



Interactive Realtime Multimedia Applications on Service Oriented Infrastructures

ICT FP7-214777

WP2 Market and Technical Requirements analysis

Survey Analysis

IRMOS_WP2_Survey_Analysis_TID_v3_0.doc

Scheduled Delivery: 31 Oct 2008

Actual Delivery: 3 Nov 2008

Version: 3.0

Project co-funded by the European Commission within the 7 th Framework Programme		
Dissemination Level		
PU	Public	X
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RE	Restricted to a group specified by the consortium (including the Commission)	
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Responsible Partner: Telefónica I+D (TID)

Revision history:

Date	Editor	Status	Version	Changes
15.10.2008	Mario del Campo	Initial Version	1.0	Initial Contribution
28.10.2008	Mario del Campo	First Revision	2.0	Suggested changes from ALUD (Klaus Satzke) and USTUTT (Georgina Gallizo) incorporated
03.11.2008	Mario del Campo	Final Version	3.0	Suggested changes from TID (Eduardo Oliveros) incorporated

Authors

Mario del Campo (Telefonica I+D), Alba García (Telefonica I+D) and Eduardo Oliveros (Telefonica I+D)

(This document has been elaborated with the content of two IRMOS deliverables: D2.1.1 "Initial version of Requirements Analysis Report" and ID2.1.2 "Updated version of Requirements Analysis Report")

Internal Reviewers

Klaus Satzke (ALUD) and Georgina Gallizo (USTUTT)

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Acknowledgements

The research leading to these results has received funding from the EC Seventh Framework Programme FP7/2007-2011 under grant agreement n° 214777

More information

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Glossary of Acronyms

Acronym	Definition
API	Application Programming Interface
AR	Augmented Reality
AVR	Augmented and Virtual Reality
D	Deliverable
EC	European Commission
HDTV	High Definition Television
IRMOS	Interactive Real-time Multimedia Applications on Service Oriented Infrastructures
ISONI	Intelligent Service Oriented Network Infra-structure
RAID	Redundant Arrays of Inexpensive Disks
SDTV	Standard Definition Television
SLA	Service Level Agreement
SME	Small and Medium Enterprise
VR	Virtual Reality
WP	Work Package

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1. Executive Summary

This document has been elaborated with the main objective of summarizing the final analysis and results of the survey to the participants, for closing the loop and gathering feedback from them. The reader will find that the document is organized in two main sections:

- Section 3: contains the description, results and analysis of the survey, taken from the IRMOS public deliverable D2.1.1 [1].
- Section 4: contains the technical requirements for the IRMOS platform, derived from the user requirements specified in the survey. This information is included in the IRMOS confidential deliverable ID2.1.2.

The survey was mainly focused on European organizations with current expertise and involvement in real-time technologies in order to obtain end-user requirements for the IRMOS solution. The number of surveys received has been 45, where SMEs participation raised to 64%. From the analysis of the results, a set of user functional requirements has been obtained and categorized in General technical Requirements, Security Requirements and specific requirements for the Digital Film Postproduction, eLearning and Augmented and Virtual Reality scenarios. This set of user requirements represents an input for the identification of functional requirements of the IRMOS platform. Companies showed a big interest in security aspects, especially related to the data confidentiality (67%) and integrity (58%). Regarding technical capabilities, the most demanded features for eLearning include multivideo conferencing, virtual reality and tutor and discussion boards. For the companies belonging to the Digital Film Post-Production area, scanning/digest services, mastering services and grain management services are the most appreciated whereas for the Augmented and Virtual Reality companies a high video quality and a secure exchange of data, video and audio are considered to be the pillars functionalities to look at.

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2. Introduction

In order to investigate the end-user requirements, the survey has been propagated among more than a hundred organizations, mainly across Europe, whose economic sector leads with real-time technologies. Most of the organizations that have collaborated with the IRMOS project are involved in any of the sectors covered by the scenarios included in the project (Film Post Production, eLearning and Augmented and Virtual Reality). From the results and analysis of the surveys a list of end-user requirements has been identified and enumerated in this document.

2.1. Scope of the document

For covering a wider target audience, the choice was the realization of an online survey. By the use of this web application, WP2 team looked for attracting as many organizations as possible to cooperate in the search of end-user functional requirements. These user requirements together with the specification of use-cases regarding the three scenarios of the project constitutes a valuable input for the determination of specific, measurable, assignable and time-related requirements of the IRMOS platform and it is an initial guess for the preliminary identification of components and modules to be considered in the platform architecture (WP3).

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3. Survey to potential users/customers

This section includes a description of those organizations that participated in the online survey and the description of the survey: how the survey is structured and which objectives were pursued with the questions included.

3.1. Selection of target audience

The target audience of this survey has been organizations whose business target is related to real-time technologies. Partners in the IRMOS consortium already belongs to these economic sectors and consequently, most of the companies contacted for filling out the survey are contacts that these companies already have.

In addition, we have contacted other organizations with no initial business relations with the partners of the IRMOS consortium. Some partners have established communication with national organizations via specific associations. For instance, in Spain there is a network of SMEs that are mainly focused on innovative solutions and aim to participate in EC funded projects [2]. Furthermore, several companies contacted in Greece and UK, that are part of the application scenarios sectors, have been identified using Internet.

We have contacted more than a hundred organizations to collaborate with us in the definition of requirements from the user's point of view and the information obtained for this survey will be crucial in the definition, analysis and design of the IRMOS platform architecture. To check the whole list of companies, please check List of target audience.

3.2. Elaboration of the survey

The **objective** of elaborating a survey addressed to European organization, outside the IRMOS consortium, is to capture the needs and requirements that these organizations have regarding real-time applications. Consequently, the survey is mainly focused on **obtaining the end-user requirements** of real-time applications, specifically those related to eLearning, digital film postproduction and augmented and virtual reality economic sectors.

The election of an online survey as the way to carry out this task was mainly based on the fact that our target audience was basically European organizations (mainly SMEs) and this represents the best way to reach as many organizations as possible. However, we support the opinion that face-to-face meetings represent a closer and warmer way to gather information, this is why some of the surveys carried out by Postproduction organizations were done during face-to-face meeting and taking advantage that a meeting of postproduction film companies took place within the survey elaboration dates.

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The survey can be divided in two main parts. The first one is common for all audiences and includes general questions regarding general organization information, security issues and general technical requirements. The second part groups the specific scenario questions. Depending on the target interests just one or more of these scenario questions can be answered.

Consequently the survey has been structured in 4 main blocks or sections. The first 3 blocks correspond to the general questions and the forth block to the scenario specific questions. These are:

1. **Organizational:** This block of questions is composed of general questions about the organization that will allow us to classify adequately the answers with respect to:
 - a. Type of the organization (SME, large company, academic)
 - b. Role of the organization in the value chain.
 - c. Economic sector.
 - d. Experience on the real-time technology sector.
 - e. Profile and position of the person completing the survey.

Objective: To know general aspects of the organizations to analyse and categorize the rest of the questions in the survey.

2. **Security:** the IRMOS project, being a distributed solution, has the knowledge protection and the security as crucial matters that will affect requirements and features of the future IRMOS platform. This section has been structured around identifying the risks that users perceive when they use IRMOS:
 - a. Assets, i.e. the valuable things for an IRMOS user, which includes their reputation, data, ability to deliver services etc.
 - b. The threats to those assets, e.g. how an asset might be compromised and the result, e.g., the disclosure of confidential data due to unauthorised access by a competitor or the loss of ability to deliver a service to agreed QoS due to a denial of service attack by a hacker.
 - c. The impact of compromising an asset, e.g. law suits, financial penalties, reduced profit, compromised reputation etc.

Objective: To extract non-functional end-user security concerns.

3. **Technical Requirements:** In this section we try to determine:
 - a. The average technical capacities of the organizations that will use the IRMOS platform. Thus, the user interface could be adapted to their abilities.
 - b. Capacities and functionalities that could be considered essential on the IRMOS platform and common to any soft real-time application running on it.

Objective: To obtain general technical capabilities expected from the IRMOS solution.

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4. **Scenario Specific:** this block of questions is directly related to the three scenarios considered in the IRMOS project:
- a. **eLearning:** we try to answer the following considerations:
 - i. The level of experience with eLearning techniques in the past that will allow us to know if the user is beginner, medium or advanced.
 - ii. eLearning scenario functional requirements, allowing the user to choose the content capacities, the tutor support, the use of other capacities, the use of more than one trainee, the most appropriate devices, technologies (including virtual reality) and eLearning barriers and expectations analysis.
 - b. **Augmented and Virtual Reality:** this survey tries to find out the following different aspects from the organizations.
 - i. Application areas where AVR is applied: design, engineering, manufacturing and research & development
 - ii. Collaborative working
 - iii. Simulation
 - c. **Digital film post-production:** we try to summarize.
 - i. Marketing questions
 - ii. Functional requirements: RAID, 3D capacities, remote working, average time for a film postproduction job

Objective: To extract functional end-user requirements scenario specific.

