.

- How to implement the migration of assets, resources, and processes?
- How to maintain the assets accordingly?
- How to manage, search, and access assets during transition?
- How to assess cost?

Finally, SQS must integrate client's processes in their test centre and revitalise the process. Necessary interfaces have to be set up and utilised in a new context – all these questions raised regularly in operational business can now be partially answered by means of TIMBUS results.

The extended definition of the context term will be applicable to the usage of ISO 25010[86]. The methods and models developed in the area of contexts and reasoning will be applied to the existing process assessment, analysis and improvement methods. For the short term the results were used to educate our customers with a need in preservation of information, the possibilities and challenges in digital preservation.

The risk management results from TIMBUS have been applied in a new approach towards enterprise architecture assessment. Beginning in November 2012, SQS successfully used the method in a project with a customer in the banking sector to assess their enterprise architecture of a sales support system. By taking a risk oriented approach rather than a qualitative approach to the assessment of design decisions, it was possible to identify risks for the operation of a large enterprise IT system. In particular, TIMBUS results were reused for the collaboration with representatives from the BCM and risk management departments. The lessons learnt in TIMBUS regarding "contexts" and "changes to contexts" proved valuable when assessing the impact of future changes to business and IT processes as well as business and IT architecture. We now have a much wider view on the artefacts-to-be-considered; rather than setting a focus on development and technical artefacts only, we now can reason about legal aspects (IP rights, data protection etc). On the other hand, we also take into account system dependencies at runtime such as web services, data services, backup and recovery strategies etc.

We also conducted an improvement workshop with the IT and testing leads of a mail order company on the topic of risk based testing. We deployed risk management methods from TIMBUS (assessing and evaluating risks according to ISO31000 and deploying IERM processes in client project organisations) as to holistically assess the client's current set up beyond the core IT organisation. We were able to integrate business processes and business risks as a guiding principle for IT processes and the management of IT related risks.

As illustrated by the examples above it is not the primary goal to develop so many services in the original domain of digital preservation. But SQS SET and Service Management identified complementary use-cases based on the results of TIMBUS and methods of digital preservation. For example, these include but are not limited to:

- see the projects as described later as a part of our exploitation;
- the decommissioning of legacy systems;
- in the due diligence exercise in mergers and acquisitions;
- for the support of IT migrations;
- for re-organisation of IT operations; for re-locations of data centres;

The identified use cases are based on the insight that the preservation of information is not limited to the time aspect but can be extended to the transition of information from on context into another. SQS SET and Service Management perceived TIMBUS with a more generalised view as the preservation of information between changing contexts over time. The changes may also regard to the geographical location (e.g. migrate a process to offshore), organisation (mergers and acquisitions) or the physical environments (changes of the IT-landscape). SQS researches many opportunities in the fast changing businesses which need methods to reduce risks based on the unique and dynamic business challenges.

To provide SQS management with tangible figures for exploitation values from TIMBUS, we have assessed the impact of individual deliverables to SQS service portfolio.

TIMBUS Deliverable Structure	SQS Service Structure					
	Functional Testing	Non-Functional Testing	Quality Management	Test Automation	Test Management	Test Tools & Environments
Exploitation	x	x	x			x
DP & Intelligent Enterprise Risk Management	x	x	x		x	
Dependency Models		x	x			x
DP & Legal Issues	x	x	x	(x)	x	x
Business Process Contexts		x	x		x	
Use Case Specific DP & Holistic Escrow		x	x			x
Validation of DP'ed Business Processes & Verification of Exhumed Business Processes		x	x			x
Architecture for Intelligent ERM		x	x			
Preservation Architecture		x	x			x
Intelligent ERM Tool Suite			x			x
Dependencies Monitor & Reasoning System			x		x	x
Legalities Lifecycle Management		x	x		x	x
Virtualisation Manager						x
Populating and Accessing Context Model			x			x
Business Process Preservation test Bed		x			x	x

Figure 57: Impact of individual deliverables to SQS service portfolio

In addition, we analysed the impact of our exploitation initiatives in terms of client projects in TIMBUS year 3 and 4.

Project ID	effort per Project	timbus factor	project earned value
Automotive Banking (2012/2013)	200 PT	35%	70 PT
Automotive IT (2011)	200 PT	15%	30 PT
Automotive IT (2013)	230 PT	15%	35 PT
Defense (2013)	680 PT	20%	136 PT
Public AT (2013)	20 PT	20%	4 PT
Public DE (2013)	250 PT	20%	50 PT
Public DE (2014)	500 PT	20%	100 PT
Totals			**425 PT**

Figure 58: Impact of our exploitation initiatives in terms of client projects (PT=man day)

As can be seen above in Figure 57 and Figure 58, we have completed projects with a turnover of approximately 2000 man days. As we only use different aspects of TIMBUS in these projects, this turnover is multiplied with a "TIMBUS factor" to account for value generated by TIMBUS activities in the projects and results in approximately 400 man days allocated to TIMBUS. Some of the exploitation initiatives will be described in more detail in the following subsections.

9.10.3 SQS Exploitation Initiative #1: Automotive Banking

SQS's exploitation initiatives are basically client projects that are supported by TIMBUS methods and techniques. The first initiative was launched at a client's project in the automotive banking field. Our client had planned for an IT migration and expansion of a distributed sales platform. Originally hosted at one of its subsidies' data centres the platform was successful and it was considered to roll out the platform for the entire group while at the same time the IT had to be relocated as to account for the new group wide role. Table 44, below details this initiative.

