2017

Digital Coaching to Build Sustainable Wellness Routines for Young Elderly

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30TH BLED ECONFERENCE: DIGITAL TRANSFORMATION – FROM CONNECTING THINGS TO TRANSFORMING OUR LIVES (JUNE 18 – 21, 2017, BLED, SLOVENIA)
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University of Maribor Press

Digital Coaching to Build Sustainable Wellness Routines for Young Elderly

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Abstract Our focus is on digital wellness services for the "young elderly" (the 60-75 years old) age group. Wellness services will help young elderly people to improve and maintain their independence and their functional capacity. Digital coaching will help the users to build good and effective wellness routines and to sustain and develop them for better health. Potential early adopter groups are identified and the functionality of digital coaching for wellness services is worked out.

Keywords: • Digital coaching • Digital wellness services • Wellness • Young elderly • Ageing population •

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https://doi.org/10.18690/978-961-286-043-1.6 ISBN 978-961-286-043-1

Available at: http://press.um.si.

1 Background

The proportion and socioeconomic relevance of ageing citizens is already high in most EU countries and there is growing political pressure to find trade-offs between the costs and the sub-stance of the care programs.

The young elderly (the 60-75 years old) age group represents 18-23 % of the popu-lation in most EU countries; this is a large segment of the population that according to recent statistical estimates will be about 97 million EU citizens by 2020. For ex-ample, this age group will represent 22.6 % of the Finnish population by 2020 and has already reached 1.7 million in Sweden (2015) and 10 million in Italy (2016) (WHO 2014). Furthermore, given their income level and accumulated wealth, the young elderly represents very large and growing markets for digital wellness ser-vices, especially in higher per capita income EU countries.

This demographic trend has clear economic and scientific implications (cf. UN 2014).The opportunities and challenges offered by the young elderly market in most EU countries, is a market that so far mostly has been ignored by mobile service developers and providers, offering progressive companies new areas for expansion across the EU and beyond. It also provides fertile ground for collaborative research as it offers potential for researchers to work to find innovative solutions for large user groups, testing and anticipating the benefits and impacts of deploying digital wellness services among the young elderly.

We have seen the need to build an industry/research collaboration program to work out the means to build sustainable wellness routines for young elderly that would (i) be progressive and innovative enough to get their interest, (ii) be adaptive and use-ful enough for their individual needs to get adopted as part of daily routines, and (iii) be flexible and meaningful enough for the users and their changing context so that wellness routines would become sustained and con-tribute over time to better health and quality years for the ageing population.

The program, which has been worked out in both a national and a H2020 version, is called Digital Wells and has the ambition to help form and support interventions in the daily routines of young elderly so that the interventions form wellness routines. In turn, these routines will help to preserve physical, cognitive, mental and social wellness for the young elderly and help to build the basis for healthier elderly years. To make the interventions usable, practical and sustainable a virtual coach – VAIDYA – has been designed to ease and support the adoption of digital well-ness services among the young elderly and to pave the way for some quickest possible go-to-market initiatives (VAIDYA is an acronym for Virtual Assistance for Intelligent Digital wellness services for Young elderly Autonomy; Vaidya (Sanskrit: वैद्य) is a Sanskrit word meaning "physician"; Pranabhisar Vaidya - the ones who protect lives by curing diseases and exhibits complete knowledge theoretically as well as practi-cally (Wikipedia)).

2 Introduction

The society needs to have a strategy and priorities for the young elderly which are – and need to be – different from the strategy and priorities for the senior (75+ years old) age group. A majority of the young elderly are healthy, active and socially in-teractive and do not require much intervention or support from the health and social care systems of the society. The logic behind working out digital wellness services for the young elderly is that improved health in this age group will significantly raise the probability for continued improved health in the senior age group, for which ill-health among large numbers of citizens turns out to be very expensive (in Finland the health care costs for the 65+ age group was 3.8 B€ in 2014; statistics show that a Finnish citizen on average spends 80% of their lifetime health care costs during the last 10 years of his/her life) (Statistics Finland 2014).

