

# Exploring Ambient Assisted Living Job Profiles

Theodor Panagiotakopoulos  
e-CoMeT Lab  
Hellenic Open University  
Parodos Aristotelous St., 18,  
26335, Patras, Greece  
panagiotakopoulos@eap.gr

Aspasia Theodosiou  
Technological Educational institute of  
Epirus & Hellenic Open University  
Parodos Aristotelous St., 18,  
26335, Patras, Greece  
cissy\_theo@hotmail.com

Achilles Kameas  
e-CoMeT Lab  
Hellenic Open University  
Parodos Aristotelous St., 18,  
26335, Patras, Greece  
kameas@eap.gr

## ABSTRACT

Ambient Assisted Living (AAL) is meeting wide acceptance and implementation, becoming a rapidly growing economic sector and creating new jobs. Nevertheless, proper education for qualifying employees in the AAL area is still massively lagging behind. CompAAL is an EU funded project aiming to develop a set of qualification profiles for players in the field of AAL. This paper presents the preliminary results of user analysis regarding AAL qualifications and training needs, as well as the research methodology used for collecting and processing related data.

## Categories and Subject Descriptors

K.4.2 [Computers and Society]: Social Issues – Employment;  
K.7.1 [The Computing Profession]: Occupations

## General Terms

Theory; Standardization

## Keywords

Ambient Assisted Living, professions, qualification profiles

## 1. INTRODUCTION

European communities are already facing and will continue to face significant demographic changes. The average age of the population is expected to increase dramatically and according to projections published by the European Office for Statistics, deaths will outcome births in all EU countries, while the percentage of people aged above 80 will be tripled in 2060 [5].

The life expectancy growth comes with an increasing prevalence of disabilities and health problems not only inducing great limitations both to elders and their families, but also affecting the society as a whole (e.g. low productivity, social isolation). This situation creates huge challenges and calls for new solutions towards improving the quality of life, supporting health needs, facilitating concepts such as “aging well” or “healthy aging”, and maintaining the independence of elders [7].

Towards this direction, during the last decade, numerous research efforts focused on developing innovative ICT products

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and services for aging. In the context of what has been called “gerotechnology” [10]- interdisciplinary research field that aims to develop technology able to cater for the needs and ambitions of aging and aged people - Ambient Assisted Living (AAL) constitutes a fundamental research domain in which Europe has given enormous attention. AAL refers to intelligent systems of assistance for a better, healthier and safer life in the preferred living environment and covers concepts, products and services that interlink and improve new technologies and the social environment [1]. AAL environments integrate a set of technologies and span to a wide range of application domains addressing health support, social inclusion, entertainment and safety, among others.

While its realization and commercialization is constantly increasing, AAL is becoming not only an issue of technological research and development, but also a rapidly growing economic sector creating new jobs. Although the sheer number of innovations in AAL of the last decade is enormous, they can only be implemented successfully if the labour market disposes of sufficient well-qualified professionals in the field. The innovations in the field of AAL need professionals, who know how to incorporate, install, maintain, and use AAL products. However, there are no specific vocational or lifelong training courses available in European countries related to the use and development of AAL systems and tools.

Currently, companies involved with the implementation of AAL services and products, face a large gap between offer and demand of qualified employees. According to a recent study, the major barriers to innovation in AAL environments are to be found in the lack of adequately trained actors [6]. Nevertheless, further education for people working in the AAL area is still massively lagging behind [2]. Judging from the above, there is a great need for structured offers of specialized vocational training for a wide range of professionals that are increasingly “affected” by AAL in their daily work

CompAAL is an EU funded project in the context of the Leonardo da Vinci Lifelong Learning Programme with 11 partners from 8 European countries (Greece, Germany, France, Austria, Switzerland, Hungary, Bulgaria, and Spain); falling squarely within the EU agenda “New Skills and Jobs”. It aims to develop a set of qualification profiles for players in the field of AAL firstly at a national and then at a European level. Based on those profiles, which will be developed following the learning outcomes approach, training guidelines will be drafted. The latter will be made available to education institutions in all European countries paving the ground for the development of transparent and comparable AAL related qualifications at European level.