Table 44: SQS Exploitation Initiative #1: Automotive Banking

Exploitation Initiative #1	Relocation Initiative for Banking IT system
Partnerships	SET members and 2 consultants from Technical Quality / Application Lifecycle Management teams
Audience(s)	SQS client
Exploitation Goal	Defining a migration strategy for a complex IT landscape while preserving access to life systems and data by applying iERM to a client project
Expected Exploitation Benefit(s)	improved revenue, a qualitative improvement is achieved when TIMBUS methods can be applied in the course of the project customer satisfaction
How to measure the Benefit	It is assumed that 35% of this initiative's turnover is achieved due to the deployment of TIMBUS methods; turnover is based on SQS day rate for 200 person days.
Exploitation Resources	SET members: 1 Consultants: 2
Dependencies	This initiative has been successfully completed so there are no outstanding dependencies. However during execution we did have the following dependencies: • Sales approach: Projects are typically initiated by colleagues from the sales department; they have to have a high level view on the capabilities of the methods from TIMBUS. • Delivery assurance: Deliverables produced in the course of the project are different from what consultants are used to (e.g. new approach to risk assessment).
Roadmap	
Steps and	This initiative has been successfully completed so there are no further actions

	actions needed	needed.
	Actions taken	Trained consultants; Applied Risk assessment, Enterprise Architecture evaluation, migration planning
	Current status	Project completed. Enterprise Architecture and Risk assessment have proven a valuable tool for decision making in the course of migration planning.
	Timeline	This initiative has been successfully completed. The milestones below represent the plan that was in place and when the various tasks completed: 1. Initial Analysis 2. Re-documentation of Enterprise Architecture 3. Dependency Analysis 4. Risk assessment for migration options 5. Architecture and risk evaluation 6. Implementation support and planning of the migration

9.10.4 SQS Exploitation Initiative #2: Automotive IT

Initiative #2 aimed at deploying TIMBUS methods in the field of automotive IT, i.e., the information technology that usually serves as an IT backbone for in-car-IT. As modern cars are also a valuable source of data for car manufacturers, we had interfaces with telematics systems. Table 45, below details this initiative.

Table 45: SQS Exploitation Initiative #2: Automotive IT

Exploitation Initiative #2	Project management in Automotive IT environments (telematics, in-car-IT)
Partnerships	Consultants from Technical Quality / Management Consulting teams
Audience(s)	SQS client
Exploitation Goal	Applying iERM in IT projects for improved decision making
Expected Exploitation Benefit(s)	Improved customer satisfaction Improved decision making
How to measure the Benefit	It is assumed that 15% of this initiative's turnover is achieved due to the deployment of TIMBUS methods; turnover is based on SQS day rate for 430 person days.
Exploitation Resources	SET members: 1 (0.5 FTE) Consultants: 4 (4 FTE)
Dependencies	As in initiative #1, there were internal dependencies to the sales department and our delivery assurance. In parts, the results from TIMBUS were used to improve SQS's project management, enterprise architecture, and quality management capabilities. Correspondingly, we had to manage content wise dependencies to SQS's internal subject matter expert group ("Innovation

		Groups"). External dependencies were identified in IT operations, telematics, and in-car-IT.
Roadmap		
	Steps and actions needed	This initiative has been successfully completed so there are no further actions needed.
	Actions taken	Trained consultants; Applied IERM and Enterprise Architecture methods
	Current status	Projects completed in 2013; expected benefits were met and due to the successful outcome new projects are underway in 2014
	Timeline	Duration from September 2013 to January 2014; projects were completed with a formal decision for future roadmap. Since February2014 the successor project has been active as a regular operational project.

9.10.5 SQS Exploitation Initiative #3: Defence & Public Sector

Initiative #3 aims at large size projects in the defence and public sector. The standard set up of projects in this business sector involves numerous suppliers (supplying the technical know-how) with little technical expertise with the purchaser. We support our clients with tools and methods borrowed from TIMBUS to enable and facilitate fact based decision making with regards to quality of work products. Table 46, below details this initiative.

Table 46: SQS Exploitation Initiative #3: Defence & Public Sector

Exploitation Initiative #3	Defence and Public sector
Partnerships	Technical Quality / Management Consultants
Audience(s)	SQS client
Exploitation Goal	Improved project delivery; project management; supplier management
Expected Exploitation Benefit(s)	improved revenue CUSTOMER SATISFACTION
How to measure the Benefit	It is assumed that 20% of this initiative's turnover is achieved due to the deployment of TIMBUS methods; turnover is based on SQS day rate for 1450 person days.
Exploitation Resources	SET members: 1 (0.5 FTE) Consultants: 5 (5 FTE)
Dependencies	Internal dependencies to the respective market unit for sales and delivery assurance have to be considered. Client dependencies and relationship management with various suppliers have

		to be maintained.
Roadmap		
	Steps and actions needed	Projects are usually completed in December. Follow up projects have been defined and are now carried out; further actions will be to widen the scope of our consultant's quality work. At project start, the focus was on testing artefacts and load/performance properties of the IT systems. For the future, we will address source code quality and regression testing as a next step and try to come up with a holistic view on system quality.
	Actions taken	Trained consultants; applied IERM methods; leveraged Enterprise Architecture Methods
	Current status	Several projects were completed in 2013; successor projects in 2014 have started for the same clients.
	Timeline	Project end expected end of 2014 with opportunity to continue for 2015

9.10.6 SQS Conclusion

As described above, the TIMBUS services are not adopted directly into the SQS' service portfolio. Digital Preservation is not and will not be a Service offered by SQS in the mid-term. Holistic Escrow which was identified as a potential service in the beginning of the TIMBUS project does not fit in the strategic alignment of SQS. But it was shown, that the methods developed in TIM-BUS are valuable and could be integrated in the services offered by SQS.

At the end of the TIMBUS project, SQS has gained great experience and value from its participation in the consortium. We have had the privilege to work with diverse and interesting partners in a way which would not have otherwise been possible. This has shown to our organisation the continued benefit of participation in funded research projects as this diversity and exposure to SME's, industry and academic institutions from across the EU provides access to expertise and ideas not readily accessible internally in our daily operations. SQS has also grown its profession-al network and grown valued relationships which will last for years to come with partners in Ire-land, the UK, Portugal, Austria and Germany.

Of course, that is only the start of the benefit which SQS has seen and is continuing to see. The TIMBUS services are indirectly adopted into SQS' service portfolio as described in this final exploitation report even though our menu of services may not explicitly list "Digital Preservation" or "Holistic Escrow". The results reported have shown that TIMBUS results can be integrated into our services. This is important because research results that can't be applied would have been of very little benefit to SQS. While SQS would not expect every client or every client project to be heavily interested in data and/or context preservation – and this is why those subjects are not on our service offering at present - we feel strongly that they are topics which are important and will only grow further in importance over time. Therefore, in the capacity of serving our clients cur-rent and future needs in the best possible way, SQS feels that it's time in TIMBUS has been enjoyable, fruitful and productive in helping the organisation to find its path into the future.