We use wellness (which is more precise than well-being) as the target concept as wellness will tackle different aspects of functional impairment. The WHO defines wellness as "the complete mental, physical as well as social well-being of a person or groups of persons in achieving the best satisfying or fulfilling life and not merely the absence of disease or any form of infirmity (WHO 2014). There has been lively debate over the years about the dimensions of wellness; UCR [12] has compiled the following seven dimensions (here abbreviated):

- Social Wellness is the ability to relate to and connect with other people in our world.
- Emotional Wellness is the ability to understand ourselves and cope with the challenges life can bring.
- Spiritual Wellness is the ability to establish peace and harmony in our lives.
- Environmental Wellness is the ability to recognize our own responsibility for the quality of the air, the water and the land that surrounds us.
- Occupational Wellness is the ability to get personal fulfilment from our jobs or our chosen career fields while still maintaining balance in our lives.
- Intellectual Wellness is the ability to open our minds to new ideas and experiences that can be applied to personal decisions, group interaction and community betterment.
- Physical Wellness is the ability to maintain a healthy quality of life that allows us to get through our daily activities without undue fatigue or physical stress.

Adams (2003) and Els & de la Rey (2006) show the need for holistic wellness models and have tested this approach with a large empirical study. Here we will avoid any conceptual debate and use the following definition: wellness – to be in sufficiently good shape of mind and body to be successful with all requirements of everyday routines. The choice of wellness instead of health has the benefit that we are not dependent on access to health data that is strictly regulated in most EU countries with confidentiality and privacy limitations.

In this paper we will operate with wellness in two dimensions - intellectual wellness and physical wellness.

There are of course challenges for introducing digital wellness services; the first challenge is that common wisdom has it that young elderly do not have smartphones. Statistics now show that smartphones are becoming affordable general purpose instruments and will be even more so by the year 2020 (the mobile connection subscriptions are more than 100% of the population in most EU countries; the propor-tion of smart phones is closing on 70% in several EU countries). Recent statistics (http://www-teleforum-ry.fi) shows that the number of smartphones in Finland was 6.029 million in 2016 (about 73 % of the young elderly had a smartphone, cf. sec-tion 2); on an average Finnish consumers had 20 apps installed on their smartphones, of which 4 were paid (less than the EU average).

A second challenge is the doubt that digital wellness services will be at all attractive to the young elderly; this follows on a belief we have found in the market for mobile value services (Bouwman et al. 2008, 2014, Carlsson & Walden 2012, 2014)that (i) elderly people will not learn how to use services on mobile phones, (ii) there is no real use for mobile services in their daily routines, (iii) advanced technology should be developed for young people – and (iv) if elderly people use the services it will create the wrong brand image for the service developers. We have now been run-ning a research and development pro-gram for digital wellness services 2014-17 with support from two associations for elderly with more than 100 000 members; our findings show that the mobile service market beliefs are misconceptions.

A third challenge is to work out (i) empirically verifiable results on the intervention with digital wellness services, (ii) valid, theory-based results on how the design of digital wellness services will match the multiple wellness criteria, and (iii) empirical verification on how digital wellness services will help reduce functional impairment. There are several research methodologies avail-able to meet this challenge; here we will summarize the three methodologies we are using.

Action research has been one of the key directions of service design and work with information systems (Baskerville 1999) for a couple of decades and would in our present case tackle problems with the development and implementation of digital artefacts. The development work is often described as co-creative (Gronroos 2008) – “to find solutions that work and to not care too much about scientific precision”.

Design science is another possibility; this is fundamentally a problem solving para-digm with roots in engineering and science and is working out designs in order to find ways to tackle real-world problems. Design science research is described as a paradigm in which a designer answers questions relevant to human problems via the creation of innovation artefacts that will contribute new knowledge (Hevner et al. 2010, Lahrmann et al. 2011, Mettler et al. 2010). The designs build on an under-standing of what is needed to deal

with the problems; the design is both a process (a set of activities) and a product (called an artefact) and both can be validated and verified to be logically consistent and technically free of errors.

Action design research (ADR) (Sein et al. 2011) found that design science is too technologically oriented and is not paying enough attention to the organisational or user context of the artefacts. The ADR works with digital artefacts that are ensem-bles shaped by the user context both when designed and developed and when used. The ADR deals with the dynamics and the complexity of the context – in our case the interventions to create wellness routines - that are problems for engineering-inspired methods; we use the ADR in our research program.

The fourth challenge is the realisation that we cannot just create digital services and everything will then take care of itself. This shows that we need to support the building of an infrastructure (typically of SMEs) for design, development, implemen-tation, commercialisation and maintenance; the approach that we propose is to build an ecosystem of service and infrastructure developers and providers and to support them with theory and methodology for agile business SCRUM processes (Bouwman et al. 2014).