To check the complete survey, please go to IRMOS User Requirements Survey, included in the D2.1.1[1] as Annex B.

3.3. Survey analysis and results

3.3.1. General Questions: Organizational

This section addresses the analysis of the organization part of the survey. During the 22 days the survey has been active we have received 45 complete answers and 12 incomplete answers which have not been taken into account.

Each of these 45 surveys includes none, one or more related scenario in which the user is interested in (see Figure 1). Thereby the sum of the number of surveys per scenario is not the same as the total number of surveys filled in since one organization could be interested in several scenarios. For instance, 20% of the eLearning and digital film postproduction organizations are also interested in Augmented and Virtual Reality and 50% of the AVR organizations are also concerned about eLearning.

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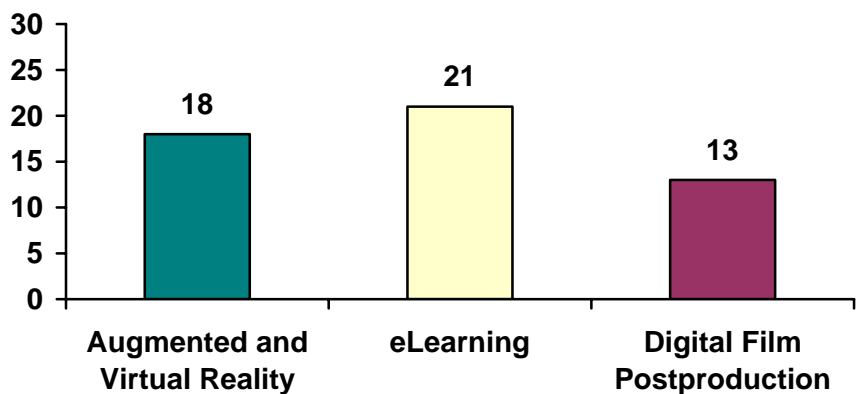


Figure 1 Number of surveys filled in per scenario

The IRMOS target audience is mainly focused on SMEs but large companies and academic organizations are also part of the target audience. Figure 2 Organization type distribution gives a quantitative view of the organization types that have submitted the survey. Small (37%) and medium (27%) business have provided the majority of the answers. To summarize, we have obtained a satisfactory SME participation rate over the total (64%) which represents one of the main objectives of the project.

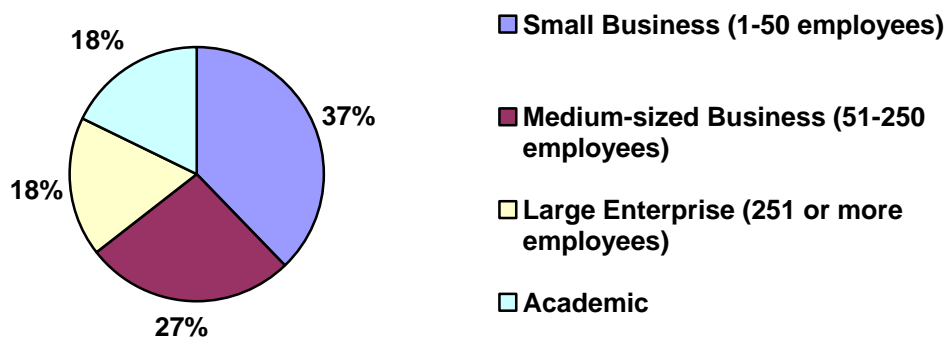


Figure 2 Organization type distribution

Next we show the distribution of organizations per economic sector (see Figure 3 Economic sector distribution.) which represents a very balanced audience on Simulation, eLearning, Digital film postproduction and engineering (some organizations belong to more than one sector).

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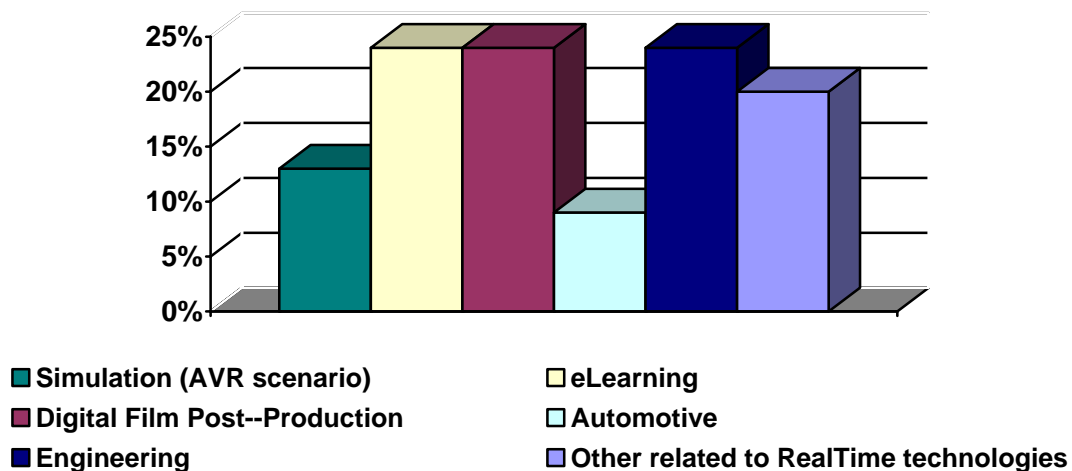


Figure 3 Economic sector distribution.

53% of the organizations surveyed already have business in the area of real-time technologies, proportionally spread between the three scenarios, with the exception of three organizations within other different economic areas: motion capture systems, robotics and Real-time Oil & Gas drilling & production data.

Regarding the classification of organizations in relation to its role as stakeholders in the value chain: Application Provider was the main role selected by AVR organizations. In digital film postproduction the Service Provider role was the predominant role. Finally, in eLearning there is not a principal role, being End-User, Service Provider and Application Provider the most important ones.

Among the organizations surveyed there are almost the same proportion between those which are relying on external resources (46%) and those which are not (40%; 14% chose not to answer the question). For example, automotive (100%), simulation industries (80%) and Postproduction (54%) generally use external resources. On the other hand, eLearning (60%) and Engineering (45% vs. 27%) do not use external resources.

When choosing their providers, companies mainly consider the Quality of Service (88%) as the most significant aspect, followed by price and reputation in the same proportion (53%). In relation to billing, most of the organizations choose to pay per task (76%) versus a fixed budget (47%).

Analyzing the respondents' internal position in their organizations, most of the people are technical managers. Figure 4 shows the diverse positions. Regarding the authority to purchase equipments or services, 40% can recommend or specify the purchase and 30% can directly make the final decision.

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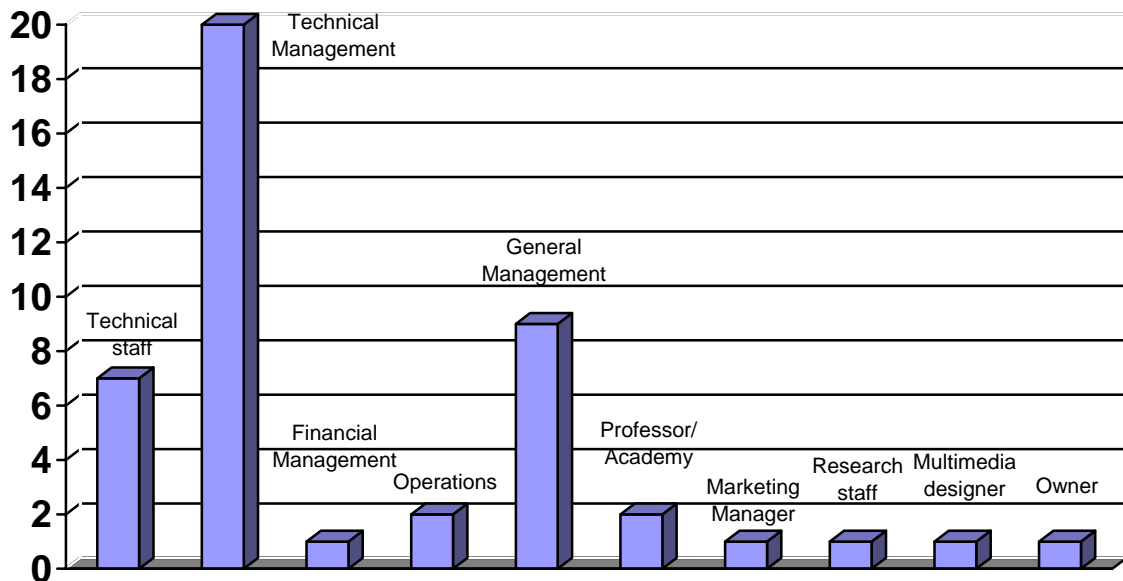


Figure 4 Position of the target audience in their organization.