10 Conclusion

This document should not be seen as the end, but rather merely a current status in a continuing story as all the individuals, and the partners, who have worked on this project since 2011 take their experiences and knowledge with them into the future. Many initiatives are ongoing, new ones will rise and benefits will continue to accrue. For now, this document has done all it can by presenting the reader with an updated market assessment, highlighting both new and previously existing trends which are of relevance to TIMBUS and presented out the partner reports. The TIMBUS research continues to have opportunities to deliver high impact solutions to address the challenges of long term accessibility to data through the mechanism of preserving business processes. The approach of the project has remained novel, unique and valuable throughout.
Our market assessment shows that many of our previous conclusions continue to hold true with the bottom line being that the driving forces behind the need for digital preservation are increasing with little sign of this changing. The larger diversity and perverseness of technology devices results in products with shorter lifecycles. The technologies which run on these devices are tied to point-in-time hardware and are either evolving or becoming extinct. New business practices must be adopted to reflect this more urgently than has been the case to date as the technologies are changing more rapidly than ever before.

The objectives of the exploitation work package, which were detailed in this document, were:

- ✓ Project partners will apply relevant results of this project in their activities or use them in order to enhance their market competitiveness, to strengthen their product portfolios and to broaden their network of customers.
- ✓ Systematic analysis and continuous monitoring of the market situation and trends.
- ✓ Definition of market strategy and rollout plan.
- ✓ Analysis of individual exploitation plans.
- ✓ Feedback to project plan due to results of this work package.

These have been achieved through publishing the individual exploitation plans and strategies that each partner is pursuing to achieve those plans. Work-package 2 has acted throughout the project life to date as a conduit between the external market and internally into the project. We have engaged and carefully considered input from stakeholders outside of the consortium.

TIMBUS has made good progress at getting its message out and has identified targeted audiences and specific messages which each partner has included, along with milestones in their individual exploitation plans. Those plans have already created significant impacts internally in the partner organisations as well as with our identified stakeholder groups. The exploitation reports in this document have detailed a diverse and exciting range of such work been driven by each of the TIMBUS partners and we look forward with positivity and ambition toward presenting our final exploitation outputs/results at the final review in February 2015.
And thus, our research project has come to its conclusion. TIMBUS has not only met, but also exceeded its goals and while the consortium partners take great satisfaction in their many individual and indeed, collective achievements, we also pause to consider our digital future and the challenges that lie ahead for our society. Are we destined to live in a *personal data economy* in the medium term, what will this mean for the wealth of born digital content, the vast majority of those we struggle to assess their value and the tools we need to do justice to all aspects of its preservation still elude us. It is easy to be pessimistic about this daunting task, however this consortium is not and our research has shown that it is within ambitious, and successful research projects such as TIMBUS where we will find the answers

Appendix A: Market-Watch Bibliography (Links to Referenced Material)

Date	Summary	Source(s)
21/02/14	Will Today's Digital Movies Exist in 100 Years?	http://spectrum.ieee.org/consumer-electronics/standards/will-todays-digital-movies-exist-in-100-years
13/02/14	Print Books vs. E-books: What's the Future of Reading?	https://www.surveymonkey.com/blog/en/blog/13/03/25/print-books-vs-e-books-whats-the-future-of-reading/
12/02/14	iRODS v4.0 is due for release in March 2014	http://irods-consortium.org/dev/wp-content/uploads/13/02/irods-intro.pdf
12/02/14	The Storage Evolution: From Blocks, Files and Objects to Object Storage Systems	http://www.snia.org/sites/default/education/tutorials/2008/spring/storage/Bandulet-C_The_Storage_Evolution.pdf
12/02/14	WW1 soldier diaries published online - crowd sourcing their digitisation	http://www.bbc.co.uk/news/uk-25716569
06/02/14	Trinity, Google Maps digitise Fagel map collection	http://www.techcentral.ie/trinity-google-maps-digitise-fagel-map-collection/
03/02/14	Top 5 questions to ask before outsourcing your archives to a cloud vendor	http://trumantechnologies.com/blog/ready-archive-cloud
14/01/14	Roger Highfield, Director of External Affairs at the Science Museum in London gave a short interview on George Hook recently talking about the topic of digital preservation so it shows just how main stream and ready for public consumption the topic is:	http://www.newstalk.ie/Keep-Your-Data-Safe
09/01/14	Imagine if you could surf Facebook ... from the Middle Ages. Well, it may not be as far off as it sounds. In a fun and interesting talk, researcher and engineer Frederic Kaplan shows off the Venice Time Machine, a project to digitize 80 kilometers of books to create an information system of Venetian history across 1000 years	Frederic Kaplan: How to build an information time machine
08/01/14	Government Notifies Standard For Digital Preservation Of e-Governance Data	http://www.siliconindia.com/news/technology/Government-Notifies-Standard-For-Digital-Preservation-Of-eGovernance-Data-nid-159159-cid-2.html
07/01/14	CES 2014: Sony shows off life logging app and kit	http://www.bbc.co.uk/news/technology-25633647
01/01/14	Data Storage Innovation Conference	http://www.snia.org/events/dsicon2014?utm_source=SNIA+Email+List&utm_campaign=1ab799dab6-3rd_CFP_DSI_12_17_2013_copy_01_1_1_2014&utm_medium=email&utm_term=0_28326954a0-1ab799dab6-53360005
29/12/13	BBC News: Classic 70s and 80s games go online	http://www.bbc.com/news/technology-25527786
21/12/13	Laser Archaeology	http://ngm.nationalgeographic.com/13/12/laser-archaeology/johnson-text?utm_source=Twitter&utm_medium=Social&utm_content=link_tw20131221ngm-archtext&utm_campaign=Content
17/12/13	Impala: another google inspired platform	http://techcrunch.com/13/12/15/impala-another-google-inspired-platform-enters-the-mainstream-data-world/
16/12/13	Nice Presentation by SNIA compares cross protocol storage standards (i.e. S3, Swift, CDMI, HDFS and WebDAV)	http://snia.org/sites/default/files2/SDC2013/presentations/Cloud/ScottHoran_Lessons_Learned_Implementing.pdf
13/12/13	Ford set to digitize material from its archives for an online museum	http://www.freep.com/article/131212/BUSINESS/312120161/Ford-set-digitize-material-from-its-archives-an-online-museum
09/12/13	Announcing Suro: Backbone of Netflix's Data Pipeline	http://techblog.netflix.com/13/12/announcing-suro-backbone-of-netflixs.html?m=1
30/11/13	Autodesk Launches New Tool for Digital Preservation | ArchDaily	http://www.archdaily.com/452845/autodesk-launches-new-tool-for-digital-preservation/
30/11/13	Browsers expiring over time	http://en.wikipedia.org/wiki/File:Usage_share_of_web_browsers_(Source_StatCounter).svg
25/11/13	Social media: The next generation of archiving	http://fcw.com/articles/13/11/25/exectech-social-media-archiving.aspx
24/10/13	document from Mercedes showing how many open source licenses are actually used in the software that powers/drives/ships with modern cars	http://www4.mercedes-benz.com/manual-cars/ba/foss/content/en/assets/FOSS_licences.pdf
21/10/13	Back up that castle: Digital preservation group makes 3D copies of world's landmarks	http://www.startribune.com/nation/228616831.html
21/10/13	Million-Year Data Storage Disk Unveiled	http://www.technologyreview.com/view/520541/million-year-data-storage-disk-unveiled/