The paper has been structured in the following way: in section 1 we gave the back-ground and in section 2 the key definitions and a summary of the methodology; in section 3 we summarize results from a study of the acceptance and use of mobile apps and attitudes to wellness among young elderly on the Åland islands; in section 4 we introduce the principles of digital coaching and synergistic hybrid wellness solu-tions; section 5, finally, gives a summary and some conclusions as a basis for the continued work on wellness services.

3 Young Elderly on Mobile Apps and Wellness

We will start by addressing two of the challenges we identified ("young elderly do not have smartphones" and "it is doubtful that digital wellness services will be at all attractive to the young elderly"). In a recent project we cooperated with the associ-ation for elderly in the city of Mariehamn (in the Åland Islands) and asked them to invite their young elderly to participate in a survey in the fall 2015; we collected 101 usable answers (26.6 % response rate) (see Carlsson & Walden 2016, Carlsson & Carlsson 2016, for details).

The proportion male/female is 44.6/54.5%; 83.1% of the respondents belong to the young elderlly, and a further 14.9% are a bit older; 65.3% are married and 14.9% are widowed; 77.2% have a university or technical/commercial degree (uni-versity education is rather rare for this age group, which is why we combined it with the more common second level degrees), 20.8% have a basic education.

In the sample 75.2% are retired and 23.8% are working full- or part-time or are carrying out voluntary work; the most typical annual incomes before tax is < 30 k€ (51.5%), 30-40 k€ (19.9%), 40-50 k€ (9.9%) and >50 k€ (17.8%). These profiles are typical for the Åland Islands and are representative for their group of young el-derly; here we will use these profiles as a snapshot of the young elderly – we will add to the profiles in the following to get a fuller description of the potential users of digital wellness services.
As we plan to run the digital wellness services over smartphones we need to find out how frequent they are in the sample; we asked about the phones in use and found out that a majority (about 73%, but not all) use smartphones; this was con-firmed by the result that 72.9% of the respondents use mobile apps for navigation, weather forecasting, Internet search, etc. (requires smartphones).

We added to the profiles of the young elderly by asking how useful, easy to use and valuable mobile apps are for them following Davis (1989) and Venkatesh et al.(2012) structure of questions. For the about 70 respondents that use mobile apps we found that the adoption of mobile apps scored high on a 5-grade Likert scale on several items:

- mobile apps are useful in my daily life [4.32];
- I will continue to use mobile apps [4.19];
- mobile apps help me to carry out my tasks faster [4.08];
- using mobile apps helps me to carry out important tasks [3.94];
- I can use mobile apps without assistance [3.91];
- I have the necessary knowledge to use mobile apps [3.87];
- It is easy for me to learn to use mobile apps [3.79];
- I can use the mobile apps I need with the phone I have [3.75].

The results give us some insight to build on: (i) the young elderly use of smartphones is sufficient to launch digital wellness services; (ii) the young elderly are confident users of mobile apps, which is a prerequisite for getting the wellness ser-vices adopted. This settles the first challenge ("young elderly do not have smartphones") and as mobile apps are digital services we can also claim that the second challenge is settled for the sample in the Åland Islands. The research contin-ues, but so far we can stick to the proposal that digital wellness services could be developed and offered on smartphones for the young elderly.

Then we moved on to get an understanding of what perceptions the young elderly have of two wellness dimensions, physical and intellectual wellness. A number of proposals scored high on a 6-grade forced scale (101 respondents):

- intellectual challenges are important for my wellbeing [4.91];
- I get sufficient intellectual stimulation from my everyday life [4.61];
- my physical health has been good compared to people around me [4.38];
- my resistance to illness is good [4.24];

- the amount of information I have to process in my daily life is suitable for me (not too much, not too little) [4.20];
- I expect my physical health to remain good [4.14];
- I expect my physical health to deteriorate with increasing age [3.94].

The results we got show that the young elderly have clear perceptions of the two wellness dimensions; thus it makes sense to develop digital wellness services. In a next step we intend to cover also the emotional and social wellness dimensions.

Then we need to find out if there are any characteristics that could single out the most promising potential users as we want to get good, strong initial adoption of the wellness services. Our idea was that relations between socio-economic charac-teristics, attitudes toward the use of mobile applications and perceptions about wellness would help us to identify promising potential users; details can be found in Carlsson & Walden (2016) and Carlsson & Carlsson (2016).

We first run a factor analysis with 19 statements on mobile applications and 11 statements on wellness. The results gave an indication for possible sum variables (cf. Table 1) which were tested for reliability by calculating Cronbach's alpha coeffi-cients; the target value ($\alpha > 0.7$) was met for the constructed sum variables (their names show the groupings we found).