3.3.2. General Questions: Security

This section is focused on the assets of value to IRMOS users like their reputation, data, the capacity to deliver services, benefits, etc, analyzing which could be the security threats to those assets that could compromise them.

Disclosure, loss or unwanted modification of confidential data or information directly affect to company reputation and revenues as well as the degradation of their services. Because of this reason several security issues that could compromise these asserts have been identified and subsequently analyzed:

- Data/information confidentiality
- Data/information integrity
- Licensed/authorised usage of Resources/applications
- Denial/degradation of services

The next figure illustrates the level of concern about the different security issues between our audience and those risks that they consider not covered adequately in their current infrastructure or way of working.

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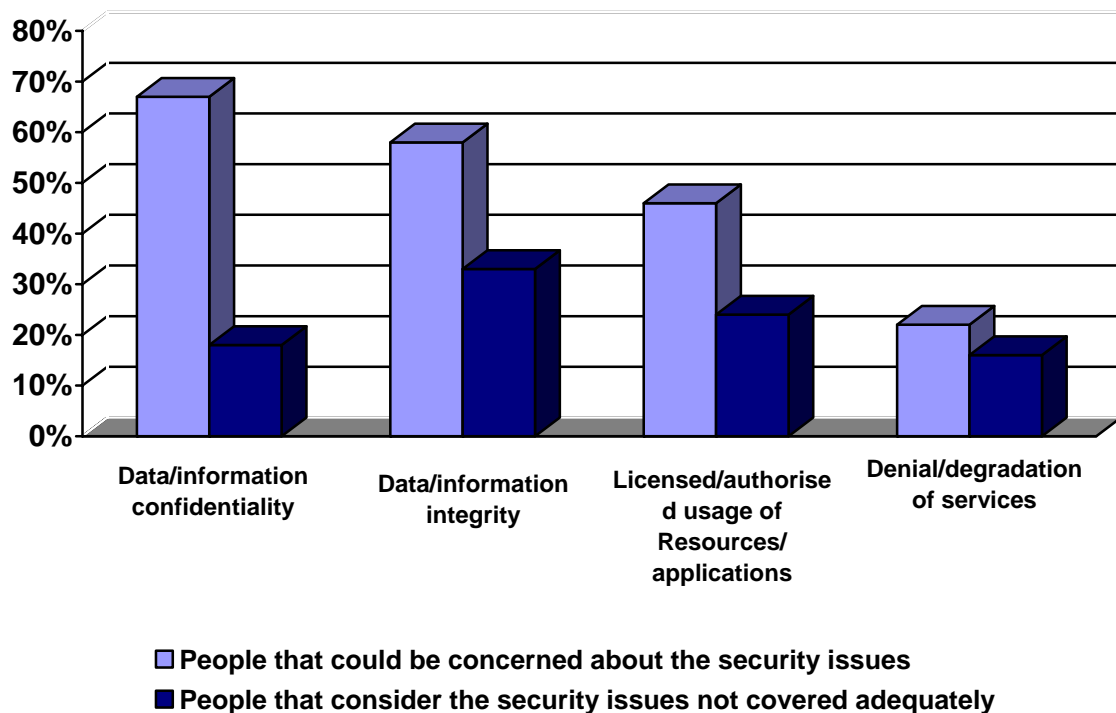


Figure 5 Security issues.

In general, data is considered by almost 70% of the companies as a delicate asset threatened by different issues. Disclosure of confidential data or information as a result of an unauthorized access of a hacker or an employee concerns to many of IRMOS potential users. The same happens with loss or unwanted modification of data caused by hackers. These threats to data confidentiality and integrity have a great impact on loss of reputation, customer confidence and revenues. In less proportion this could also cause financial penalties and loss of productivity. In some cases all these threats are also considered to be caused by competitors, customers or collaborators.

Other issue that can be considered as a possible reason of loss of reputation or benefits is the unauthorized usage of resources or applications that could also cause financial penalties or legal actions. In this case customers and collaborators are contemplated as originators of this problem in same proportion as hackers. This unauthorized use of resources is also considered as a potential threat to data confidentiality.

The degradation, interruption or failure to deliver services can cause a high impact on reputation and benefits but just the 22% of companies are concerned about this issue. This problem is also considered as a consequence of the loss of data confidentiality and integrity. The persons responsible for this issue are mainly the employees followed by hackers.

3.3.3. General Questions: Technical Requirements

Most of the organizations count on some internal IT support having their employees a good level on IT technologies. This indicates that the organizations do have knowledge

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on Internet and new technologies which makes them an adequate audience for the IRMOS environment.

Regarding high-level general functional requirements, our target audience consider interactivity as the most important requirement that should be guaranteed by the eLearning/digital film postproduction/Simulation Real-time applications, followed by response time, a good level of audio/video quality and throughput. The access to high quality real-time software and services are essential requirements just for the 30% of the surveyed.

Multivideo conference plus collaborative tools are the most demanded real-time communication capabilities. Other real-time communications capabilities suggested by users are digital data and presence. 'Virtual reality and real world in the same scenario' is in general the preferred application scenario selected. However, postproduction sector organizations showed not much interest in combining virtual reality and real world, they are more interested in context awareness tools and just virtual reality technologies.

In relation to collaborative work applications, they are considered essential for businesses today (35% of organizations considered it 'a must' and 40% 'important').

In general, all users need to have the control over their applications (Start/Stop/Pause/Resume) and the rights to customize the application in terms of user interface (69%), performance (64%) and video quality level (53%). They also agree that their application usage is mainly interactive as their applications or users react to job results.

3.3.4. Specific Scenario: eLearning

57% of the organizations have chosen eLearning scenario, but just half of them belongs to eLearning sector. The following figure analyzes the economic sectors of these organizations:

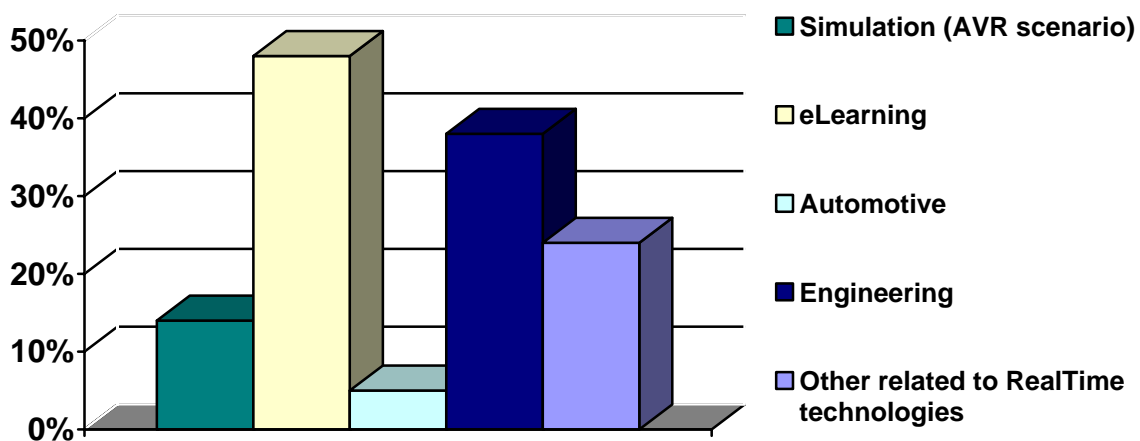


Figure 6 Organization types interested in eLearning scenario.

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The figure shows a high variety of sectors interested in this specific scenario, but the analysis also reveals that from the total of these organizations more than a 38% do not use already eLearning. This proportion decreases to 20% when talking in concrete about the eLearning sector.

The eLearning scenario is mainly applied in education, academic and scientific fields (70%) and in information technology fields (54%); and it has a good adaptation response among trainees. Other areas in which eLearning is being used but with a minimum percentage (around 20%) are: customer service, professional/industry-specific and management/executive and sales. One person from the eLearning sector commented that the customer satisfaction is high but the budget required divided by the number of students that attend the courses is not satisfactory. Several people remarked that thanks to eLearning their customers can afford a large number of users/students and can make use of richer content (video, audio and so on).

