



Ambient Lighting Assistance for an Ageing Population

Specific Targeted Research Project

Final Plan for Using and Disseminating Knowledge

Deliverable 5.1

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Plan for using and disseminating knowledge for ALADIN

In Deliverable 5.1, we want to give an outline of all activities undertaken as part of workpackage 5 “Exploitation and Dissemination” of the ALADIN project. The research carried out within the ALADIN project has led and will lead to new product developments and improvements of existing product portfolios. The evaluation results have been analysed and are being exploited for scientific (dissemination) and economic (exploitation) purposes.

The plan for using and disseminating knowledge describes the measures which have been or will be taken to disseminate the non-confidential knowledge gained in the project to the public as well and to expert circles and how to use (exploit) the results of the project for commercial purposes by the partners. Moreover, the relevant outcomes of the project work for the different target audiences e.g. scientific community, the European R& D community and other stakeholders are identified. The dissemination plan also includes the policy for publication and dissemination of the work on the part of the project partners. In addition, the production of the necessary materials has been defined, in the format and language that are adequate for the dissemination in the different media channels to reach the targeted audiences.

The dissemination of the knowledge aims to increase awareness, to stimulate further research and development, and to increase the state of the art, regarding light and health for elderly people. This report has been regularly updated and therefore gives a cumulative overview of the project’s activities in terms of dissemination and exploitation.

The dissemination material is available both for central activities developed at a project level and for the possible opportunities for the dissemination by the individual partners. It has been created in the languages that the Consortium considered necessary, taking into account considerations such as costs of translation, impact of the translation etc. The dissemination activities have been a core aspect as it is essential to present the ALADIN project and its findings as widely as possible.

The dissemination channels depend on the type of audience:

- Scientific community: articles for scientific publications and participation in regional, national and international scientific workshops.
- European citizens as the final target users: press releases and articles in general public as well as domain-specific media (e.g. lighting industry)
- Experts: Participation in conferences and workshops
- Societal stakeholders: the key decision makers and business stakeholders have been a key group to interact with, because of their power to create awareness and impact in the society.

The overall goal is to assure that ALADIN will become a reference system when looking for independent living for the elderly, healthy ageing and Ambient Assisted Living applied to the elderly. The results of ALADIN project should be translated into innovative product developments to support the elderly in their daily routines and to create new research fields for the scientific community.

1.1 Economic relevance and market potential

Now that the ALADIN prototype is complete and is being tested in real-life settings, the consortium partners have started to look at opportunities of exploiting the system and its components. The challenge consists in turning research findings into a cost-effective solution that can be marketed successfully to older people across Europe who wish to enhance their wellbeing and improve their quality of life by means of an intelligent adaptive lighting system. They may also want to alleviate existing chronic conditions like minor cognitive impairments such as loss of memory and disorientation, prevent new ones and/or delay their onset. Additionally, lack of (natural) daylight may cause seasonal depression and sleep disorders due to irregular and correspondingly desynchronized circadian rhythms. This may be compensated by longer exposure to light during winter times and higher illumination levels in general since with ageing people's vision tends to deteriorate.

There is ample evidence of the economic potential of ALADIN-related research. Europe's population is ageing rapidly. ICT and assistive technologies can help deal with the challenges and opportunities presented by this demographic change. Based on the analysis of published data and demographic trends, we can assume a growing target group of up to 135 millions of European elderly aged 65+ by the year 2050. With an ageing population, the number of people with various physical, psychological or other impairments including chronic conditions such as sleep disorders or diminished vision is expected to rise in all EU countries. Still, on the whole, older adults aged 65+ are active and healthy members of society. We have to look at those of very advanced age (e.g. 75+) to find a notable prevalence of age-related disorders. Sleep quality, however, may be considered a wide-spread problem for the elderly as a whole. LMU found that 40-70 % of the elderly complain about sleep disturbances. Bad sleep quality is only one of the conditions that can be helped with adaptive lighting.

Given the fact, that the average income of the elderly is also expected to increase, a host of economic opportunities with great business potential are opening up for age-related products and services, especially in the health and care field, but also in the housing and building markets. Many houses will need to be adapted to cater for the needs of such people. Homes suitable for older people range from homes that fulfil basic accessibility standards such as no-step entrances and lifts to fully serviced accommodation with care provision. Because the ALADIN system is modular and therefore flexible, it can be implemented in all housing categories.