A non-parametric Mann-Whitney U-test was run in order to explore possible differ-ences be-tween gender, age (combined to two categories: –69 years; 70–), highest level of education (–higher vocational school; technical/commercial degree + univer-sity), marital status (single; in a relationship), current work status (working (full, to some extent, volunteer); retired), annual in-come (–30000 €; 30001–) and the level of experience of using mobile applications (routine; experienced).

We found that there were significant differences in the positive attitudes to using mobile apps between the two age groups (cf. Table 1); the younger age group was more positive (cf. mo-bile_ apps_ positive). The more educated group was experi-enced in using mobile apps (cf. mo-bile¬_apps_experienced). The more educated group was socially active in using mobile apps (cf. mobile_apps_social). The group with higher income gave more value to mobile apps (cf. mo-bile_apps_value). Males with higher income had a positive perception of (their) physical well-ness (cf. physical_wellness_positive). The group with a more active work status had a posi-tive perception of their intellectual wellness (cf. intellectual_wellness_positive). We need of course to take some care with making conclusions from the collected data; the sample of 101 respondents was not fully randomly selected and the survey was not fully reliable as we had no possibility to check the circumstances under which the questions were answered. Nevertheless, the results are interesting as the young elderly have not been much studied in this way before.

The insight we gained from the Åland island material relative to our overall vision, (i) to get young elderly interested in digital wellness services, (ii) to get them to adopt them and (iii) to make the services part of their daily routines, we should start with young elderly, who are,

- Active in full time/part time/volunteer work & advanced users of mobile apps & < 70 years
- Experienced users of mobile apps & more educated
- Males with good physical health & income > 30 k€ per year
- More educated & find mobile apps good value for the price

Table 1: Reliability analysis for six sum variables, obtained Cronbach's alpha (all items included,
*-marked item removed; used value underlined) and corrected Item-Total Correla-tion

Using mobile applications - statements	Corrected Item-Total Correlation [>0.3 recomm.]
I have the knowledge needed for using mobile applications [Q9_6]	0.727
It is easy for me to learn to use mobile applications [Q9_8]	0.819
I can use mobile applications that I want with my current phone [Q9_9] NOT included*	0.560
I think that mobile applications are user-friendly [Q9_10]	0.809
It is easy for me to become skilful in using mobile applications [Q9_12]	0.767
I'm using mobile applications without the help of others [Q9_17]	0.760
SUM variable I: Mobile_apps_positive Cronbach's alpha	**0.904** | **0.913** when *item deleted
I think that mobile applications are useful in my everyday life [Q9_1]	0.814
People who are important to me think that I should use mobile applications [Q9_2] NOT included*	0.656
The use of mobile applications increases my ability to take care of things that are important to me [Q9_3]	0.836
Mobile applications will help me to accomplish tasks more quickly [Q9_5]	0.773
Using mobile applications increases my productivity [Q9_7]	0.709
Using mobile applications has become a routine for me [Q9_22]	0.829
I will continue to use mobile applications in the future [Q9_20]	0.754
SUM variable II: Mobile_apps_experienced Cronbach's alpha	**0.925** | **0.926** when *item deleted
There are people who support me when I am using mobile applications [Q9_4]	0.461
I can get help if I have any problems when using mobile applications [Q9_11]	0.503
People whose opinions I value recommend me to use mobile applications [Q9_13]	0.584
Using mobile applications is very entertaining [Q9_19]	0.535
SUM variable III: Mobile_apps_social Cronbach's alpha	**0.729**
Mobile applications that cost something are reasonably priced [Q9_18]	0.700
Mobile applications give good value for the price [Q9_21]	0.700
SUM variable IV: Mobile_apps_value Cronbach's alpha	**0.820**
Compared to people around me my physical health has been good [Q10_2]	0.714
My resistance to physical illness is good [Q10_4]	0.774
I expect my physical health to remain good [Q10_11] NOT included*	0.593
SUM variable V: Physical_wellness_positive Cronbach's alpha	**0.832** | **0.858** when *item deleted
I look for challenges that require thinking and reasoning [Q10_1]	0.585
The amount of information that I have to process during a normal day suits me very well (not too much, not too little) [Q10_7]	0.557
I get sufficient amounts of intellectual challenges in my everyday life [Q10_3]	0.619
Intellectual challenges are important for my well-being [Q10_10]	0.651
SUM variable VI: Intellectual_wellness_positive Cronbach's alpha	**0.791**
I avoid tasks that require that I concentrate on them [Q10_5]	0.333
I expect my physical health to deteriorate with increasing age [Q10_6]	0.341
I have often found that my life lacks in intellectual challenges [Q10_8]	0.503
My physical health puts constraints on my everyday activities [Q10_9]	0.341
SUM variable NOT constructed Cronbach's alpha	0.593