This paper presents the preliminary results of the user analysis regarding AAL qualifications and training needs. Using a joint

research methodology, we explored the needs and requirements of potential AAL job sectors and relative professions, as well as existing professions able to staff the AAL value chain in the near future. These job needs and requirements reflect the actual training needs for qualified personnel in the field of AAL.

The paper is structured as follows. In the next section, the desk research methodology we applied is described in detail. In section 3, the findings of the study are presented and discussed. The last section summarizes the work and its outcome and hints on the future stages of the work.

## 2. RESEARCH METHODOLOGY

In the context of CompAAL we conducted a desk research as part of a two phase research methodology. The desk research's primary aim was to identify the main needs and requirements of future jobs in the field of AAL. In addition, our research focused on defining the learning outcomes of already existing relevant professions that are insufficiently trained (in the framework of related qualification programmes) and are required by the AAL field. The term "learning outcomes" refers to the set of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, either formal, non-formal or informal [4].

In order to accomplish this quite complex task, our approach was guided by the aim of developing a transferable methodology that can be of a wider use by various interested stakeholders. The methodology suggested here is comprised by several easily identified and implemented steps and is based on two major pillars. On the one hand, researching future AAL job sectors (hereafter called job roles), and on the other, researching already existing AAL-related professions, both with their relevant qualifications. "Qualification" is a formal outcome of an assessment and validation process which is obtained, when a competent body determines that an individual has achieved learning outcomes to a given standard [3].

Such a twofold methodology has the ability to deal with the existing as well as the future qualifications needed in the field of AAL jobs and weigh the one against the other. As a result, one can be able to suggest specific qualification modules on the basis of what is actually missing.

The methodology used in this desk research was structured in seven steps; each step receives input from previous step(s), and produces output for the following step(s), after processing some data. The output of a step is produced as a transformation of the input, which results from activities that process the input together with context data.

### 2.1 AAL Job Roles

We started from the research assumption that a certain number of job roles can be considered to be of great importance for the field of AAL. The idea here was to cover all aspects of this new technology sector (technological, social, ethical, etc.). Yet, a central belief of our research hypothesis was that the initially selected job roles would need validation and verification through the desk research. This means that the selected job roles were not considered as an absolute set, but just as starting point. The initial job roles along with indicative tags are shown in Table 1.

AAL Assistant/ Consultant/ Agent/Conductor mainly refers to the provision of consultation in obtaining the best-suited AAL products and services taking into account both available market

products and user needs and requirements. It bridges the gap between technology and consumers by familiarizing consumers with AAL products and guides them to select the most suitable one.

AAL solutions/ service developer/ provider incorporates all the activities of designing, developing and supplying AAL products to the market. It contains selling, promoting, marketing, evaluation, user support and technical support activities.

AAL Usability specialist deals with usability issues, such as interface design, ergonomics, transparency, unobtrusiveness and personalization. It ensures that end users (in their majority with limited ICT knowledge) can use (access, understand and interact) an AAL product easily and according both to the creator's original intentions and each user's individual needs, capabilities and requirements.

**Table 1. The initial job role list**

Job roles	Tags
AAL Assistant/ Consultant/ Agent/Conductor	market analysis, requirements' evaluation
AAL solutions/ service developer/ provider	design, development, system setup, maintenance, marketing
AAL Usability specialist	ergonomics, interaction design, user involvement
AAL Social networker	activity planning, socializing, sharing
AAL Caregiver	care provision, medical support and guidance, confrontation
AAL Ethical issues specialist	data privacy and security, data protection, user consent
AAL Architect	smart homes, smart appliances, sensor networks
AAL Network Provider	bandwidth, quality of service, access networks
AAL Financial Manager	billing, financial planning

AAL Social networker is responsible for user's social inclusion and participation. It focuses on motivating users to perform social activities, as well as providing the means for doing them.

AAL Caregiver is mainly assigned with care provision tasks. The difference in AAL is that this role integrates ICT systems, devices and services operation, management and handling.

AAL Ethical issues specialist addresses ethical issues like data protection and security, privacy and user monitoring limitations. It also implements relevant policies through proper technologies and mechanisms and consult consumers about the ethical aspects of using AAL products.

AAL Architect focuses on issues regarding design (e.g. aesthetics) and construction (e.g. electrical infrastructure) of smart spaces that will facilitate functionality of AAL products. This role's objective is to enable and ensure that customers can use AAL products properly in their domestic environment.