	Same as above, just a different report	http://www.gizmag.com/billion-year-data-stor-age/29530/?utm_source=Gizmag+Subscribers&utm_campaign=a9a5ac8942-UA-2235360-4&utm_medium=email&utm_term=0_65b67362bd-a9a5ac8942-91281145
11/10/13	CED emerging technology roadmap 2013-2016	https://timbus.teco.edu/svn/timbus/work_package_2/T2.3_Exploitation plan/Documents/
10/10/13	The DCC is working with the Research Data Alliance on a Metadata Standards Directory (MSD), but we need help from the whole community. Please find below a message from the MSD Working Group, explaining how you can contribute. We really would appreciate your input.	Mail from William Kilbride on 10th Oct 2013
27/09/13	Perseids: a project belonging to the Parseus Digital Library.	http://sites.tufts.edu/perseids/
27/09/13	P1484.13.2/D10, Sept 2013 - IEEE Approved Draft Recommended Practice for Learning Technology - Metadata Encoding and Transmission Standard (METS) Mapping to the Conceptual Model for Resource Aggregation	http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6603249
27/09/13	MUSICAL PRESERVATION and Elvis's lost tapes	http://www.theatlantic.com/entertainment/archive/13/09/just-how-much-of-musical-history-has-been-lost-to-history/279948/
04/09/13	Will Your Data Still Be Around Tomorrow?	http://www.forbes.com/sites/xerox/13/09/04/from-clay-tablets-to-electronic-tablets-preserving-content-and-knowledge-over-time/
02/09/13	Add an expiration date to your tweets using a simple hashtag	http://www.theverge.com/13/9/2/4686228/time-your-tweets-to-disappear-with-using-a-simple-hashtag-twitterspirit
27/08/13	How Big Data is changing the world	http://www.bbc.co.uk/news/technology-23253949
19/07/13	Amazon, MS cloud outages	http://www.bbc.co.uk/news/technology-23762526
16/07/13	Good ol' tape will survive cloud era, too!	http://www.ciol.com/ciol/features/189797/tape-survive-cloud-era
16/07/13	History of magnetic tape	http://www-03.ibm.com/ibm/history/ibm100/us/en/icons/tapestorage/
15/07/13	Storage technology trends for archiving	Rodger Mooney mail to Mike Nolan based on data supplied from a meeting with Oracle, it also had a graph in there: • IDC 2012 – Project 300x growth in data from 2005 to 2020 • 80% of data growth is due to machine generated data. Sensors, camera's, images medical. It's not all human generated data anymore. Much of this is kept for long periods of time. • 80% of data is never used after 90 days. You don't want to store it on expensive storage. • Why is it not used? 80/20 rule creeps in again. 80/20 appears a lot in life when explaining phenomena. • Tiered storage architecture used today. • Storing data on different devices based on the usage type of that data. • If you stored all data on fast disk storage it would equate to 7.5$Million per PB. • If 20% was on high speed disk and 80% on lower speed disk it would equate to 3.5$M /PB • If you did a tiered approach of 5% on high speed disk, 15% on lower speed disk and 80% on tape storage the cost is significantly lower 0.9$M /PB. Taken from Horison technologies Aug. 2012. • IDC: Tape is still driving the digital archive market with tape being the established primary storage tier for long term retention. See that the 80/20 rule still applies with tape accounting for 80%.
10/07/13	They have some factors for sustainability here.	http://blogs.loc.gov/digitalpreservation/13/06/why-cant-you-just-build-it-and-leave-it-alone/
08/07/13	London based company using ontologies for semantic search	http://www.ontology.com/
27/06/13	Intel's taking a serious look at object storage. What's their game?	http://www.theregister.co.uk/13/06/27/intel_chipping_away_at_objects/
08/06/13	Spar Point Group	http://www.sparpointgroup.com/
08/06/13	CyArk is a 501c3 non-profit organization with the mission of: digitally preserving cultural heritage sites through collecting, archiving and providing open access to data created by laser scanning, digital modeling, and other state-of-the-art technologies	http://archive.cyark.org/about