4 Digital Coaching through Digital Fusion

In early work with the young elderly (Carlsson & Walden 2014, 2015) we found that the interest in using digital well-ness services on smartphones started to decrease after 2-3 months of continued use; when the services were combined with activity bracelets the period of active use doubled to about 4-6 months. These are early indicators and have something to do with the fact that there is a one-time cost for the activity bracelets (the smartwatches cost around 350 €, the more advanced bracelets 120-250 €, the cheap bracelets 40-50 €). This follows the pattern, that if you have paid for a bracelet you keep up the wellness routines in order to get value for the money you have spent. In an Insight report (http://www.nuance.com) it was found that 95% of applications on smartphones are abandoned within 1 month of download; Gartner found that the abandonment rate of smartwatches is 29%, and 30% for fitness trackers in a study with more than 9500 participants in Australia, U.K. and the U.S.

This creates a dilemma for building wellness routines. In order to get health effects among the young elderly the wellness routines need to be sustained for at least 3-5 years, the ideal would be to keep them up for 15-20 years, i.e. well into senior years; there is a need to build variety and advanced, intelligent functionality into the digital wellness services. A way to deal with this dilemma is coaching, i.e. to make variety and innovative, advanced functionality part of the digital wellness services, which will keep the ser-vices interesting. The material we worked out in section 2 already gave us some insight about the young elderly and this should be a starting point for giving the us-ers individual advice and guidance on how to improve their wellness routines (coach-ing) as a function of how advanced they are and what their goals and objectives are. Personal trainers/coaches have been proposed but will be too expensive.

We have worked out the functional requirements of the digital coach called VADIYA:

- The coach builds on digital fusion: fusion of heterogeneous data sets ((i) individual data, (ii) group/cluster data, (iii) big user group data) from 100+ applications and devices; algorithms to build information from data sets; fusion of sets of information with computational intelligence methods; ontology (fuzzy, soft) to build knowledge from sets of information; approximate rea-soning and soft computing for knowledge fusion
- Coaching is built with data, information and knowledge of different granularities (i) context dependent, (ii) individual wellness, goals, (iii) "good practice"
- Coaching is adaptive to national language, cultural habits, changes in legislation
- VAIDYA coaching is continuous and is built to change dynamically; should be maintained, supported, enhanced, changed, developed (sometimes radically)
- VAIDYA is unobtrusive technology: virtual coach on smart phone + omnivore platform that will have 100+ interface solutions for sensor data + data from wearables + new innovations

- VAIDYA builds on ideal wellness profiles that are worked out; for individuals, for groups/clusters of similar service users, for countries with similar cultures and traditions, etc.; deviations from the ideal profiles worked out with (fuzzy) MCDM methods to offer recommendations of how to make optimal steps towards the ideal profiles

A digital personal coach was proposed by Schmidt et al. (2015) to help fitness tracker users to personalize their training. The coaching builds on partially observa-ble Markov processes and Markov decision processes that use data from the fitness trackers; when reported the coach was in first prototype development. The imple-mentation and use of Markov processes may offer some challenges.

The digital fusion is needed as data will be multi-dimensional in each one of the four different wellness aspects. Some of the data can be collected with sensors (physical and social wellness) other parts will need a gamification interface and support (cog-nitive and mental wellness) (Hamari et al. 2014). Part of the data needs to be in real time; part of it can be daily and weekly summaries. We will need digital fusion to operate with heterogeneous data from different contexts and for different forms of wellness. All of it should be presented in an understandable and tailorable form for young elderly users, which is known as knowledge fusion.

The fusion methods and technology will add value to the digital wellness services:

- data fusion offers summary statistics from (several) apps and devices, goal attainment over days, weeks, months
- information fusion produces trends, deviations from trends, targets and tar-get revisions; shows levels usually reached by similar service users
- knowledge fusion compiles activities to combine, add, enhance information for advice & support; tailors enhanced activity programs

An illustration of the differences between data, information and knowledge in the wellness con-text was collected from a Polar A360 activity bracelet and is shown in fig. 1.