AAL Network Provider enables data transmission between customer environments and service providers' premises. It provides the communication infrastructure and the required resources needed for AAL products' operation.

Finally, AAL Financial Manager is in charge of managing the accountings related to AAL products and their use. Furthermore, it provides feedback on cost effective AAL solutions on customer demand.

## 2.2 Desk Research Methodology

The first step of the implemented desk research methodology concerned a keyword based search (some of the key words we used are shown in the right column of Table 1) of all the relevant material on the web. This material included studies, reports, white papers, published research papers at national and international level, national research initiatives/projects, and nationally available market products/services. This task allowed us to attend to the national status in the AAL field in each of the participating countries and analyze the different approach each country adopts for AAL. Furthermore, the collected material enabled us to evaluate and appropriately modify the selected job roles, while identifying some others depending on the national situation of each country/partner. This search uncovered the significance that certain AAL related job are believed to have in the near future and gave us the opportunity to associate them with specific existing professions and/or employment sectors in Step 4.

During the second step, we defined the expected AAL job roles' main requirements/occupational standards using the material collected in the first step. As occupational standards are considered the specific professional tasks and activities the holder of a qualification is supposed to be able to carry out and the competences needed for that purpose [3]. In our research, the occupational standards of the AAL job roles were described in terms of the following components:

- mission
- responsibility
- deliverables
- main tasks
- working environment
- Key performance indicators

In order though for a professional to demonstrate such competences, s/he has to learn them; therefore the occupational standards that emerged from the previous step were used in step 3 as the basis for forming the learning outcomes of our AAL job roles [3]. The actual methodology employed for expressing the learning outcomes of each job role adopted the following general guidelines:

- Use the ABCD / SMART [11] approaches in writing the learning outcomes.
- Each learning outcome should refer to one and only level in Benjamin Bloom's taxonomy [12], [13].
- Avoid complicated sentences. If necessary use more one than one sentence to ensure clarity.
- Each learning outcome should contain one and only one action verb; use the list of verbs associated with each level in the taxonomy.

- Avoid vague terms like know, understand, learn, be familiar with, be exposed to, be acquainted with, and be aware of. These terms are associated with teaching objectives rather than learning outcomes.
- The learning outcomes must be observable, measurable and capable of being assessed.

The first three steps of the methodology, as presented above, dealt with potential AAL job roles delineating relevant professions along with their desired occupational standards. The next three steps dealt with already existing professions outlining their current qualifications.

In the context of the fourth step we tried to outline the diverse professions, which relate directly to the job roles of our research hypothesis. We worked with the assumption that the AAL employment sector is rapidly growing, but it is yet in its beginning and exclusive AAL professions do not exist at the moment. For this reason we considered that the existing professions are called to fulfill the needs of the AAL field at this stage.

The fifth step focused on identifying the qualifications related to the already defined professions/employment sectors from step 4. Then, the identified qualifications were categorized according to their training level. Given that differences occur not only across European educational systems, but also across areas of education and training between institutions, a categorization based on factors such as the length of study, was deemed impractical. Therefore, in our categorization of the training level of each of the identified qualifications we used as our reference system the 8 levels of the European Qualification Framework for lifelong Learning (EQF)<sup>1</sup>. For instance, the profession of Computer Engineer was examined for each participating country and its relevant qualifications (e.g. Bsc, Msc, EQF Level 5, 6, 7) were recorded and classified.

In the sixth step, the qualifications that emerged from the previous step were decomposed into qualification descriptors, as well as the knowledge, skills and competences (learning outcomes) learners should have when they obtain each relevant qualification. The decomposition was performed on a country-specific basis, offering the opportunity to highlight the differences and similarities of the training courses among the participating countries.

The desk research was completed in the seventh step, where the current qualifications (actual state) were compared to the desired ones (desired state). The comparison between the desired and the actual state was performed on learning outcomes level and served as the basis for the proposal of new qualification modules.

## 3. DESK RESEARCH FINDINGS

In each of the European countries participating in the project, an individual desk research was conducted, producing eight reports that were synthesized to faithfully draw together all countries' findings and conclude to solid suggestions regarding the required learning outcomes in the emerging AAL job sector. The synthesized findings concern AAL trends in the participating countries, AAL job roles list finalization, AAL professions projections and required qualifications of expected jobs in the field of AAL. All these are presented in detail in the remaining of this section.