With the idea of analyzing different facilities normally incorporated into eLearning programmes, our target audience has been asked to evaluate considering the usefulness of these facilities to access programme content, for communicating and giving tutor support and others. Next can be found a classification of this issue, starting with the most useful to the less useful, taking into account in each case just those organizations that make use of each facility:

- On-line tutor support: *very useful*
- Providing general programme information: *very useful*
- Providing programme study materials: *very useful*
- Providing online tests or quizzes: *very useful*
- Contacting other programme participants by email on study matters: *useful*
- Providing links to web resources: *useful*
- Assignment feedback: *useful*
- Taking part in programme online discussions / groupwork: *useful*
- Tracking participation: *useful*
- Assignment handling: *useful*
- Encouraging trainee use of the e-portfolio feature: *not very useful*

Among all the possible barriers that can slow down the successful delivery of eLearning applications, time to prepare the materials stands out above all the others. The lack of awareness of eLearning benefits also affects its adoption and in a third position, for those organizations already using eLearning, there are both management encouragement and lack of tutor support / contact.

Interests in using or learning different technologies like chatting rooms, discussion boards, forums, video conferencing and virtual reality & tutor are shown in the next figure.

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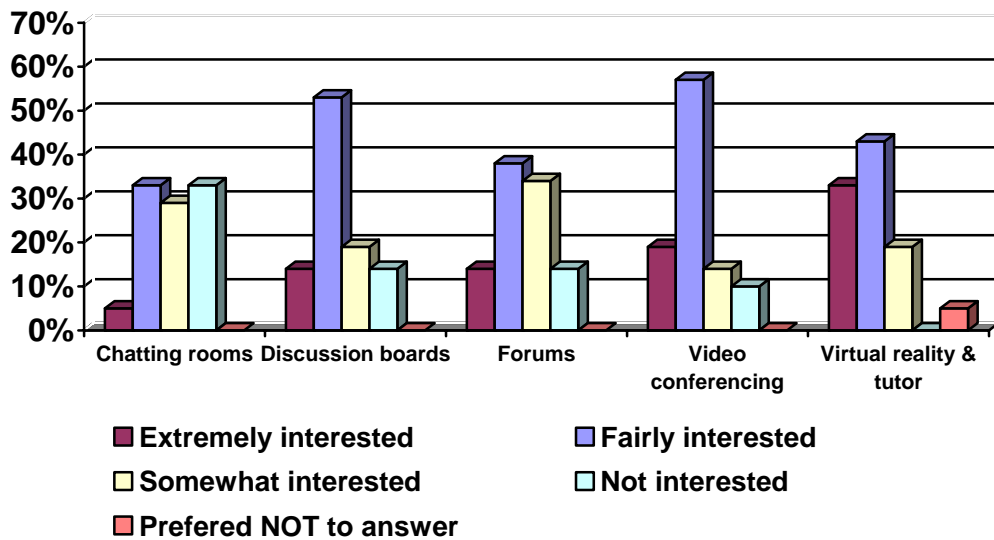


Figure 7 Interest level in diverse technologies.

Most organizations need or think they could need interactive eLearning with more than one trainee. All users access to online content with a personal computer and just a 20-30% with mobile phones, smartphones or PDAs. There are a few that have already experienced any virtual technology (like 3D movie), most of them coming from the AVR sector and just once or a couple of times in places like cinemas or Space and Advanced Telecommunications Expo Europe or a few times with Second Life. Exceptionally one of the surveys shows experience with digital studio applications like brainstorm, for-a, ORAD and WIZRT during 4 years.

Analyzing several virtual reality contexts regarding eLearning our users have evaluated the level of satisfaction as follows:

- Samples of 3-D virtual reconstruction of parts of museums/historical buildings/laboratories/hangars: *57% think it is very useful.*
- High impact activities simulation (flight simulator, etc): *52% very useful.*
- Training tool for employees located in different branches around the world: *47% useful, 29% very useful.*
- Physical and mental rehabilitation activities: *33% useful, 29% very-useful.*

Other contexts suggested by our audience where Virtual Reality can be used were: Virtual Studio for TV applications and several other activities where visual perception (concrete examples applications) is useful.

To conclude with this scenario, teaching in dynamic context is, for 76% of eLearning audience, the most appreciated expectation of adding real-time features to eLearning. 45% of them also think that training supported by virtual reality and teaching in time aware conditions are relevant advances. In addition, one of our surveyed users has considered as well the possibility of adaptation to the user needs.

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3.3.5. Specific Scenario: Augmented and Virtual Reality

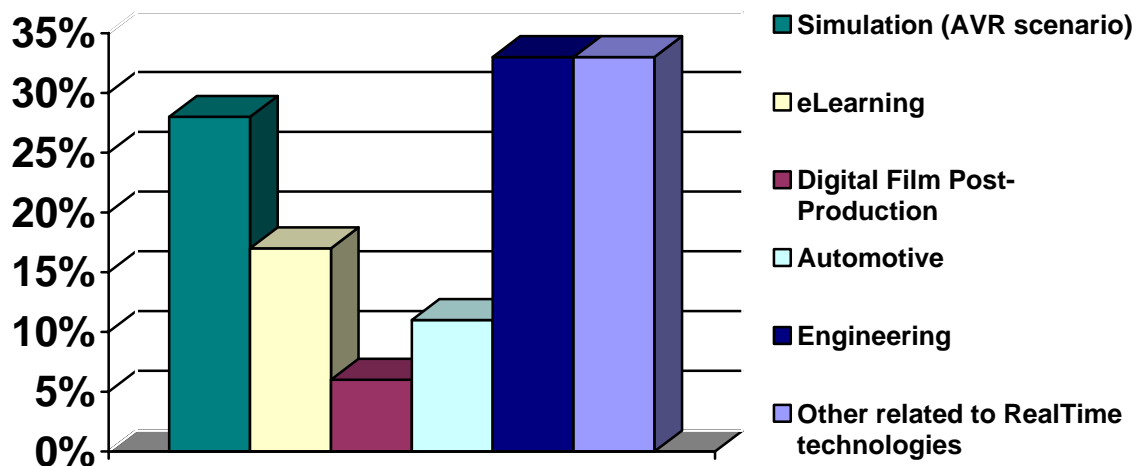


Figure 8 Organization types interested in AVR scenario.

Augmented and Virtual Reality scenario rouses curiosity and interest of all sectors (see Figure 8), but just 50% of the answers received confesses they already make use of Virtual Reality. Considering this percentage some areas in which Virtual Reality is applied have been analyzed in terms of utilization:

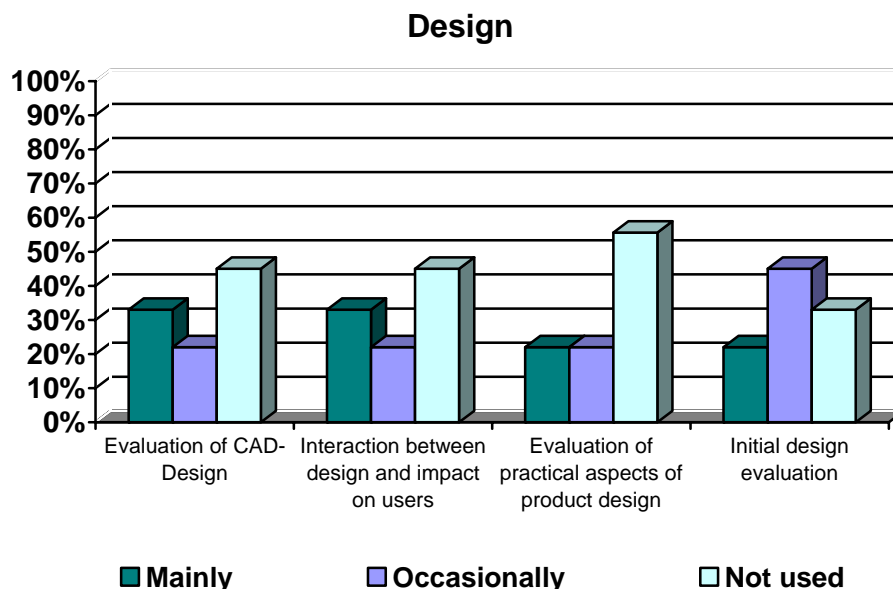


Figure 9 Design areas in which Virtual Reality is applied.

First thing that appears after analyzing this and next figures is that there are many areas in which Virtual Reality technologies are not used by our organization sample. Taking this factor into account, we can consider design as one of the areas where Virtual Reality

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is widely used among our end-users, at least 40% of them make use of VR in the different aspects considered, and in concrete we can highlight 'Evaluation of CAD-design' and 'Interaction between design and impact on users'.