03/06/13	Tessella's digital preservation service available via G-Cloud	Tessella's digital preservation service available via G-Cloud
30/05/13	EDF Forum (European Data Forum)	http://13.data-forum.eu/program http://www.slideshare.net/EUDataForum
30/05/13	Duraspace demo	http://duraspace.org/tomorrow-529-duracloud-brown-bag-duracloud-glacier-1230pm-et
27/05/13	BBC scraps multi-million pound archive project	http://www.techweekeurope.co.uk/news/bbc-kills-digital-media-initiative-117244
06/05/13	Spectra Logic Backup and Archive Blog	http://www.spectralogic.com/blog/index.cfm/13/4/16/Tape-NASThe-Storage-Game-Changer
06/05/13	A Measurement Framework for Evaluating Emulators for Digital Preservation	http://web.ebscohost.com/ehost/detail?sid=dc1243a6-76b8-452c-a8f1-c7b66c333188%40sessionmgr104&vid=1&hid=122&bdata=JkF1dGhUeXBlPWI-wLHVybCx1aWQmc2l0ZT1laG9zdC1saXZl#db=syh&AN=76258983
06/05/13	A Service-Oriented Approach to Assess the Value of Digital Preservation by ENSURE project	http://rd.springer.com/chapter/10.1007/978-3-642-37804-1_17
06/05/13	Springer series book from TIMBUS	http://rd.springer.com/article/10.1007/BF03323472
01/05/13	CERN scientists launch project to restore world's first website - Irish Innovation News – Siliconrepublic.com	http://www.siliconrepublic.com/innovation/item/32480-cern-scientists-launch/
01/05/13	views in the debate around the retention of personal data on the internet and how it could be data mined	http://www.libdemvoice.org/the-independent-view-data-preservation-instead-of-data-retention-34314.html
27/04/13	The Long Hill library in New Jersey ran a DP workshop as a fundraiser to pay for a new digital imaging service	http://newjerseyhills.com/echoes-sentinel/news/digital-preservation-workshop-at-long-hill-libary-to-cover-photos/article_6c25e0f2-acf0-11e2-b1ec-001a4bcf887a.html?mode=jqm
27/04/13	Google afterlife	http://www.independent.co.uk/life-style/gadgets-and-tech/news/google-death-manager-search-engine-giant-lets-you-plan-digital-afterlife-with-inactive-account-manager-tool-8569848.html
25/04/13	RALEIGH, NC April 24, 2013 – The State Library of North Carolina, in conjunction with the State Archives of North Carolina, is releasing a redesigned, streamlined and mobile friendly digital preservation education site.	http://digitalpreservation.ncdcr.gov
17/04/13	Using tape as a NAS medium	http://www.spectralogic.com/blog/index.cfm/13/4/16/Tape-NASThe-Storage-Game-Changer
17/04/13	Microsoft secure Azure Storage goes down WORLD-WIDE	http://www.theregister.co.uk/13/02/22/azure_problem_that_should_never_happen_ever/
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17/04/13	DHSR's blog, Amazon margins on data storage	http://blog.dshr.org/13/04/more-on-amazons-margins.html
10/04/13	Cambridge capturing the digital universe	http://www.businessweekly.co.uk/hi-tech/15235-cambridge-captures-the-digital-universe

Appendix B: Intel meetings in TIMBUS year 4

Date	Location	Partners in collaboration	Description of collaboration link	Comments/Reaction	Audience/Event
Recurrent meetings					
Every Tuesday and Thursday 11:00-11:30	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Customer status meeting	Customer status update meeting. This meeting is to ensure continued comms with Clanton customer. Understood that this is a low priority meeting, cancelled if no updates to be given or higher priority tasks at hand	Sarah Frawley, Derek Leahy
Every Tuesday at 10:00-10:30	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT Flex	TIMBUS/Clanton POC status meeting	Status review with Mike Nolan and IT Flex Services	Fearghal O'Hare (IT Flex Services)
Every Monday at 10am	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Making an SoC class	A class presented every week for 10 weeks outlining the different roles, tasks with the process of developing a new SoC	Sarah Frawley, Derek Leahy
Every Monday at 10am	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Intel Digital preservation customer meeting	Meet with Phil Mondor to discuss the processes for digital preservation within Intel	Phil Mondor
Once-off meetings					
04/12/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS), Intel IT and Intel IT Flex Services	Clanton POC update/information sharing.	Provide update in Clanton POC to see how this POC's results can be reused and benefit the Intel IT Archival project team	Rodger Mooney, Fearghal O'Hare (TI Flex Services)
24/11/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Mergers and Acquisition division	Increase network support within Intel; contact with M&A member in Leixlip	Raised further awareness about TIMBUS within Intel. Very well received by Lisa; with high interest in getting update on TIMBUS/Clanton POC, in a view to possibly run POC.	Lisa Raftery
24/11/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Further discussions around IT Tiered Storage and review Archive project status and how TIMBUS can help.	Applying number of platforms for archive. Looking at what to do with data; possible use of online object store.	Rodger Mooney
04/11/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT EC	Customer tech support team meeting	Discuss issues with Testbed setup	Sergey Nemov (Engineering Computing)
23/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT EC	VM setup meeting with Customer tech support team	VM installed and ports and firewall issues fixed	Sergey Nemov (Engineering Computing)

22/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Customers GIT tool training	Training on the GIT setup within the customers dev environment	Sarah Frawley, Derek Leahy
16-18/09/2014	PASIG Event, Karlsruhe, Germany	Intel Labs Europe (IPLS) and DPC	PASIG conference in Karlsruhe, Germany	Attended PASIG event, networking with participants and presenting on TIMBUS	Angela Dappert + PASIG participants, incl. OPF
11/09/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	TIMBUS presentation to Intel CIO during Intel Leixlip visit	Timbus caught Kim's attention and couple of her comments : - "this is the type of work I would like to see more" - "I will be very interested in seeing the results of the POC" She also mentioned IT has spent about $1.8 million on data retrieval so far this year	Kim Stevenson (Intel CIO)
11/09/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Sync-up on IT archive project	There is an archive strategy plan going on with visibility up the chain of command. Part of the effort is to identify all of the groups with archive related issues, efforts and concerns. Review and discuss: • Owner • Stakeholders • Status • Efforts • Future plans	Phil Mondor and Rodger Mooney
10/09/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS), TIMBUS consortium and OPF	TIMBUS Tools demos to OPF	TIMBUS tools owners provided demos for: • LLM • Extraction Framework • DPES	Ed Fay; Carl Wilson; Becky Mc Guinness; Angela Dappert; Sara Day; Galushka, Mykola; Carlos Coutinho; Daniel Draws; Barbara Kolany-Raiser; Wasif Gilani
10/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT EC	Firewall review	Get access to customers production environment	Sergey Nemov (Engineering Computing)
10/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT EC	Customer dev machine and Test machine install	Customer dev machine build	Sergey Nemov (Engineering Computing)
03/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel TMG	Test labs admin meeting	Meet with the customers test labs admin to discuss the possible hardware and software available to the PoC project with view of securing development and test machines	Ciaran Dowling (TMG)
01/09/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Customer backup process review	Review in more detail the customers backup scripts used for backing up their environment, manual tasks, where they spend time and any common problems	Sarah Frawley