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<sup>1</sup>[http://ec.europa.eu/dgs/education\\_culture/](http://ec.europa.eu/dgs/education_culture/)

### 3.1 AAL Field: National Status

The material gathered in the first step of the desk research revealed several interesting observations regarding the national status of the participating countries in the field of AAL. Furthermore, it showed the different demands determining the characteristics in the field of AAL in different countries spanning from market-driven, to customer/society-driven and technology-driven. The following list summarizes the issues mentioned above:

- Research in all participating countries is mainly driven by European Programmes, and more specifically by the Ambient Assisted Living Joint Research and Innovation Programme<sup>2</sup> that is partially funded by the European Commission through a dedicated action in the 7th Framework Programme.
- The available products and services are thus mainly the results of research projects funded partially or fully by the European Commission. The majority of those recorded concerned simple alert devices, as well as social networking programmes and TV channels that promote social interaction.
- Germany is the leading expert in the field of AAL with research projects, studies and national integrated programmes focusing both in technological and social aspects. Research and study topics explored include living conditions- independent living, house building, mobility issues, social inclusion, market research, education and training, healthcare, intelligent services for older people etc.
- Austria appears as an emerging player in the field of AAL, as there are already relevant studies and national projects, as well as commercial products (e.g. Home Butler and Cure) available in the market. Analysis of the information gathered provides strong evidence of an emerging research agenda that focuses mainly on the way AAL solutions can be socially accepted and on the involvement of older people in the innovation process of AAL technology.
- In both France and Switzerland, relevant studies and reports indicate a strong national policy orchestrated by government and institutions towards exploiting AAL innovations for the provision of support to the third age and more specifically the elder's independent living.
- In Bulgaria and Hungary research is still very technologically driven and conducted mainly by university research centres. National policy reports and studies relevant to the field of AAL could not be located.
- In Greece and Spain there are no national research projects in the field and the relevant research activity is conducted mainly within the context of the Ambient Assisted Living Joint Research and Innovation Programme. Yet, while in Greece the main focus is on technological issues, in Spain there is a strong interest in the social aspect of AAL technologies.

### 3.2 Job Roles Evaluation

Based on the systematically organized material demonstrating the development in the field of AAL in each country, a careful process of verification and modification of the initial AAL job roles list was conducted. This process evaluated the initially

selected job roles, revealed potential new ones, and uncovered the significance of certain AAL job roles in national terms. Moreover, the national desk research reports provided feedback in terms of job roles' frequency of appearance, representation of primary and support activities in the AAL value chain and distinction between what we call "hybrid" and "monocultural" AAL job roles.

#### 3.2.1 Verification and modifications

A very important aspect of the findings is the way each job role is perceived and employed in the value chain of each participating country. The difference in the cultural and educational backgrounds explored is partly reflected in the language terms employed for the initially selected job roles. Some of those differences are illustrated in the modifications presented in Table 2. Such differences adhere to national qualifications systems that are inevitably complex as they have to be based on social and cultural traditions and the institutions of each country. At the same time they provide us with adequate information for what the learning individuals are expected to demonstrate at the end point of their relevant qualification. In order to make the learning explicit and to direct attention towards what the learner knows, understands and is able to do independent of the learning process followed, we complemented our research with the provision of each job's occupational standards and learning outcomes.

A concrete detailed example is given by the "AAL Solutions/Service Developer/Provider" job role. What we can gather from this job role's occupational standards and its learning outcomes in Greece is that it is exclusively driven towards technology and includes both the development of AAL solutions and their maintenance. However, in Germany the suggested "AAL Solutions Developer" job role is conceived on a more abstract level, as a role responsible for designing overall strategies and able to influence relevant policies: "The AAL all-rounder: S/He has an overview about needs and offers in the AAL field, develops plans for new products, processes and has knowledge about market issues". Along the same lines the Austrian and the Swiss reports provide a different set of learning outcomes in defining the "AAL Solutions Provider" role. In short, the role is summarized as the one that "*make things available*". Yet, within that conceptualization the issue of maintenance and service cannot but constitute a separate role. For this reason, a new role is proposed named "AAL Maintenance Engineer".