1.2 Strengthening exploitation capability

The main aim of our industry partners is to exploit the economic opportunities that have arisen as a result of an ageing population. Despite the opportunities opening up as a result of demographic change, so far no substantial market for assistive technologies (ATs) seems to have developed in any of the EU countries. Mere market forces have not optimally leveraged the potential provided by ICTs and ATs for independent living. Obviously, the acceptance and take-up of ICT-based solutions require a more demand-driven and user-oriented approach rather than policy-driven orientation.

Surprisingly, market exploitation has been slow despite the well-documented effects of optimised lighting and despite the enormous economic opportunities due to demographic change. This may be due to reasons such as low market awareness and visibility, lack of sustainable business models, lack of standards, but also regulatory frameworks and public policies that hinder the uptake of age-related ICT-based products and services. Whilst the last point is beyond the scope of our project, we intend to **address the barriers to market exploitation** of assistive technologies (ATs) mainly:

1. By involving leading international players and innovators in the lighting industry in the further development of the prototype
2. By adopting a design-for-all approach
3. By forming strategic alliances along the value chain
4. Design appropriate business models for sustainable operation.

1.2.1 Further development with industry partners

Our industry partners have drawn up business plans for the different target groups based on the evaluation results of WP4 “User testing and evaluation”. At the same time, two of the academic partners (LMU and FHV) have founded spin-offs to be in a better position to exploit the outcomes of the ALADIN project (see business scenarios 2.3.1 and 2.3.2). Besides, partners are looking into teaming up with leading suppliers of innovative lighting solutions such as Zumtobel, Osram and Philips to guarantee the mainstreaming of products targeted at the mass-market of older people. This would enormously strengthen our exploitation capability.

The ALADIN system as a whole as well as its individual components may be licensed to an industrial company such as an international lighting or medical care company as well as to component suppliers in the field of sensor technologies, LEDs and electronics. Its modular and open architecture makes it easy to integrate it in building management systems and general assistive environments. Therefore it can be marketed both as a stand-alone product as well as an add-on or option for already existing systems.

Whilst not dismissing this possibility, the Consortium would prefer to further develop the ALADIN prototype in collaboration with relevant companies. At the moment, Consortium partners are in contact with four main prospective clients from lighting industries: Osram (Munich, Germany), Zumtobel Group (Dornbirn, Austria), Siteco (Traunreut, Germany), and Durlum (Schopfheim, Germany). They are all interested in further research in this field, and they are looking for new and innovative lighting solutions for the elderly.

Zumtobel Lighting Division (ZUM), in particular, is anxious to build on ALADIN research and take it further. To this extent, FHV submitted a proposal in the AAL Joint Programme with ZUM as the leading industry partner - which unfortunately did not get funded in the 1st Call. We are now exploring other possibilities for translating research findings into marketable products with a time distance to market of two to three years.

1.2.2 Design-for-all philosophy

Before validating it in real-life settings, the ALADIN system including the user interfaces for the different ALADIN applications as well as the various components such as the sensors, has undergone extensive user-testing. For **user acceptance** it is essential that all components and interfaces of the lighting solution are easy to use, unobtrusive and highly reliable. By taking into account older people’s requirements, we believe that all customers will enjoy a more usable experience. This is an aspect we are communicating much more forcefully now that it is coming to exploitation because we are convinced that lack of user acceptance constitutes a major barrier to the successful take-up of AAL products and solutions.

This design-for-all philosophy greatly enhances the potential for commercial exploitation because it extends the group of potential beneficiaries to anybody wishing to enhance their wellbeing, improve their sleep and enhance their mental performance.

1.2.3 Involve stakeholders along the value chain

In the case of health care, the traditional value chain from R&D, product design, services or processes, production, marketing & sales to distribution and customer service has to be modified to include end-users and their associations as well as health and care professionals, local and regional authorities and building companies.

As can be seen from the partners' business scenarios as well as in the chapters 3.4 (Dissemination activities in housing and building sectors) and 3.5 (Dissemination activities into lighting industry) we are addressing stakeholders along the value chain for age-related products, in particular relevant professionals and their associations as well as building companies, housing associations, local and regional authorities and public and agencies engaged in elderly care. Besides, in the course of the field trials, strategic alliances have been formed to implement the solutions and thus create the foundation for commercial exploitation after project completion.