In work with young elderly groups (Carlsson & Walden 2014, 2015) discussion quite often focused on wellness as a sum of different activities and it was pointed out that “my best (individual) wellness is not achieved by maximizing my physical wellness, but by finding some smart combination of intellectual, physical and social wellness”. Further study showed that wellness could be synergistic, i.e. that combinations of different forms of wellness could be “more than the sum of the individual wellness forms”. Orienteering can produce synergistic wellness: (i) it offers cognitive and in-tellectual challenges in finding the optimal paths through the forest; (ii) it is one of the physically most demanding sports; (iii) the “family of orienteers” is closely knit - also internationally – and promotes social wellness.

Similar versions of synergistic wellness activities can be found among the young el-derly – con-certs offer intellectual, emotional and social wellness; volunteer help and support of senior citizens offer physical, emotional and social wellness; singing in choirs offer emotional and social wellness, and so on.

The digital coach VADIYA should provide advice and support for synergistic wellness activities - and for hybrids of wellness activities that work out innovative and some-times unique combinations that would offer new challenges for the young elderly users. There is of course the question of time for various activities and support for trade-off between wellness activities, i.e. how to get the best wellness value for time allocated to various activities (which sounds a bit like "productivity of working time").

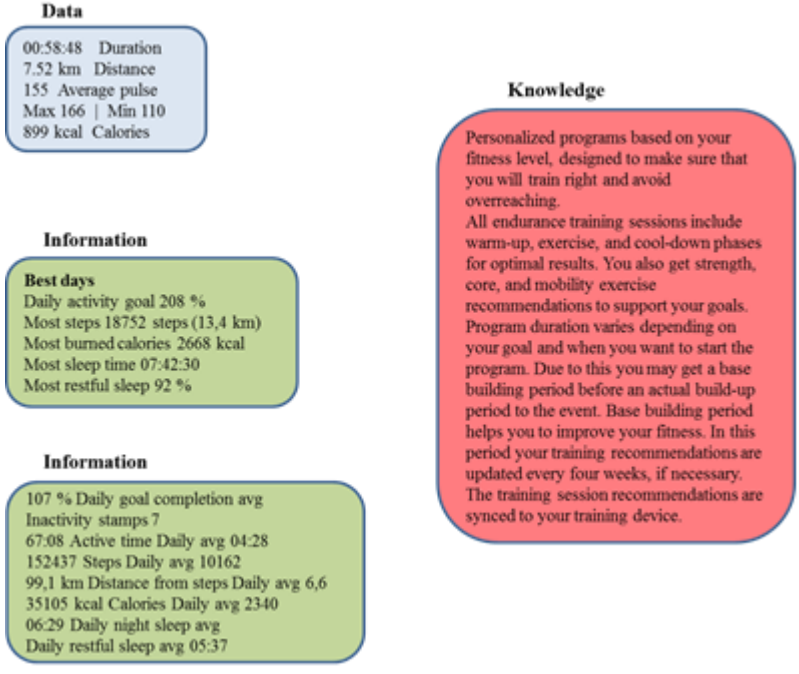

Figure 1: Data, information and knowledge fusion

5 Summary and Conclusions

We noted that the proportion and socioeconomic relevance of ageing citizens is high in most EU countries but that the young elderly has been ignored by the politicians worrying about the ageing population as they are "too active, and in too good shape" to request any budget-funded support from the society.

Thus there are two cases of missed opportunities: (i) there is a potential market for digital (mobile) services that represents 18-23% of the population in most EU coun-tries; the young elderly are estimated to be 97 million by 2020 in the EU countries (a market that should get some business attention); (ii) interventions that create sus-tainable wellness routines among the young elderly will reduce the probability for serious illness among the senior citizens.

We use wellness as the target concept – to be in sufficiently good shape of mind and body to be successful with all requirements of everyday routines.

In the study in the Åland islands we could identify some first groups of supportive users of digital wellness services; the first group is young elderly who are active in full time/part time/volunteer work and are experienced users of mobile apps and are < 70 years; the second group is young elderly who are experienced users of mobile apps and are more educated; the third group is young elderly who are males with good physical health and an income > 30 k€ per year; the fourth group is young elderly who are more educated and find mobile apps good value for the price.

Work with young elderly groups pointed to a dilemma: interest for mobile and digital services tends to diminish rather quickly (in 3-5 months, with activity bracelets in 4-6 months) but well-ness routines need to be sustained for at least 3-5 years to give positive health effects. We proposed to introduce digital coaching as part of the digital wellness services to make the use of them sustained. There is no doubt that much work remains to get wellness routines built and adopted by the young elderly.

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