Another important finding of the Austrian and Swiss desk research is the suggested "AAL Coach" job role. This job role is rather hybrid having its responsibilities partially covered by other roles. More specifically, its responsibilities are covered by the "AAL Solutions/Service Developer/Provider" (implementation process), the "AAL Usability Specialist" role (supervision and management of the ergonomics and interaction design issues of AAL products) and the "AAL Assistant/Consultant/Agent/Conductor" role (bridging the gap between technology and consumers).

Although the same terms were conceived differently, in some cases the use of different terminology did not imply different occupational standards and associated learning outcomes; such was the case with the terms Caregiver (initial job list), Medical Care Agent (Germany) and Health Assistant (Bulgaria). On the contrary, in the case of the AAL Social Networker, the difference in terms was actually reflecting in a rather accurate way a different approach. In the suggested by the Bulgarian report "AAL Social Assistant" job role the emphasis is placed upon the role's responsibility in enhancing social relations. The German

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<sup>2</sup>[www.aal-europe.eu](http://www.aal-europe.eu)

**Table 2 Modified job role list**

	AAL Assistant/ Consultant/ Agent/Conductor	AAL Solutions/ Service Developer /Provider	AAL Usability Specialist	AAL Social Networker	AAL Caregiver	AAL Ethical Issues Specialist	AAL Architect	AAL Network Provider	AAL Financial Manager	AAL Maintenance Engineer
Greece	N/A	√	√	N/A	√	√	N/A	√	N/A	N/A
Germany	N/A	AAL Solutions Developer	AAL Usability/ Mobility Expert	N/A	AAL Medical Care Agent	N/A	√	AAL Networker	AAL Service and Financial Manager	N/A
Austria	AAL Coach	AAL Solutions Provider	N/A	N/A	√	AAL Client advocate	N/A	√	N/A	√
Switzerland	AAL Coach	AAL Solutions Provider	N/A	N/A	√	AAL Client advocate	N/A	√	N/A	√
Bulgaria	N/A	√	N/A	AAL Social Assistant	AAL Health Assistant	N/A	N/A	√	N/A	N/A
Hungary	√	√	N/A	N/A	√	√	N/A	√	√	N/A
Spain	N/A	√	√	N/A	√	N/A	N/A	√	N/A	N/A
France	N/A	√	N/A	N/A	√	√	N/A	√	N/A	N/A

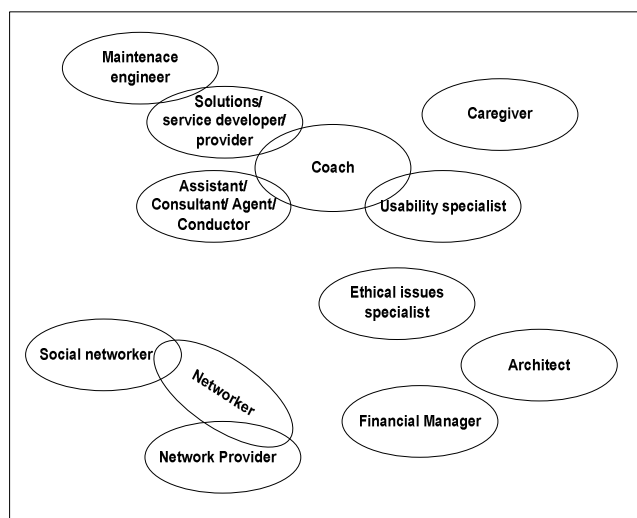
suggestion for a modified “AAL Networker” role is conceptualized in terms of “*assistance for social communication and also ICT based medical home monitoring*”. While in the case of Bulgaria the emphasis reveals a society that is not greatly affected by the use of IT, the German suggestion is predicated upon the assumption that the sociality of elderly people is to be enhanced through the use of modern ICT.

To provide a final example, the “AAL Usability-mobility specialist” job role suggested by the German desk research, reveals a specification of the initial “AAL Usability specialist”, beyond the planning and implementation of assistance systems in the home environment. The “AAL usability- mobility” expert will make sure that usability solutions specially designed for elderly or people with special needs are provided. Such a specification could be attributed to the significant level of AAL related research in Germany.

It can be concluded that the persistence of differences in qualifications and studies among the countries involved in the CompAAL project – which owes a lot to cultural differences-reveal themselves in different ways, such as the terminology used, the tradition of certain job sectors, the theoretical or more applied approach adopted in the teaching of certain subjects etc.