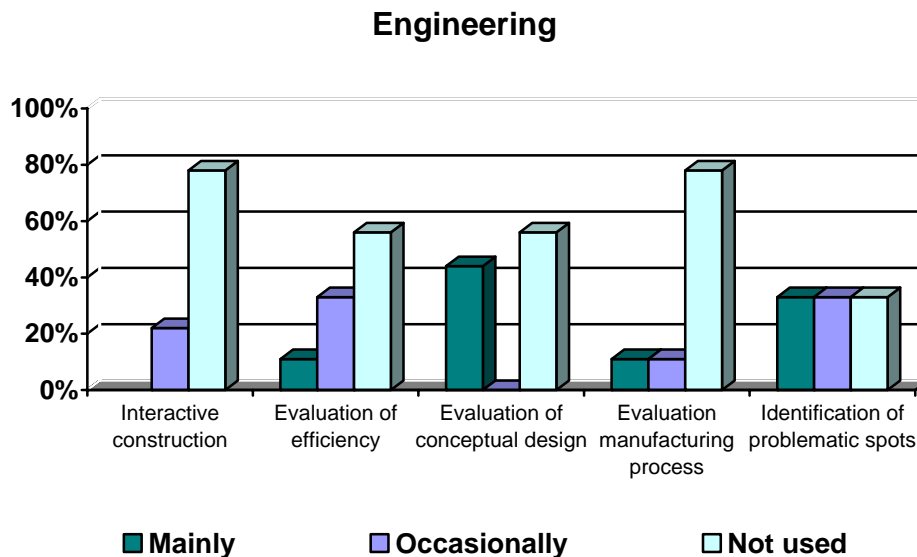


Figure 10 Engineering areas in which Virtual Reality is applied.

Most of our audience does not resort to Virtual Reality in engineering area in most cases, excluding identification of problematic spots technique. Evaluation of conceptual design is the engineering field in which Virtual Reality is mainly used the most with a 44% of percentage.

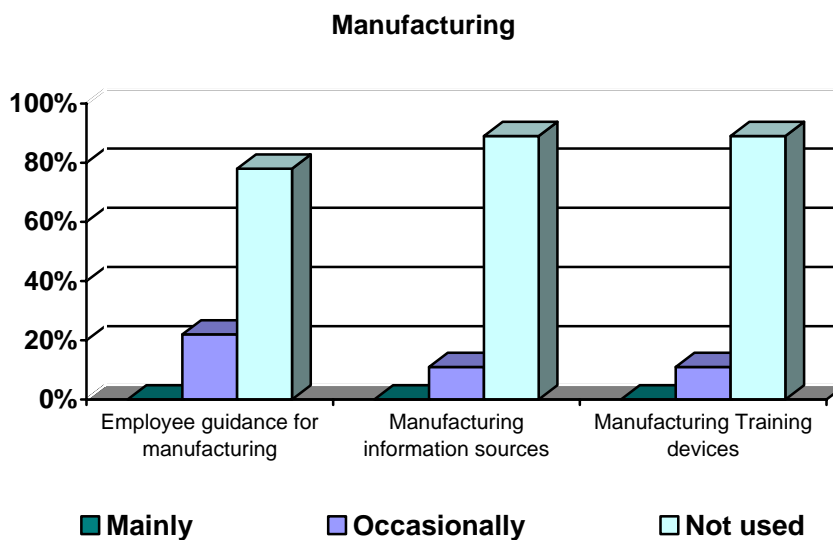


Figure 11 Manufacturing areas in which Virtual Reality is applied.

There is a general lack on using Virtual Reality in manufacturing field being 'employee guidance' the only technique that has been used by more than 20% of the users.

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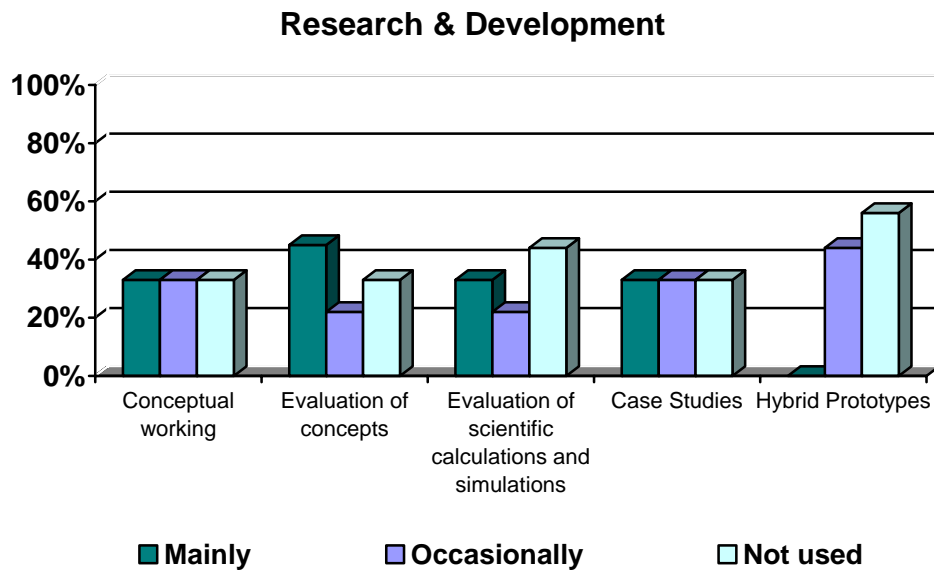


Figure 12 Research & Development areas in which Virtual Reality is applied.

Research and development area can also be considered as one of the greater users of Virtual Reality techniques as Figure 12 shows. VR is mainly used in the evaluation of concepts and scientific calculations and simulations as well as in conceptual working and case studies. Hybrid prototypes are rarely used with Virtual Reality techniques.

Focussing now our attention in Augmented Reality we discover that only 11% of our target audience already makes use of it in their organizations. The Augmented Reality equipment they have is headsets with cameras and also tangible interfaces in less proportion. Regarding Virtual Reality equipment most of them use desktop-systems (60%) and in less proportion (around 20%) cluster-based (>3 nodes), powerwalls, CAVE and VR integrated into meeting-rooms.

The possibility of making use of a Remote Augmented Reality service provided by a partner does not seem to be a viable option for 22%. Furthermore, most of users are interested in Remote AR for evaluation of simulation data based on comparison with physical prototype-based experiments although some of them have confidential data for such scenario and confess this issue could impose a problem since it has not been solved in similar cooperation before. In addition, video quality has been considered very important in this kind of sessions.

Other reference applications of IRMOS are being already used by these organizations, like COVISE (28%) and OpenCOVER (11%). The 28% confirm they make use of other VR applications like Custom Developed, Electro (EVL), IC:IDO software, Metaio software, IDO: Review DeltaGen PW and brainstorm media sws.

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All surveyed organizations have desktop office computers with Internet access and 83% of them confirm their company IT security restrictions allow TCP/IP connections to the Internet (e.g. firewall exceptions possible) against 11% that do not.

Just 33% confess their organization is already using Collaborative Work. Some requirements with regards to confidentiality taking into account in video conferencing sessions are secure data exchange and even video and audio exchange for some users.

Simulation packets that are frequently used includes:

- 3D studio Max
- Vector works
- Comsol
- Ansys
- IC:IDO
- Covise
- Cfxpost
- PAM LS DYNA abaqus fluent
- SPICE
- Matlab
- Mathcad
- Others (home-made code and in-house software, e.g., for earthquake simulations or ocean currents)

Actually some of these organizations are running several types of simulation like:
Table 1 Type of simulation carried out by different organizations and its complexity.

Type of Simulation	Complexity: Average simulation run duration (h)	Complexity: Average number of cores employed
Gallery interactives	-	-
Electromagnetic field problems	12	4
Scientific models of natural phenomena	1	
Crash Static Analysis CFD Mouldflow	5	-
Flow analysis and structural analysis	6	-
System simulations, physical simulations, electrical simulations	0,1	-

Most organizations are interested in interactive simulation or they are already using it but we did not obtain a clear conclusion about if their simulation code was parallelized. Regarding the question if their data could be run on a third-party computational resource during simulations most of users agreed that it could be possible under certain circumstances.