1.2.4 Possible business models for sustainable operation

From the point of view of commercial exploitation, the basic ALADIN system might have to be supplemented with some extra functions such as automatic daylight supplement to smoothen contrasts between light and shade or automatic corridor illumination by motion sensors. The purpose of the latter is to provide navigational support by means of lighting since fear of falling down is one of the most common worries among the elderly. Besides, the use of lighting to address safety and security concerns, e.g. as a protection against burglary or theft, should also be considered, when it comes to turning the prototype into a marketable product.

From the perspective of a future rollout of the ALADIN system and having in mind the preventive rather than therapeutic intention, it may be advantageous to conceive ALADIN as a convenient ambient assistance device addressed to technically open-minded younger end users. In the long run, however, the very elderly (75+) might constitute an equally interesting target group, provided the ALADIN functions related specifically to age-related impairments such as deteriorating sleep quality are emphasised. In this case, it would be important to target the intermediaries, i.e. family members, formal and informal caregivers, when marketing the system.

The price of the system is still a major barrier to marketing the system on a larger scale. Even if we succeed in bringing the price down due to economies of scale, the price would still be beyond the means of most older people unless it is taken care of by their health insurance providers. This is why we are particularly looking at care facilities for the elderly as a potential target group. This, however, requires a certain measure of adaptation since at the moment ALADIN is designed for single rooms in private households.

The modular and open architecture of our ambient lighting solution make it easy to integrate it in building management systems and general assistive environments. Therefore it can be marketed both as a **stand-alone product as well as an add-on or optional device** for already existing systems. Besides, the partners will leverage the alliances established during the project for **'packaging' the technology with appropriate support measures** which will have to be adapted to the differing social and organisational needs across Europe. LMU, in particular, is pursuing this strategy for marketing AAL products.

LMU also intends to use the outcomes of the project to extend its portfolio of advice and consultancy services. APOLLIS will use the project to further expand its activities in age-related empirical studies and market analyses. Apart from founding a spin-off that will specialise on marketing AAL products and services, FHV expects to enhance its position as a major player in the AAL field and thus increase its chances for future interesting R&D research.

To summarise, we have addressed or are addressing the other barriers mentioned before in the following ways:

Barrier to market take-up	Remedial measures
Low market awareness and visibility	Concerted effort to raise public awareness by means of (international) workshops, seminars, conferences and publications
Lack of user-specificity	Extensive end-user testing; adherence to recognised usability and accessibility standards
Lack of standards and interoperability	Employ the (de facto) standards used in building management /communication systems such as TCP/IP, OPC, BACnet and DALI for transmission.
High prices	Bring prices down through economies of scale; cooperation with health insurance providers, extend target group to include senior residences and other application scenarios

1.3 Possible future avenues for exploiting ALADIN

In all future developments that build on the ALADIN project we must emphasise its **USP** (unique selling point), which is **user- and situation-specific personalisation and customisation**. This is one of the outstanding features that distinguish our solution from the other lighting offerings available on the market. So called 'ambient lighting' with varying colour and brightness has been used and on offer for several years. Zumtobel, for instance, have several ambient lighting solutions in their product portfolio. However, the user has no possibility to interact with the predefined control strategy (mostly defined by the time of the day or the function of the room) and the lighting solutions do not take into account individual and situation-specific differences. Our solution, however, can be tailored to the individuals and their environment by capturing sleep and activity/movement patterns as well as psycho-physiological parameters such as skin conductance or heart rate. The data obtained via the sensors could be supplemented by personal interviews, user assessment and possibly online rating.

Based on the findings of our field trials and many discussions we have had with experts as well as representatives of our end-users, the following avenues for future developments look promising:

1.3.1 Packaging technology with support measures

It has been shown clearly that technology can only complement but never replace real social interaction with humans. Although the great majority of the elderly want to live independently at home for as long as possible, they nevertheless want to be embedded in a social network. LMU, for instance, is collaborating with SOPHIA, an information and communication platform developed by a housing foundation (Joseph-Stiftung) together with the university and clinic in Bamberg (see www.sophia-tv.de). Via a videophone this 'virtual nursing home' connects people to a large variety of health and care as well as social services in the region. LMU München cooperates with the south German office.

Sophia Südbayern with P.S. (www.sophia-suedbayern.de) is an SME and has been using additional innovative and individual communication solutions for the elderly who need help or social contacts. Apart from its technical and R&D expertise (SOPHIA Consulting GmbH) it will leverage its commercial agencies in Germany who can reach over 100.000 households owned by THW (Partner of the SOPHIA Holding) with an interest in combining social services with modern ICT and care centres for elderly people. The aim is to enable location independent services with the same quality of operation e.g. the same mobile ICT based security and support systems implemented in southern Bavaria.