27/08/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	TIMBUS/Clanton POC kick-off meeting	Meet and greet, introduce Clanton. Overview of customer IT environment. Agree future communication plan including recurring meeting dates and times	Sarah Frawley, Derek Leahy
26/08/14	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	TIMBUS/Clanton POC discussion	Overview of the research material and theories to date including use cases, demo tools, external partners and stakeholders	Sarah Frawley
25/08/2014	Intel Ireland, Leixlip, Ireland		KIT-Intel Galileo discussion	Discuss about Galileo's and agree on next steps.	Till Riedel
22/08/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IOT team	Clanton POC meeting	Meeting with Noel Murphy to agree on terms for Clanton POC – Noel approved the POC	Noel Murphy (Clanton team)
19/08/2014	Intel Ireland, Leixlip, Ireland, Folsom, CA, USA	Intel Labs Europe (IPLS) and Intel IT InfoSecurity	Discuss about POC	Internal meeting to discuss in more details about POC scope and requirements	Phil Mondor
14/08/2014	Intel Ireland, Leixlip, Ireland		Partnership with Open Planets Foundation	Initial meeting with the Open Planets Foundation to discuss about TIMBUS-OPF collaboration and agree on next steps	Ed Fay; Carl Wilson; Becky Mc Guinness
14/08/2014	Intel Ireland, Leixlip, Ireland		Partnership with Open Planets Foundation	Preparation meeting to discuss about our partnership with the Open Planets Foundation and how it could support with the exploitation of the TIMBUS results after it ends	Angela Dappert; Sara Day; Carlos Coutinho; Galushka, Mykola
07/08/2014	Intel Labs, Santa Clara, US	Intel Labs, Santa Clara, US	TIMBUS and IP reuse	Review of TIMBUS project • Scope, capabilities, technical details, upcoming plans and timeline. • Collect feedback from Design Engineers currently involved in IP-reuse • Discuss TIMBUS and how/if it will be included in the Archive strategy proposals	Mondor, Philip; Borkar, Atul; Mehta, Sudeep; Hill, Teresa; Venkataramanan, Guruguhanathan; Katta, Chandra
07/08/2014	Intel Labs, Santa Clara, US	Intel Labs, Santa Clara, US	Key stakeholder (iLabs) IP re-use sync -- Session 1 of 2 -- BIG DATA	Deep dive of TIMBUS and discussion on how/if it could accelerate development time when reusing IP. 1. High level update on current status of Graphics IP re-use and challenges (Guru) 2. Review Big Data and Indexing Solution for recovered archives (Atul) 3. Overview of capabilities reviewed in POC 4. Input from Intel labs as	Phil Mondor; Teresa Hill; Mehta, Sudeep (IRR); Venkataramanan, Guruguhanathan Intel Labs SC); Katta, Chandra; Golebiewski, Marcy (Big Data); Borkar, Atul

				key stakeholder	
04/08/2014	Intel Labs, Santa Clara, US	Intel Labs, Santa Clara, US	Meeting with M&A	Dave Williams (M&A) had expressed interest, and re-iterated, in utilizing TIMBUS for M&A activities	David Williams
04/08/2014	Intel Labs, Santa Clara, US	Intel Labs, Santa Clara, US	IL Open House	Present TIMBUS at Intel Labs Open House	Intel Labs, including Intel Labs GM, Wen-Hann as well as Intel legal attorney Michael P and the SOC design teams
31/07/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel Clanton Design team	Timbus review	Update and touch base on TIMBUS status and discussion relating to requirements for potential POC	Sarah Frawley
28/07/2014	Intel Ireland, Leixlip, Ireland, Folsom, CA, USA	Intel Labs Europe (IPLS) and Intel IT InfoSecurity	TIMBUS sync-up meeting	Update on TIMBUS status and progress	Phil Mondor
14/07/2014	Intel Ireland, Leixlip, Ireland, Folsom, CA, USA	Intel Labs Europe (IPLS), Intel Clanton Design team and Intel IT InfoSecurity	Clanton joint PoC - DOT follow-up discussion	Internal meeting to identify other key stakeholders to increase support for Clanton POC and agree on next steps	Mondor, Philip L; Frawley, Sarah; Hill, Teresa L
14/07/2014	Intel Ireland, Leixlip, Ireland & Chandler, AZ, USA	Intel Labs Europe (IPLS) and Intel PC Client	Growth of Intel Labs Europe status within research and business environment	Divya is now leading up Intel's Data Society research strand, taking over from Sean Koehl. This initial meeting resulted in an internal blog article (Please don't reinvent the wheel!) in Intel which got lively comments.	Divya Kolar (Technology Evangelist)
03/07/2014	Intel Ireland, Leixlip, Ireland & Portland, OR, USA	Intel Labs Europe (IPLS) and Intel IT Cloud	TIMBUS Overview	Discuss how TIMBUS relates to data archival process; Eshe interested in and supportive of TIMBUS; support idea of pilot with Clanton team first PoC in Leixlip	Eshe Pickett, Sarah Frawley
03/07/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Cold Storage in the Cloud	Discuss Trends, Challenges and Solutions	Rodger Mooney
03/07/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT Flex Services	TIMBUS Planning Session	Didier joining TIMBUS project as Exploitation Lead and support other activities, incl. Dissemination.	Didier da Costa
16/06/2014	Intel Ireland, Leixlip, Ireland, Folsom, CA, USA	Intel Labs Europe (IPLS) and Intel IT InfoSecurity	TIMBUS preparation meeting	Prepare slides for Sudeep	Phil Mondor
12/06/2014	Intel Ireland, Leixlip, Ireland, Folsom, CA, USA	Intel Labs Europe (IPLS) and Intel IT InfoSecurity	Archival sync-up meeting	Planning for POC, how will it fit in to what Phil's team is doing	Phil Mondor