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3.3.6. Specific Scenario: Digital Film Postproduction

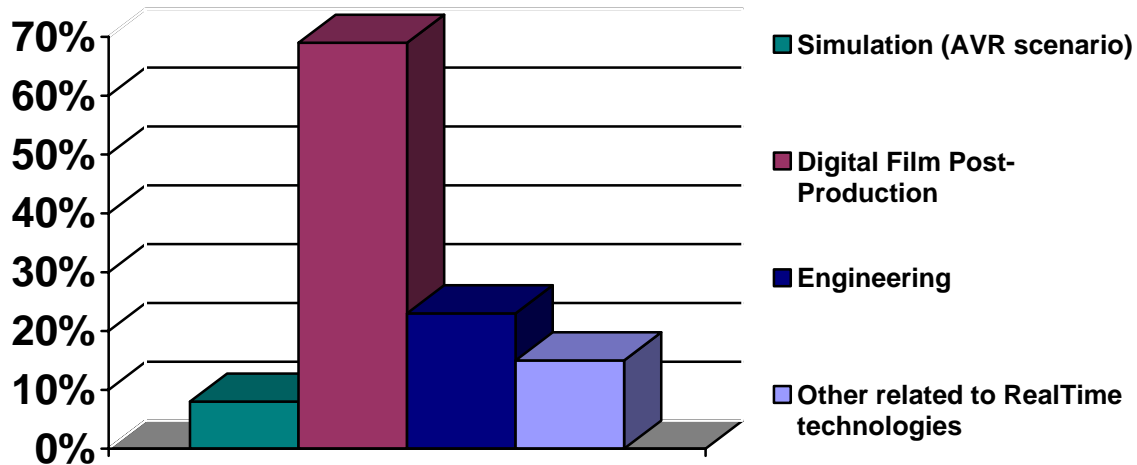


Figure 13 Organization types interested in AVR scenario.

Digital Film Postproduction scenario is mainly focused its own sector although we can see in Figure 13 that some other sectors are interested in this scenario but already do not have business related to it. Most of digital film postproduction companies are medium-size business in relation with this area in different ways like short form, long form, commercials, broadcasts and archive.

Next we introduce a list of different services these companies are currently offering, ordered from the most used to the least used:

- Scanning/Ingest: *very used (78% or more)*
- Mastering: *very used*
- Grain Management: *very used*
- Scratch Removal: *quite used (55-67%)*
- Primary Colour Correction: *quite used*
- Full Blown Colour Correction: *quite used*
- Conforming: *quite used*
- Digital Dailies: *very used*
- Dust Busting: *quite used*
- Restoration: *less used (33-44%)*
- Titling: *less used*
- Digital FX: *rarely used (22%)*

Thomson Grass Valley, Autodesk and Avid equipments are the most used, followed by ARRI, Apple and DaVinci. In less proportion we can find Pandora, MTI, Filmlight and Digital Vision.

In Table 2 some percentages related to analogue film originated content and different resolutions are included:

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Table 2 Analogue film originated content and different resolutions percentages.

	Average	Standard Deviation	Minimum	Maximum
Today's percentage of analogue film originated content	49.1	29.91	0	90
Today's percentage of SDTV resolution	59.3	30.8	30	100
Today's percentage of HDTV resolution	28.3	27.487	0	100
Today's percentage of 2K resolution	26.9	27.752	0	95
Today's percentage of 4K resolution	4.1	4	0	5
Today's percentage of Above 4K resolution	0	0	0	0
Expected percentage of analogue film originated content in 3 years	30	22.863	0	70
Expected percentage of SDTV resolution	26.3	19.32	0	60
Expected percentage of HDTV resolution	40	29.059	0	100
Expected percentage of 2K resolution	25.5	21.787	0	70
Expected percentage of 4K resolution	14.3	13.74	0	30
Expected percentage of Above 4K resolution	0	0	0	0

Today's percentage of analogue film originated content is around 50% but it is expected to decrease to 30% in three years. Something similar happens with SDTV resolution that will fall from 59.3% to 26.3%. 2K resolution will not change from 25% in the same period as well as above 4k resolution that will not be utilized at all in that time. On the contrary HDTV (28.9%) and 4K (4.1%) resolutions are expected to increase around 10-15% which makes these two resolutions the more promising and interesting in the long term.

For 66% digital film postproduction enterprises 3D work is very or extremely important for their future business as well as real-time functionality is for their future purchases. However these percentages decrease by half when considering the other organization types included in Figure 13.

Around 70 % of the organizations are willing to use remote postproduction services if provided by a partner, in less proportion if we only consider postproduction companies (55% can imagine themselves using this kind of service).

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Most of the users have in average 1 month or below from getting the order for a postproduction job until the real job starts. Regarding the average time for postproduction of a movie they have from 1 month or below to 3 months. The total size of storage they use for digital film postproduction varies from 2.5 TBytes to 200 TBytes, being 63 TBytes the average.

Comparing digital film with analogue film in terms of the cost structure development 54% of users consider it is higher against 15% that says it is lower. In same proportion there are users who believe the cost does not change and users that did not answer the question. Considering the in-house failures based on disk problems a 54% of organizations had a rate of one per year in the past two years against a 30% that affirms they had no failure.

Almost all our digital film postproduction target audience makes use of RAID¹ systems, most of them Raid 5 but also Raid 3 and Isilon. The biggest missing elements they appreciate that need to be covered in today postproduction infrastructure are:

- defined workflows mid term backup devices
- defined workflow with metadata exchange between different brands
- fast backup devices
- fast archive & backup
- interactivity
- tapeless facilities

Storage problems caused serious trouble in the workflow to several organizations over the past 24 months that could be avoided in the subsequent project. Other grave problems they have were related to data loss and missing interoperability between different brands.

3.3.7. End-user requirements derived from survey analysis

This section represents the outcome of the online survey. In the following tables we include the end-user requirements derived from the analysis of the survey results. The requirements have been classified as functional and non-functional requirements. The criterion to include a certain need as a requirement is to have been addressed by a sufficient majority of organizations in the survey responses. It is important to clarify that not all the functional and non-functional end-user requirements listed below can be considered automatically as IRMOS platform requirements. Later in the project, an analysis must be done in order to identify if these requirements should be addressed by the applications or by the IRMOS platform.

3.3.7.1. Functional end-user requirements

Next we include the table with the non-functional end-user requirements addressed in the survey:

¹ **RAID** — which stands for **Redundant Arrays of Inexpensive Disks**— is a technology that employs the simultaneous use of two or more [hard disk drives](#) to achieve greater levels of performance, reliability, and/or larger data volume sizes, RAID 3: **Striped set with dedicated parity**. RAID 5: **distributed parity**

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Table 3 End-user General Functional Requirements (EUGFR) – General Requirements.

Requirement	Description	Id
Multivideo Conference	Audio and video conference	EUGFR01
Collaborative Tools	Collaborative tools shared among the conference users (e.g. shared whiteboard)	EUGFR02
Collaborative Work	Real-time collaborative work support	EUGFR03
Control of the application	To be able to start, stop, pause and resume the application	EUGFR04
Customizable User Interface	To give the users the rights to customize the User Interface (layout: colours, size)	EUGFR05
Customizable Performance	To give the users the rights to customize the Performance (response time, delay)	EUGFR06
Customizable Video Quality level	To give the users the rights to customize the Video Quality level (low, medium, high)	EUGFR07

Table 4 End-user General Functional Requirements (EUGFR) – eLearning Scenario.

Requirement	Description	Id
Virtual Reality and Real World in the same scenario	Combine Virtual Reality and Real World (Augmented Reality) in the same scenario. The teacher and the students are real, but they have got their avatars present in the virtual world.	EUGFR08
On-line tutor support	Support provided by a on-line tutor (real or virtual)	EUGFR09
General programme information	Module study guide is designed to support and guide students in their learning. It indicates what is to be learned, how this can be learned and how students can ascertain whether they have mastered the learning material.	EUGFR10
Programme study materials	The material for the courses: Lecture notes, PowerPoint slides, images.	EUGFR11
Online tests or quizzes	Assessment and validation activities	EUGFR12
Email contact among participants	Contacting other Programme participants by email on study matters	EUGFR13
Links to web resources	Provision of web links related to	EUGFR14

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	the on-going course.	
Assignment feedback	Student feedback on the course.	EUGFR15
Online discussions / groupwork	Taking part in programme online discussions / groupwork	EUGFR16
Tracking participation	Tracking the student activities: which courses/classes he has had, which activities have been completed or are still pending.	EUGFR17
Assignment handling	Student courses management: courses or activities assignment to the students.	EUGFR18
Interactive eLearning with more than one trainee	More students can be connected to the same class and they can interact through chatting services, discussion boards, forums, video conference calls from their PCs or their mobiles.	EUGFR19
High impact activities simulation	Simulation of high impact activities, such as flight simulator.	EUGFR20
Dynamic Context	Teaching in dynamic context thanks to real-time features	EUGFR21
Discussion boards	It refers to particular sub-forums dealing with a specific topic	EUGFR22
Forums	It refers to the entire students' community involved in a given set of courses.	EUGFR23
Video Conferencing	Support of video conferences among the user that access to the class.	EUGFR24

Table 5 End-user General Functional Requirements (EUGFR) – AVR scenario.