### 3.2.2. Understanding the AAL professional field

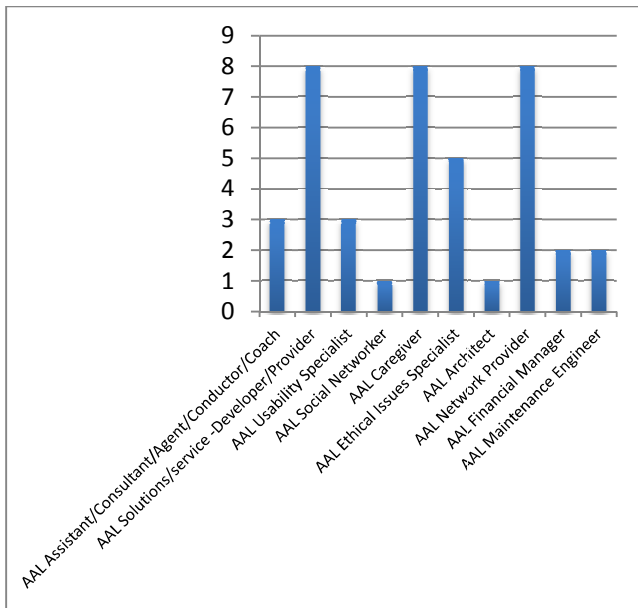
Taking the aforementioned findings into account, this subsection focuses on various aspects of the AAL field and the importance attributed to the different AAL job roles under investigation. The complete set of the emerged job roles along with their relations is shown in Figure 1



**Figure 1. Finalized AAL job roles and their relation.**

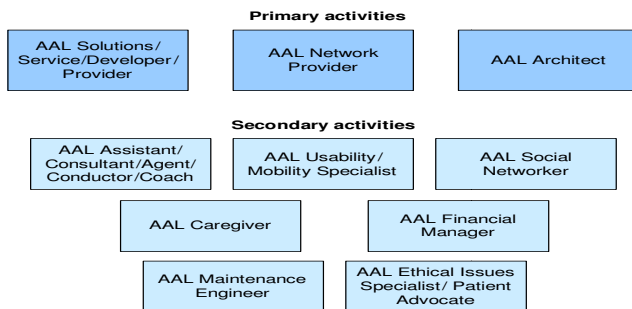
Figure 2 shows the frequency of occurrence of each job role- how often, in other words, a certain AAL job role was encountered during desk research across all partner countries. Here the predominance of three job roles (“AAL Solutions/service Developer/Provider”, “AAL Caregiver”, “AAL Ethical Issues Specialist” and “Network Provider”) and their modifications is rather revealing of a basic common understanding of the attributes consisting the emerging AAL professional field. This is centered around three interrelated elements: the technological, the human/social and their intersection.





**Figure 2. Job roles frequency of appearance**

Figure 3 aims to situate the diverse job roles in the AAL value chain and group them accordingly as primary and support activities. Primary activities are those directly related to creating and delivering AAL products and services. Support activities, are not directly involved in production, but they may increase effectiveness or efficiency (e.g. human resource management).



**Figure 3. Primary and secondary activities in AAL**

Finally, the more general trend towards hybrid job profiles (Figure 4) is also well reflected in our findings [9]. Hybrid job roles in the AAL sector can be defined as those that equally combine high level technical skills and so called soft skills [8]. The more general trend is based on the claim that hybrid roles are key roles in today's world in their complex translating and interpreting between different groups and audiences – i.e. technical experts.

**HYBRID ROLES**

- AAL Coach (new)
- AAL Networker (modified role)
- AAL Usability/Mobility specialist (modified role)

**MONOCULTURAL/CORE ROLES**

- AAL Architect
- AAL Financial Manager
- AAL Caregiver
- AAL Social Networker
- AAL Network Provider
- AAL Ethical Issues Specialist/Patient Advocate
- AAL solutions (service) /developer (provider)

**Figure 4. Hybrid and monocultural AAL job roles**

**3.3 AAL professions**

While trying to map potential AAL professions in the AAL job roles, the literature did not reveal any entirely new professions. This confirmed our assumption that, because AAL is still in its beginning, existing professions somehow relevant with the AAL supply chain are called to fulfill the current needs of this field. The only exception concerned the "Social Networker" job role, for which we found scattered indications of its goals, main tasks and responsibilities. This information allowed us to draw the picture of a new profession that we named "Community Manager". Nevertheless, the available information for this profession is insufficient warranting further investigation.