10/06/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS), Intel IT and EAB	Risk Based approach to Archival	Teleconference on how to present archival challenges to management in such a way as to improve the chances of political and financial support.	Rodger Mooney and Alan Elwood (EAB member)
14/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT Flex Services	TIMBUS exploitation planning	Internal session to plan exploitation initiatives	Mike, Perumal, Sridhar
13/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Sync on IT Archive POC/TIMBUS	Review and discuss status on IT Archive POC and TIMBUS	Rodger Mooney
12/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT Flex Services	TIMBUS planning session	Internal planning session	Mike, Perumal, Sridhar
08/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT Flex Services	TIMBUS planning session	Internal planning session	Mike, Perumal, Sridhar
02/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Cold Storage in the Cloud	Discuss Trends, Challenges and Solutions	Rodger Mooney, Gary Dunne & Adam Mendoza
01/05/2014	Intel Ireland, Leixlip, Ireland	Intel Labs Europe (IPLS) and Intel IT	Sync-up session with Rodger Mooney	Status updates from each side	Rodger Mooney

Appendix C: TIMBUS-OPF Sustainability Work Plan

Work Plan for Sustainability of TIMBUS Extractor Framework

Carl Wilson

26/11/2014

Introduction

This document make a few assumptions regarding the readers' familiarity with TIMBUS software and the OPF's aims regarding software curation / sustainability.

Outline of agreement

The TIMBUS project and the Open Preservation Foundation have agreed that OPF will spend ten days working on aspects of TIMBUS software sustainability. Under the agreement the 10 days effort must be spent before the TIMBUS project ends on December 31st 2014.

Overall aims

The software curation activities described later are consistent with criteria from the OPF's software maturity model for OPF-Labs projects. An overview of the model is provided at the end of the document. The OPF-Labs criteria are chosen to help a technical user, probably a developer, to:

- find the software online;
- quickly work out what the software does and how it's used;
- build a local working instance of application for testing, this may be virtualised; and
- enhance/contribute to the software project.

The above points really capture the aims of the activities. Concrete outcomes are described later in the work plan.

Software scope

The TIMBUS project produced several software tools / systems, more than could be curated meaningfully over 10 days. The TIMBUS consortium have chosen the Extraction Framework and a subset of the accompanying Extractors for curation. Extractors are software agents that gather contextual / environment information from hardware, and installed operating systems. The Framework provides software and a web GUI to manage and execute Extractors on remote (or local) systems. These were chosen because:

- they're logically independent from the other TIMBUS software, though they provide information for populating the TIMBUS context model; and
- the extraction and recording of contextual information about a computing environment is of wider applicability.

Formal list of software products

The following list was suggested by Carlos Coutinho after consulting TIMBUS partners. It's also agreed in principle by the OPF:

- TIMBUS Extraction Framework, an OSGi-based service environment + API;
- the Extractor Framework GUI an nodejs application with a testbed currently running at http://testbed.timbusproject.net:3001;

- the Linux Debian Software Extractor, which extracts packages and licenses information from Debian distribution-based Linux environments;
- the Linux RPM-based Software Extractor, which derives package and license information from Red Hat distribution-based Linux environments;
- the Linux Hardware Extractor, which is believed to work in Debian and Red Hat environments, and extracts hardware characteristics;
- the SSH Wrapper Extractor, which generically executes commands on remote systems via SSH and captures the results; and
- the Extractor Template + Tutorial, specifically for anyone developing new extractors.

Work Plan

The following tasks are in temporal/logical order apart from documentation which will be ongoing through the tasks. The precise resources required to complete some of the later tasks aren't definitely known. The OPF will be taking the role of a technical newcomer looking, ideally, to build an exemplar working instance of the framework. How long this takes will depend on the accuracy of the existing documentation and the quality of the software. README documentation, license and transfer to GitHub won't take more than between 2 & 3 days Static code analysis and CI tasks will consume at least the remainder of that week. The OPF and the TIMBUS technical staff can then make some informed decisions regarding what's realistic for the remainder of the time based on the findings.

Documentation

On GitHub

Ensure that the GitHub project documentation allows a technically minded newcomer (software developer) to compile and contribute to the project.
GitHub README: this will provide the main landing page/documentation hub for the GitHub project. Gather documentation / links to documentation in one place. Provide clear instructions for building the project, e.g. tools such as Maven, and dependencies.
The Labs criteria cover source code and technical documentation, there's no expectation of a website or user level documentation.

Source code documentation

In line source code comments are best written by the original developer. Ten man days is not enough time to address this kind of detailed documentation. Source code documentation will only be added or amended in the following cases:

- public APIs, classes and methods, i.e. the points of first contact between the code a new developer; and
- anywhere that a patch is applied by the OPF as a fix for any issues found in the course of these tasks.

Public API documentation will be addressed as part of the static code analysis (see later task). There are good automated tools to check and generate standard forms of documentation for Java and JavaScript.
Patch documentation will be created as required.

License

Not time consuming but important, ensure that the project licensing is clear and that there's a LICENSE file in place.

GitHub project on OPF Labs

The OPF will create a copy of the project's git repository on the OPF Labs GitHub page, with full source history and attribution, on the OPF's GitHub Labs site.

OPF patches

During the course of this work it may be necessary to fix some of the issues that are encountered. For every such issue the OPF will:

- raise an issue on the GitHub issue tracker;
- implement a broken test and fix that references the issue;
- check the above into an OPF branch of the source repository, each check in will contain a single fix only; and
- submit a pull requests to the main branch.

Travis continuous integration in place

A working continuous integration build allows a developer coming to the project to see that the code does build, and how it's built. The OPF will create a working Travis CI build of the software projects. Travis supports Java and Node applications, although it's not guaranteed that the Node app will be well suited to a CI approach.
At this stage time scales become a little more uncertain. If things go smoothly it will be because the existing documentation was adequate, and that the code built and ran as advertised. If this isn't the case then fixing problems and improving documentation will take more time

Code quality

Once Travis builds are in place the OPF will perform preliminary static code analysis using the OPF's Sonar Server. Initially the OPF will produce a report and a brief analysis, and we'll decide how to proceed on that basis. The metrics of particular interest are:

- unit test coverage;
- documentation coverage for public APIs, and the like; and
- cyclic complexity checks, these highlight often long methods that obstruficate the paths through the code.

Ensuring that the all public APIs are documented accurately is probably the most realistic and useful activity that the OPF could engage in.