Requirement	Description	Id
Video quality	Video quality is based on the original resolution of the video camera and the following compression that can reduce quality; it can only be measured in a subjective way. Video quality is guaranteed through certain network and computation requirements.	EUGFR25
Secure data exchange	Secure data exchange allows secure transmission of data, e.g. simulation data to be transferred between resources in IRMOS or from outside IRMOS into the IRMOS framework in advance or	EUGFR26

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	during a session.	
Secure video and audio exchange	Video and audio streams need to be secured towards unauthorized access by third-parties. Therefore encryption algorithms are utilised to achieve restriction on accessing the streams.	EUGFR27
Interactive Simulation	Simulation in which human operators are included	EUGFR28

Table 6 End-user General Functional Requirements (EUGFR) - Post-production scenario.

Requirement	Description	Id
Scanning/Ingest service	Digitizing/ingest of A/V content including metadata generation	EUGFR29
Mastering	Describes the whole post production process needed to generate a master version for later reproduction (e.g. DVD, film)	EUGFR30
Digital Dailies	Lower quality copy of the ingested material with sound synchronized, colour adjusted and metadata burned in. Needed to review the success of last days work	EUGFR31
Grain Management	Film originated content partly shows a grainy structure. This is a feature of the filmic look and therefore has to be controlled	EUGFR32
Dust Busting	Electronic removal of dust particle originated artefacts	EUGFR33
Scratch Removal	Electronic concealment of scratch originated artefacts	EUGFR34
Primary Colour Correction	Matching scene to scene colour look by using primary colours only	EUGFR35
Full Blown Colour Correction	Creating colour look by using all available tools, e.g. regions of interest, multiple layers, object trackers etc	EUGFR36
Conforming	Renders the content according to a edit decision list. This EDL has been created in earlier stages	EUGFR37
3D work	Postproduction for 3D (stereoscopic) content	EUGFR38
High storage size capability	63 TBytes of storage size on average	EUGFR39
RAID system functionality required.	Redundant Arrays of Independent Disks	EUGFR40

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3.3.7.2. Non-functional end-user requirements

Now, we include the table with the end-user requirements extracted from the analysis of the survey:

Table 7 End-user General Non-Functional Requirements (EUGNFR) – Security Requirements.

Requirement	Description	Id
Data/Information Confidentiality	Confidentiality: term related with the fact of keeping the data/information private, only available for interested parties	EUGNFR01
Data/Information Integrity	The data/information has not suffered any change in the transmission process, if a change occurs the receiver has the means of knowing that a change has been produced.	EUGNFR02
Licensed/Authorised usage of Resources/Applications	Authentication and authorisation mechanism is established in order to define policies to determine which users uses which resources/applications	EUGNFR03
Secure video and audio exchange	Video and audio streams need to be secured towards unauthorized access by third-parties. Therefore encryption algorithms are utilised to achieve restriction on accessing the streams.	EUGNFR04
Interactivity	To guarantee the interactive real-time multimedia application	EUGNFR05
Audio/video Quality		EUGNFR06
Response Time		EUGNFR07
Throughput		EUGNFR08

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4. IRMOS Platform Requirements derived from the User Requirements

As the reader can see in the Section 3.3.7 of this document, several End-User General Functional Requirements (EUGFR01 to EUGFR40), and several End-User General Non Functional Requirements (EUGNFR01 to EUGNFR08) have emerged after analyzing the results of the survey. Taking all of these End-User Requirements (Functional and Non Functional), several technical requirements to be complied with by the IRMOS Platform are derived from them, and described in the current section. It has to be mentioned that some of the platform requirements contained in this section derives too from the IRMOS Scenarios Use-Cases and/or from the special nature of the ISONI layers. Then, for getting a clear vision of how the survey results will influence on the IRMOS Platform design, the platform requirements have been grouped into two main categories:

1. Those derived exclusively from the End-User Requirements of the survey results will be listed in the Section 4.1.
2. Those derived from the End-User Requirements of the survey results and, at the same time, from the IRMOS Scenarios Use-Cases and/or from the special nature of the ISONI layers, will be listed in the Section 4.2.

All of this information has been taken from the IRMOS ID2.1.2 confidential deliverable and, for this reason, there is not a reference for downloading that document.

All platform requirements contained in this chapter will be grouped in the following categories:

- Data Management.
- Execution Environment.
- Network.
- Security and Users Profiles.
- Video and Audio Streaming/Multi-videoconference functionality.

4.1. IRMOS Platform Requirements derived exclusively from the User Requirements

4.1.1. Data Management

- The IRMOS platform should provide the users with mechanisms for a secure data exchange. This platform requirement is derived from the user requirements of streaming video data across a network in a secure manner, and transferring data by a potential user of an application utilising the IRMOS framework, from its workspace to an IRMOS data storage for processing. This data has to be secured so it is not leaked during the transfer or altered in anyway. The platform should be able to provide data/information integrity, meaning that the data does not suffer any change in the transmission process and if a change occurs the receiver

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has to be notified. Besides, a secure data exchange allows secure transmission of data, e.g. simulation data, video and audio, to be transferred between resources in IRMOS or from outside IRMOS into the IRMOS framework in advance or during a session. This should be customizable by the user, meaning that he can have a choice between secure/non-secure transmissions.

- The IRMOS platform should provide the users with a high storage size capability (approximated to about 63 TBytes on average). This data storage service would be used, among others, for digitizing/ingest of A/V content, including metadata generation. For this purpose, the RAID (Redundant Arrays of Inexpensive Disks) functionality is required.

4.1.2. Execution Environment

- Many potential IRMOS users have exposed that they may need to manage their applications to adapt them to their own necessities and personal preferences and requirements. This would implicate the need of a Control Panel and Administration Tool (e.g. Plesk²) through which the user could be able to manage his application. Also, the ability to *stop, start, pause or resume* the application they are executing is required.
- The IRMOS platform should provide the needed functionalities to run applications and services in dynamic context thanks to real-time features.

4.1.3. Network

- The IRMOS platform should provide the appropriate APIs and interfaces to support collaborative work to be executed through IRMOS. This includes collaborative tools shared by all the participants (e.g. shared whiteboard) and must be real-time enabled.
- The IRMOS platform should provide the means, especially concerning workflow capabilities, to combine Virtual Reality and Real World (Augmented Reality) in the same scenario. For example, in the eLearning scenario, the teacher and the students are real, but they have got their avatars present in the virtual world.
- The IRMOS platform should be able to provide the users with a very good performance regarding general real-time requirements that include: Interactivity, Audio/Video Quality, Short Response Time and High Throughput.

4.1.4. Security and Users Profiles

- The users need to have the ability and the rights to customize their User Interface (layout, colours, size). The framework services inside the IRMOS platform need to provide an API and interfaces to support this.
- The IRMOS platform should provide with means for confidentiality, that is, the data stored within the platform can be accessed only by authorized users. It is closely related to secure data exchange.
- Besides the mentioned secure data exchange in 4.1.1 section, there should also be an optional method that provides security for video and audio transmissions as part of video conferencing in a collaborative session. Examples of this can be seen with the MBone-Tools that utilise Rijndael-encryption for that concept.

2 <http://en.wikipedia.org/wiki/Plesk>

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4.1.5. Video and Audio Streaming/Multi-videoconference functionality

- Video quality of video streams sent between collaborative partners in a collaborative VR session is of importance for keeping information contained in a video stream to remote partners. This quality is of course dependent on the video camera recording the video stream as well as encoders used for encoding the video stream and used parameters. Based on the used parameter settings in relation with a negotiated SLA these parameters provide a trade-off between quality and affordability. Besides, video quality is guaranteed through certain network and computation requirements.
- The IRMOS platform should provide the users with the ability to use both Audio and Video conference. Initially, this seems to be an application specific requirement, however, this may require authentication, authorization and workflows from the framework services inside the platform. This is also tied with video streaming capabilities of IRMOS. The audio/video quality should be customizable by the user.

4.2. IRMOS Platform Requirements derived, but not exclusively, from the User Requirements

4.2.1. Network

- The IRMOS platform should provide with the needed mechanisms for various users in different locations to access the same application at the same time. Besides, The IRMOS platform should provide the users with the ability of joining to an initiated collaborative session.
- The IRMOS platform should provide edge-to-edge QoS for soft real-time services, by configuring the transport network resources which connects the service components of a virtual service network, located at potentially different locations, within the borders of the physical network(s) under control. QoS is defined by parameters like bandwidth, delay, jitter and others.
- An IRMOS user may specify the maximum acceptable delay and latency, and the minimum acceptable throughput of a specific streaming. It should be a target for SLA. It has to be taken into account that the maximum acceptable delay and latency, and the minimum acceptable throughput are also limited by the physical limitations of the transport network which cannot be overcome by the IRMOS platform

4.2.2. Security and Users Profiles

- The IRMOS platform should provide the users with a Secure User Authentication mechanism, for accessing it.
- The IRMOS platform should provide the users with a Secure User Authorization mechanism. Once a user has been successfully accessed and identified, the IRMOS platform should be able of associating this user with a predefined profile.