All the other job roles were associated with specific existing professions and/or employment sectors of each national value chain. Table 3 shows a list of indicative professions associated with our AAL job roles. The job roles that emerged from the job role evaluation are not included in this Table, due to the fact that they are considered hybrid roles and their related professions can be covered by those linked with the initial AAL job roles.

**Table 3. Existing Professions related to the selected job roles**

Job roles	Professions/employment sectors
AAL Assistant/ Consultant/ Agent/Conductor	Market analyst/consultant
AAL solutions/ service developer/ provider	Computer engineer, Seller, Marketer,
AAL Usability specialist	Interface designer
AAL Social networker	Community manager, Social worker
AAL Caregiver	Medical expert, Nurse, Social worker
AAL Ethical issues specialist	Lawyer
AAL Architect	Civil Engineer, Architect
AAL Network Provider	Computer Engineer, Electrical engineer
AAL Financial Manager	Accountant

**3.4 Suggested Qualification Modules**

Having already mapped both the job trends in the AAL sector and their relations with existing professions/employment sectors, the second set of steps in our desk research concerned the qualifications related to those existing professions. As we have already outlined, the aim was to present their training level according to the EQF reference system, as well as their learning outcomes- the latter vary significantly according to their EQF level. Yet, it was through the comparison between the learning outcomes of the actual professions and the desired ones that we were able to shed light into the insufficiently trained learning outcomes of already existing relevant professions. To put it differently: if specialist trainings are to be designed to meet the needs of the emerging jobs in the field of AAL, it is important to identify the gaps in the learning outcomes of the current professional profiles and their relevant qualifications, and on the basis of those, suggest new qualification modules.

**Table 4. AAL Architect Module**

Profession		Learning outcomes		
Qualifications	EQF level	Knowledge	Skill	Competence
AAL Architect	5	Basics of accessible building Smart housing scenarios State of the art AAL technologies AAL case management Sensing devices and networks required infrastructure	Can implement structural measures so that the AAL needs are met.  Can plan accessible buildings that integrate AAL technologies	Has an interdisciplinary approach to planning of smart spaces.  Is aware of AAL needs Is able to work in inter-disciplinary teams with specialists in AAL technologies and health care staff

**Table 5. AAL Caregiver qualification modules**

Qualifications	EQF level	Knowledge	Skill	Competence
Certificate care-Assistant (Caregiver)	3	Basic functionality of AAL products (household and care-related)	Can handle AAL products as an experienced user	Operates AAL products, reports malfunctions and performs simple maintenance tasks (like changing of batteries)
Nursing Diploma (Caregiver)	4-5	Full functionality of AAL products	Can handle AAL products as an expert	Operates AAL products as an expert user, detects malfunctions and decides maintenance actions

**Table 6. AAL Ethical issues specialist qualification module**

Qualification	EQF level	Knowledge	Skill	Competence
AAL Ethical Issues Specialist	6	Basic ICT knowledge Knowledge of AAL systems and technologies	Can implement relevant law framework and policies in AAL products  Can consult customers about ethical issues	Can evaluate security mechanisms and adjust them properly)  Is able to improve user privacy and security policies

Due to limitations of space in what follows we will only provide a few examples of the process of arriving at some of the proposed qualification modules and their learning outcomes. Given Germany's leading status in the field of AAL, it could be foreseen that most AAL-related existing qualifications will be found there (21 in total). Three of them (MS Accessible Planning & Construction, MS Ambient Living Designer, and MS Advanced Construction & Building Technology) are specifically linked to the AAL Architect job role with a common EQF level (7).

A detailed comparison between the learning outcomes of those three existing qualifications and the widely known qualification of an Architect (EQF 5) is indeed revealing: it shows that a first degree in Architecture in Germany (EQF 5) could be enriched by a module called "AAL Architect". More specifically, such a qualification module is expected to offer certain abilities (knowledge, skills and competences). For example, a qualified AAL Architect will have basic knowledge of smart housing scenarios and developments in AAL technologies (Table 4).