Virtualised extractor management instance

If there's time / resource left after the above the OPF will look to provide a virtualised reference installation. This will consist of:

- one machine running the node web app and possibly the OSGI server, although this may be a separate VM;
- a pair of Linux machines, one Debian and one Red Hat, used as targets to extract information from.

Summary

The above feels a realistic task list, possibly bordering on the ambitious. It's fine to proceed as long as there's an understanding that it's quite possible that not all of the above will be achieved.
All of the tasks up to and including Travis CI and the static code analysis are achievable. This should ensure that anyone coming to the code base should find getting up and running is a straightforward rather than frustrating experience. That's really what this process is looking to achieve.

OPF Software Maturity Model

The tasks that make up the work plan are derived from the OPF's software maturity model for Labs projects. A summary of the model is shown below with the criteria for Attic projects removed. Attic criteria are minimal and cover mothballed projects so aren't relevant.
It's not envisaged that all the criteria for Labs projects will be met, 50% test coverage alone might take multiple man months if there are few or no tests. Indeed writing unit tests is out of scope except as a part of any bug fixes implemented by OPF. It's emphasised that although a virtual demonstrator isn't required of Labs projects it would be particularly useful for the extractor framework.

	OPF-Production	OPF-Labs
Community	Active bug reports/fixes Named maintainer Contribution guidelines	Active bug reports/fixes
Documentation	Source code comments Technical documentation Installation manuals User documentation Microsite	Source code comments Technical documentation
Code quality	Test coverage 50% > 80+% Continuous integration Publishing test results	Test coverage c.50% Continuous integration
Deployment	Build from source Defined platforms Automated packaging (e.g. DEB/RPM/EXE)	Build from source
Support	Online demonstrator Virtual machine image Training materials	[no expectation]
Licensing	Defined open source licence	Defined open source licence

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[51] Dr. Ian G. Anderson's Profile on the University of Glasgow's School of Humanities website: http://www.gla.ac.uk/schools/humanities/staff/iananderson/
[52] Open Preservation Foundation: http://openpreservation.org/
[53] AIT Austrian Institute of Technology: http://openpreservation.org/about/members/ait-austrian-institute-of-technology/
[54] Bibliothèque nationale de France: http://openpreservation.org/about/members/bibliotheque-nationale-de-france/

[55] British Library: http://openpreservation.org/about/members/british-library/
[56] Goportis: http://openpreservation.org/about/members/goportis/
[57] OPF Staff webpage: http://openpreservation.org/about/people/staff/
[58] Ed Fay Johnston LinkedIn Profile: https://www.linkedin.com/in/digitalfay
[59] Becky McGuinness LinkedIn Profile: https://www.linkedin.com/profile/view?id=45557180&authType=NAME_SEARCH&authToken=OU_C&locale=en_US&srchid=10128341141773949235&srchindex=1&srchtotal=8&trk=vsrp_people_res_name&trkInfo=VSRPsearchId%3A10128341141773949235%2CVSRPtargetId%3A45557180%2CVSRPcmpt%3Aprimary
[60] Carl Wilson: https://www.linkedin.com/profile/view?id=80359691&authType=NAME_SEARCH&authToken=ZUwL&locale=en_US&srchid=10128341141774074351&srchindex=1&srchtotal=73&trk=vsrp_people_res_name&trkInfo=VSRPsearchId%3A10128341141774074351%2CVSRPtargetId%3A80359691%2CVSRPcmpt%3Aprimary
[61] *http://www.eventolinux.org*
[62] *http://www.rcaap.pt*
[63] *http://www.mancoosi.org*
[64] Digital Resilience and Preservation 21 May 2012, http://www.dpconline.org/events/details/44-resilience?xref=46.
[65] Angela Dappert (2012), *Metadata for Preserving Computing Environments.* Preservation of Complex Objects Symposia: Gaming Environments & Virtual Worlds, 26-27 January 2012. http://www.pocos.org/index.php/pocos-symposia/videogame-environments-a-virtual-worlds.
[66] TIMBUS Training Day, Tuesday PASIG 2012 (Preservation and Archiving Special Interest Group). 16 October 2012.
[67] Further information about training resources can be found in deliverable 3.5, section 5, and training events in D3.5, section 6.
[68] A list of relevant mailing lists and personal contacts for dissemination of the mailing list is available in Tables 18 and 19 of Deliverable 3.3.
[69] http://www.alliancepermanentaccess.org/index.php/aparsen/.
[70] Event details are on the TIMBUS website: http://timbusproject.net/events/events-archive/291-advancedpractitioner2014.
[71]Virtualisation and Preservation: How cloud computing changes what we think about digital preservation: Cambridge 22nd July 2014 (http://www.dpconline.org/newsroom/latest-news/1242-virtualisationanddp?q=briefing+day+cambridge).
[72] For further information, see http://www.dpconline.org/newsroom/latest-news/1129-lloyds-banking-group-joins-the-digital-preservation-coalition.
[73] Intel Labs Europe Website: *http://www.intel.eu/content/www/eu/en/research/intel-labs.html*
[74] Biographies of Intel Executive Officers: http://newsroom.intel.com/community/intel_newsroom/bios
[75] Google said to be mulling move from Intel to custom ARM chips: http://www.businesscloudnews.com/2013/12/18/google-said-to-be-mulling-move-from-intel-to-custom-arm-chips/
[76] Roadmap to Software-Defined Infrastructure: http://www.infoworld.com/t/data-center/road-map-software-defined-infrastructure-230713
[77] Wired.com blog: We Need to Act to Prevent a Digital 'Dark Age': http://www.wired.com/insights/2013/05/we-need-to-act-to-prevent-a-digital-dark-age/
[78] *Genii GWAP demonstrator: http://www.youtube.com/watch?v=C-F_kX_ggQ4*
[79] *RTE news piece on the Morpeth roll: http://www.rte.ie/news/2013/0314/376639-morpeth-roll*

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[81] E-ARK Project: http://eark-project.eu/
[82] 4C Project: http://www.4cproject.eu/
[83] List of Portuguese dams: http://cnpgb.inag.pt/gr_barragens/gbportugal/AA.htm
[84] D8.2 - Use Case Specific Risks
[85] Note that the details of these projects are confidential
[86] ISO 25010: Systems and software engineering -- Systems and software Quality Requirements and Evaluation (SQuaRE) -- System and software quality models