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4.2.3. Video and Audio Streaming/Multi-videoconference functionality

- The IRMOS platform should provide the users with a multi-video conference service. It would be desirable that this tool provides other collaborative functionalities as chat, common desktop and so on, for giving the users the ability of establishing collaborative sessions between them.

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5. Conclusions

The current document summarizes the user requirements extracted from the survey results, and the technical requirements for the IRMOS platform derived from those user requirements. The survey has been conducted in order to identify the requirements that end-users would most appreciate on Real-time scenarios like Digital Film Postproduction, eLearning and Augmented and Virtual Reality (see Section 3). Again, security concerns have been identified to be very important to companies interviewed (especially those related to data confidentiality and integrity) and, in general, a collaborative platform including multi-video conferencing capabilities and other scenario-specific aspects have been addressed.

In the following step, these user requirements have been used to derive the technical requirements for the IRMOS platform. This task has been very fruitful because up to 15 platform requirements have emerged exclusively from them, and will have a direct impact on the IRMOS Platform architecture development.

45 different companies have participated to this survey, 64% of which belonging to the SMEs sector, therefore representing a majority of the segment participants.

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Annex A. List of target audience

Digital Film Postproduction (GVG)

Potential users of IRMOS technologies are companies already active in the postproduction domain i.e. enterprises which size spans from SME's with a couple of people up to organizations with thousands of employees. Due to cultural and historical background, the ways of working and the requirements are regional different and we therefore selected a list of target customers covering all important areas worldwide.

Americas

- Chile Films
- Laser Pacific (West Coast)
- Deluxe / Efilm (West Coast)
- Technicolor (West Coast)
- Syndicate (West Coast)
- Ascent Media / Company 3 (West Coast)

US Westcoast is still the most active place for film postproduction. All important studios are located there. Deluxe, Technicolor (a Thomson company) and Ascent, the three largest Postproduction enterprises have several large facilities in the area.

Asia Pacific (APAC)

- Cutting Edge (Australia)
- Efilm Australia (Atlab)
- Hualong Film Digital Production Co. Ltd. (China)
- Prime Focus Ltd. (India)
- Imagica (Japan)
- ORIENTAL POST CO LTD (Thai)

Postproduction in Asia Pacific is rapidly growing; especially India and China are investing millions to build up their own media industry. Companies like Prime Focus of Bombay/India is buying Postproduction facilities in London and Los Angeles

Europe

- ACE Editing (Belgium)
- Barrandov Studios (Czech Republik)
- Digitalfilmlab (Danmark)
- ECLAIR LABORATOIRES (France)
- Medialab (France)
- Mikros (France)
- VCC Perfect Pictures (Germany)
- CinePostproduction (Germany)
- Focus Fox Studio (Hungary)
- Blue Gold (Italy)
- The Chimney Pot (Poland)

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- Kodak Cinelabs Bucharest (Romania)
- The Mill (UK)
- Rushes London (UK)
- Cinesite London (UK)
- Technicolor London (UK)

Growth in Europe is limited to the eastern states. Partly supported by Kodak's money many new postproduction companies have been founded, serving the regional markets.

*E*Learning

Distance and eLearning programs are becoming more and more vital in the world of higher education. Through the use of new technological resources, eLearning programs make it possible for more people to reach their educational goals.

eLearning is the unifying term to describe the fields of online learning, web-based training, and technology-delivered instruction: it uses of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere.

In the latest years, the eLearning market has had a significant growth in the use of the most advanced technologies available in terms of webcasting and devices used to access to the online contents (e.g. Personal Computers, PDA, mobile devices or wearable computers).

Then the range of potential end-users and customers in the industrial market within the range of SMEs and big player companies is still rather small, even if with a great potential: the development of communities, blogs, wikis, webpages and podcasts has started to show a tremendous potential in terms of contextualised, personalised, comprehensive, dynamic learning contents in real time.

Furthermore, in the academic field there has been always interest in eLearning and its latest evolution has been pushing institutional realities to move into new technologies to develop and validate the use of interactive systems for learning.

Then it is possible to identify two main groups of potential end-user: the industrial and the academic. They have clearly different requirements and this has to be taken into account from the first stages of the project.

Next we include a list with potential target organizations for the survey from the eLearning point of view:

- Fastweb (broadband telecommunications company)
- Royal Albert Museum (Museum)
- IZS – Istituto ZOOpofilattico (Health institution)
- ARCA – Verona (Insurance company)
- Volkswagen – Italy (Automotive company)
- Open University UK (Pedagogical research)
- University of Birmingham (Pedagogical research)

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- University of Koblenz – Landau (Pedagogical research)
- Enel Sfera (Corporate University di Enel -Italian energy company)
- Prototypes evaluation (Open University UK)
- Università Cattolica (Museum scenario)
- University of Zurich (MBA scenario)
- ORT (Training educational center)
- Tudor (Research center)
- University of Genoa (Biophysical and Electronic Engineering Department)
- BGU – university (Biophysical and Electronic Engineering Department)
- CERTH (Centre for Research and Technology Hellas)
- CTU – university
- UHK – university
- SZTAKI (Training & education)
- UoL - University of Lubiana
- RTU - University of Riga
- SIIT – university
- CTV (Czech Republic television company)

Virtual Augmented Reality

The reference applications COVISE and OpenCOVER taken from the “Virtual and Augmented Reality” scenario are expert systems, which need some effort to setup and might rely on special and expensive hardware dependent on the usage scenario. Talking about full immersive VR environments like a CAVE[3] the costs can get very high, making the hardware only affordable for large companies. Talking about usage on desktop systems, these environments can even be setup at SMEs with justifiable effort. Usage of VR environments of the size of back-projection walls, namely Powerwalls, can be rented by SMEs so far from organizations like the Virtual Dimension Centre (VDC[4]). As a conclusion out of this outline of COVISE and affiliated costs, the range of potential end-users and customers in the industry area within the range of SMEs and big player companies is rather small. However besides industrial end-users there are several users of COVISE in the academic field, within Germany, the UK, the US and more countries. It is expected that their requirements differ in some ways from what industrial end-users might request. For these differing reasons potential users for the survey will be selected from both areas industry and education and the survey has to consider these two different groups accordingly. However it is also important to reflect all accessible types of industry available. As a consequence this means that selection of the target audience from the industry area will be done to reflect SMEs and big companies as well. To correctly satisfy this condition the issuing of the survey will be done in collaboration with VISENSO who actually sells the software and has access to the mentioned companies, as well as the Virtual Dimension Center (VDC) which has a broader access to the SMEs using COVISE so far.

The ideal target audience would be an equal combination of big companies’ representatives as well as SMEs’ representatives mainly from the industry areas that have been outlined to be of relevance to the COVISE application in chapter 3.1.2. Furthermore it is considered to be essential to also have an equal amount of

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representatives from the academic and education sector in the target audience to reflect differing user-requirements. Potential SMEs and big companies from the industrial area can be:

- Festo Didactic GmbH & Co.KG
- Daimler AG
- Alfred Kärcher Vertriebs GmbH
- Robert Bosch GmbH Werk Feuerbach
- Industriehansa Consulting & Engineering GmbH
- ANDREAS STIHL AG & Co. KG
- Dr. Ing. h.c. F. Porsche AG
- Audi Deutschland AG (Neckarsulm)
- Audi Deutschland AG (Ingolstadt)
- ThyssenKrupp Drauz Nothelfer, Heilbronn
- Voith Siemens Hydro Power Generation GmbH & Co. KG
- Volkswagen AG
- BMW Deutschland AG
- Fiat CRF
- Airbus Deutschland
- SMS-Demag
- Faurecia
- Bosch Bamberg, Einspritzsysteme
- Ford Köln
- Adam Opel GmbH
- Recom Services GmbH

This group of industrial target audience offers a good range across different businesses, e.g. automotive, metallurgy, mechanical engineering or even aeronautics. In addition to these companies a selection of academic partners can also be contacted who can provide information for completion of the survey.

- California Institute for Telecommunications and Information Technology, San Diego, USA
- ETH Zürich, CH
- FH Konstanz
- FH Mannheim
- University Stuttgart
- FH Wiesbaden
- KISTI, South Korea
- National Center for High-Performance Computing, Hsinchu, Taiwan
- Sandia National Labs, Albuquerque, NM, USA
- University Tübingen
- University Cologne
- TU Dresden
- Center for Parallel Computers, KTH, Stockholm, Sweden

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This selection of target audience should provide us with good information about user requirements, reflecting industrial as well as educational markets for Virtual and Augmented Reality.