We are convinced that the successful publicly funded project SOPHIA in Germany with its user friendly operation could be transferred to other European countries. It may have to be adapted to different telecom providers and different legal regulations but the core components would remain the same. Emergency help and social or medical services for the elderly with modern ICT should be possible all over Europe.

As mentioned before, LMU is playing a key role in this endeavour. Its commercial spin-off, GRG, has submitted a proposal in the 2nd AAL Call with a focus on social interaction together with Sophia, APOLLIS and FHV. GRG is a "spin off" of Generation Research Program of the University of Munich and consists of 20 researchers coming from a variety of backgrounds (e.g. medicine, engineering, cognitive sciences, psychology). GRG conducts research for larger and medium sized companies (e.g. Phillips) and public bodies e.g. professional and trade associations. It is specialised in the application of medical knowledge to other disciplines and in the conception of innovative technologies that require medical knowledge, e.g. assistive technologies. Besides, it boasts vast experience with ethical and legal issues in health/medical research as well as in conducting large-scale field trials.

Thanks to its close links with senior citizen associations GRG can draw on an extensive pool of older people who suffer from chronic conditions. For these, it provides experts in the field of patient self-management and health education as well as ethical and legal issues. GRG can build on a range of test results from studies into social interaction and works closely with SOPHIA which represents a secondary end user organisation, but has not the ability to do scientific research. Together the two companies offer packaged solutions that combine assistive technology with technical and social support (for more details, see LMU business scenario 2.3.1). Regardless the outcome of the AAL evaluation results, LMU will pursue its strategy of combining ageing-related products with social support services.

One of the most successful outcomes of the ALADIN Project was the initialisation of the Peter Schilffarth Institute for Sociotechnology by LMU München and various co-financers. This limited liability company was founded to fund social research projects with focus on elderly people. Ambient assisted technologies and other innovative systems, in particular, should support the elderly in their daily activities to enhance their health and fitness. The main focus is to attenuate the consequences of demographic change for the social system. Therefore several research groups have the mission to improve the state-of-the-art supply for the elderly, e.g. establish showrooms for ageing-friendly living, analyse the needs and values of this specific target group and evaluate the usability of products.

1.3.2 Combine with light planning for ageing-friendly homes

In the course of ALADIN we have acquired a great deal of knowledge about older people's needs and preferences with regard to housing. Due to mobility constraints, many older people spend a large proportion of their time indoors, which makes optimising lighting so essential for their wellbeing. Lack of daylight may cause seasonal depression and sleep disorders due to irregular circadian rhythms. This can be compensated by longer exposure to light during winter times and **higher illumination levels** in general since with ageing people's vision tends to deteriorate. Besides, lights should be dimmable to enable adaptation to the time of day and thus reduce energy consumption.

When installing lighting systems in the homes of the elderly, quantity, spectrum, timing, duration and spatial distribution are important characteristics to be considered. In addition, special age-related impairments such as impaired vision have to be taken into account. In the empirical research for ALADIN, the risk of falling down emerged as one of the most common worries among the elderly. The use of **lighting for navigational** purposes therefore would clearly respond to older people's needs. Besides, a future lighting solution would have to address safety and security concerns, e.g. as a protection against burglary or theft.

Another interesting avenue to pursue is the use of light for alleviating mild cognitive impairments such as loss of memory that may signal the onset of dementia. BLL are collaborating with the Medical University of Innsbruck to investigate how to optimise lighting in this respect. They may prepare a proposal on this topic for the AAL Joint Programme.

In future, we would like to use our knowledge in ageing-friendly housing by joining the growing network of experts and consultants in this field, including the Swiss Centre for Accessible Building (<http://www.hindernisfrei-bauen.ch/> or Connexia (www.connexia.at), the umbrella organisation for all the care facilities and nursing homes in the Vorarlberg. The latter has introduced the benefits of lighting for health and wellbeing into its further training courses and is also looking at the impact of lighting on dementia, which is one of its main research interests. FHV is also in touch with various care facilities in the Vorarlberg who are interested in integrating lighting as a component in their ageing-friendly buildings.

The Peter Schilffarth Institute, too, is planning to cooperate with academic institutions for research purposes but also with industrial partner or social institutions, e.g. LMU München as an academic partner received funding from the Schilffarth Foundation for setting up an ALADIN showroom. The Institute is particularly interested in exploring the use of intelligent lighting for patients who suffer from incipient dementia. This showroom opens the ALADIN concept to a wider audience like private persons and possible project partners.