In Austria a Caregiver qualification can refer to four different EQF levels (3, 4, 5, 6). Building on those and detecting their changing requirements, the Austrian national report suggested two qualification modules related to the AAL field. The first one is comprised by learning outcomes that refer to EQF level 3, as shown in Table 5: i.e. skills (practical and cognitive) to accomplish tasks and solve problems by applying basic methods and tools in the field of AAL. Thus, a qualified AAL caregiver (EQF 3) will know and will be competent in areas such as: basic knowledge of the functionality of AAL products related to

household and care, ability to operate in an experienced way AAL products and services, as well as responsibility for completing tasks and solving problems using AAL technology.

The second qualification module suggested by the Austrian report (Table 5) refers to learning outcomes relevant to level 4-5. In this case, the competence acquired through the AAL Caregiver module refers to the ability of expertly managing AAL settings. Thus, the suggested qualification module (AAL Caregiver, EQF 4-5) includes a set of AAL related outcomes, such as advanced knowledge of the functions of AAL products and services and abilities to handle them, as well as developing solutions at a non-technical level. Both of the suggested qualifications could provide either valid extensions to the existing Caregiver qualifications (up to EQF level 5), or separate training/life long learning courses.

Currently in Greece there is a postgraduate course in Bioethics (EQF 6) and a degree in Law (EQF 5). According to the findings shown in Table 6 the AAL Ethical Issues Specialist job role should be based upon the existing Lawyer qualification (EQF level 6). A new qualification module should be added to it, which would include a set of AAL technology related learning outcomes, as shown in Table 6. These include beginner's knowledge of basic AAL technologies (i.e. networking, sensors, etc), understanding of the consequences and implications on current ethical framework of the widespread application of these technologies, and ability to propose techniques and processes to deal with negative consequences of these technologies on people's privacy and security. The suggested qualification module could also provide a valid extension to the existing Bioethics qualification.

## 4. DISCUSSION AND CONCLUSION

In this paper, we outlined the emerging new jobs and roles for AAL specialists in Europe, based on an extensive and methodologically sound research methodology. The findings of the research showed that several existing job profiles will have to be updated with new qualifications modules, so as to enable professionals to adapt in the new sector of AAL, which is increasingly affecting everyday life. The most prominent new job roles are in the broad areas of AAL Solutions/Service Developer/Provider, AAL Caregiver, AAL Networking Provider, and AAL Ethical Issues Specialist, although the need for specialist AAL skills is detected in many professions, in which the job requirements are in the process of changing. However, different aspects of AAL professions will emerge first in different European countries, i.e. in some countries the care giving and social support aspects are more prominent, while other countries have given higher priority to technological developments [14].

In any case, existing qualifications will have to be extended with new modules, in order to train AAL professionals who will be capable to deal with market needs as soon as they emerge; the missing qualifications are mostly of technical nature. The comparative study of national approaches and their mapping to EQF revealed that the new qualifications modules can be included in all EQF levels equal and above level 3. Based on the above, new training or lifelong learning programmes will have to be designed to meet the emerging market needs.

The research was conducted in the context of the CompAAL project, in an attempt to provide a harmonized and transparent system of further education for professionals in organizations and companies operating in AAL. This way, the project will enable European AAL companies to compete internationally and AAL employees to move freely between European countries. For these reasons, we applied a qualifications centered approach in drafting the new job profiles, adopting an EQF based classification and description of learning outcomes. This approach enabled us to map the various national studies and findings to a common European framework, although we encountered difficulties due to the varying levels of perception and use of the learning outcomes perspective across the involved countries [15]. It also showed the importance, in practical terms, of focusing on defining the learning outcomes that shape learners' experience, rather than starting from the content of the modules that make up a curriculum. Such an emphasis will increase the accountability of education and training institutions and systems [3] and will create a common language, thus enabling better interaction between education and labour market stakeholders.

However, the findings of our desk research on their own are not fully representative of the AAL field's current status. Feedback of labour market stakeholders (existing and prospective AAL professionals and employers) about the actual diffusion of AAL and the validity of the suggested qualifications is deemed essential. Such information would provide a more thorough specification of the knowledge, skills and competence needs in this area. This task constitutes the second phase of our research methodology (field research) and is nearly completed. Its findings will be the subject of a future publication.

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