At the moment, ALADIN is focused on older adults as it was piloted only in the private homes. However, its findings are relevant for many other target groups as well as other application areas which other institutions might want to explore further:

- Shiftworkers (e.g. in industry, in servicing sectors, hospital staff, etc.); a target group that is of particular interest to our partner Bartenbach (see 3.2.3).
- Assistive lighting systems for navigational support for older adults or people with cognitive impairments (mild dementia)
- Air-traffic controllers or any other personnel responsible for the safety and security of critical installations such as nuclear power plants or chemical factories.
- Office workers, in general, should benefit in terms of significant increases in work productivity.

- Automotive Industry Applications, like the interior lighting of cars, applying ambient illuminating systems to facilitate the handling of single functions, to reduce fatigue of the driver and to increase safety.
- The system consists of modular components which can be adapted to different contexts such as hospitals, aeroplanes, vehicles, health centres and offices, and which can be extended to other contextual variables such as temperature, acoustics or displays.

1.4 Guidance Notes for Dissemination

Apart from the guidance notes produced for the electricians who set up the lighting installations as well as for the coaches who assisted the elderly test persons during the field trials, FHV prepared a detailed system description that can be used by IT experts interested in building a similar system.

What might be even more important is the fact that ALADIN-related results has contributed to the formulation of new industry standards. They form part of the German industrial standard (DIN) V 5031-100. LMU is involved in the development of this official national standard for Lighting Technology “Optical radiation physics and illuminating engineering – Part 100: Non-visual effects of ocular light on human beings”. The development of this standard is still in progress and for the time being, the text is only available in German. Only when the work is complete, will it be translated into other languages.

1.5 Definition of target groups

From the user requirements analysis we derived the following findings that should be taken into consideration when developing assistive systems for the elderly:

Considering the ideal ALADIN user as a person with mild age-related constraints, low mobility, limited access to daylight, and little social contact, but enough open-mindedness and mental fitness to handle such technology, the target group(s) may have to be redefined:

Concerning age-related limitations and need for support, ALADIN would have to aim at much older age groups to find sufficient prevalence of constrained activity. In terms of the prototype tests a focus on elderly singles aged at least 75 years might be appropriate. However, concerning open-mindedness to new technology, ALADIN should rather aim at the ‘younger’ elderly because they tend to have higher affinity towards utilizing technology.. Besides, it is important to reach potential users whilst they are still in a position to take decisions about their environment and familiarise themselves with new technology. Another (additional) approach might be to address the older people’s relatives, friends or care-givers (e.g. nursing home staff) who are frequently involved in decisions concerning their wellbeing including the design of their immediate surroundings.

For the time being, we will **concentrate on the preventive rather than possible therapeutic effects**. Neither a limitation to the very elderly nor to the younger elderly seems adequate. The marketing efforts will focus on two main target groups:

- Address the technically open-minded and affluent younger elderly who are primarily interested in enhancing their mental performance and improving their sleep-wake cycle
- Address the very elderly (75+) who often suffer from reduced mobility and cognitive impairments (e.g. dementia)

As far as the latter target group is concerned, it will probably be necessary to address the intermediaries, i.e. family members, formal and informal caregivers, housing associations, public authorities or community organisations when marketing the system.

However, as mentioned before, we will target not only the older age groups. Given our design-for-all approach, anybody wishing to enhance their wellbeing, improve their sleep and enhance their mental performance can benefit from our ambient adaptive lighting solution.

Concerns about acceptance of new technology

The ability of elderly people to imagine the benefits of technology for independent ageing is rather limited. Typical reactions are that technology is considered to be useless or too complicated, or that it increases dependency or even aims at replacing social contact. User expectations towards technology are therefore difficult to ascertain. The potential acceptance of the ALADIN prototype therefore poses a challenge.

Overall, the following recommendations can be made with a view to increasing future acceptance:

- Lighting devices must correspond to the sensitivity and limited adaptability of the elderly's eyes. Glare effects and fast light changes should be avoided.
- The whole installation must either be a 'camouflaged' supplement to the existing infrastructure or correspond to individual aesthetic preferences.
- Motivation to use sensors is mainly correlated to safety matters e.g. automatic emergency call devices. This would require non-stop application.
- Communication or mnemonic training via screen is mostly rejected. As long as the ALADIN application has to deal with a high share of computer non-users within the target group, maximum attention has to be paid to the design of the user interface.