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# The Role of Total Cost of Ownership Tools in AAL Technology Assessment

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## Abstract

Ambient Assisted Living technologies offer a unique opportunity to improve the quality of life of persons with mild cognitive impairments while also reducing economic pressures currently experienced by European health systems. Unless an appropriate route to market is found for AAL technologies these benefits will not be realised. This paper highlights the role of Total Cost of Ownership when conducting a technology assessment by reviewing existent literature. In particular, this paper recommends that Total Cost of Ownership tools be developed in conjunction with industry collaboration and that these tools be incorporated as a key award criterion during the assessment and procurement process.

**Keywords:** technology, ambient assisted living, total cost of ownership, health systems, procurement

**JEL classification:** I11

## Introduction

World age profiles are changing. It is estimated that there will be two elderly people to every young person in the European Union by 2060, with 10% of the population estimated to be over the age of 80 by 2060 (Eurostat, 2011). In some cases, the change is more immediate. By 2010, 23% of the population of Japan was 60 years of age or older and that figure is predicted to reach 39% within the next 40 years (SBJ, 2011). While in 2011 there were 535,393 people over the age of 65 in Ireland, a 14% increase from 2005. (CSO, 2011).

In tandem with a change in world age profiles has been the development of ambient assisted technologies (AAL), (Novitzky et al. 2014; Jacquemard et al. 2014). AAL technologies attempt to utilise sensory and cloud technologies as an eHealth solution. It is envisioned that these solutions will provide assistance and support to persons suffering various diseases such as cardio vascular disease (CVD) and mild cognitive impairment (MCI). Two horizon 2020 projects are currently tasked with the development of AAL technologies with the aim being to allow users suffering from a disease to aspire to an improved quality of life (QoL). Those suffering might enjoy the comforts of their own home. In addition, the application of AAL technologies can reduce the economic burden that currently rests on stressed health care systems, caregivers and patients, (Novitzky et al. 2014).

The promise of economic advantage and relief of health systems cannot occur unless appropriate market assessment tools for of AAL technologies are developed. The procurement and assessment of AAL technologies is a complex multi-layered

process, particularly in the context of fragmented European health systems. A review of the healthcare delivery systems of partner countries within said projects elucidates the various and fragmented systems across Europe. Individual partner countries show varied combinations of public and private sector health care delivery systems (WHO, 2016). This analysis along with the experience of the two Horizon 2020 projects to date highlights the necessity to develop bespoke tools for assessment.

The two Horizon 2020 projects related to this paper present a timely opportunity. Both projects require the bespoke development of total cost of ownership tools. At project maturity both solutions will have trialled suitable total cost of ownership tools and commercialisation routes. This knowledge, in conjunction with a review of various European health systems it has made it clear that developing a bespoke total cost of ownership tool for European-wide AAL technological solutions is imperative to their successful diffusion through health systems. This paper will now present the underlying role and importance of a total cost of ownership analysis in an eHealth context.

## Methodology

Due to time restrictions and the nascence of research in the area of TCO models being applied to AAL technology assessment a secondary research approach was employed for this paper (Bryman and Bell, 2007). A literature review of extant TCO models and their application to AAL was performed with the models applicable to eHealth solutions then presented in the paper.

## Total Cost of Ownership

The following is a literature review of the role, formulation and applications of Total Cost of Ownership (TCO) analysis in AAL technology assessment.

The World Health Organisation states that health technology assessment involves a systematic approach to the evaluation of properties, effects and impacts of a technology. It is a multidisciplinary task that incorporates social, economic, organisational and ethical considerations with an objective to inform policy decision making, (WHO, 2017)

The dichotomy of European health systems, between public and private systems of delivery, elevates the role and influence of the assessment process relating to eHealth services. As assessors must evaluate the costs associated with the procurement of eHealth solutions during the technology assessment process, a clear understanding must be obtained of where costs gather along a product lifecycle; on the public or private side for example.

A big picture understanding of product or service life cycles is therefore required to complete a technology assessment. Models that assess the life cycle of a technology must reflect the particular industry and body of stakeholders for which it is intended.

The procurement process is not always fully documented, particularly in the public sector. In an effort to harmonise methodologies Caldwell et al (2007) has outlined a procurement process based on Van Weeles model. The result is a six stage process; specification, supplier selection, contracting, ordering, expediting and follow-up / evaluation.

The assessment and procurement of AAL technologies is particularly complex. Consideration must be given to existing medical support infrastructure, the supply of utility services such as electricity, cloud services, staff training and implementation. In some institutions the assessment and procurement of AAL technologies can be

perceived as a strategic activity, necessitating a medium to long-term scope. Aiding this process the Total Cost of Ownership tool (TCO) (Hurkens and Wynstra, 2006) is used to understand indirect costs. This allows organisations to assess the lowest possible cost to be incurred when in negotiation with suppliers.

Ellram and Siferd (1998) have identified three segments to successful TCO analysis; operational, tactical and strategic. Through the TCO analysis organisations can uncover opportunities to either avoid or reduce cost. Due to the fragmented nature of European health systems this can prove to be a difficult task. Not only is there a lack of a common framework for deployment but cost structures vary from state to state.

TCO analysis highlights the many layers involved in the assessment of a technology. For example, it is often the case that the assessment and acquisition of an AAL technology includes the considered procurement of a product and service. As a result, performing TCO analysis during a technology assessment not only informs matters relating to direct and indirect cost (Leenders et al, 2006) but also elucidates a number of other influential factors:

- cost reduction opportunities
- supplier evaluation and selection criteria
- data for negotiations
- points to focus suppliers on cost reduction opportunities
- advantages of expensive, high quality items
- clarification and definition of supplier performance expectations
- a long term supply perspective
- forecasting for future performance.

There are a number of methods for estimating TCO. Organisations generally choose a TCO approach from one of two overriding methodologies; a standardised TCO tool approach or the development of a bespoke tool.

Hurkens et al (2006) highlight a number of methods to use when estimating costs. The first of these, the monetary based method, which allocates the costs of purchasing a service or product to the different true costs of components in the offering.

The second method is the cost-ratio or value based method, (Carr and Ittner, 1992; Ellram 1995). This method incorporates the monetary method with qualitative performance data. By evaluating non-monetary data, a supplier rating score can be amassed, resulting in a total cost factor, (Wynstra and Hurkens, 2006).

Benton and Shin (2007) offer a third model that introduces five performance factors; quality, delivery, technology, price and service. Suppliers are given a numeric rating, the highest being 1.0, indicating hidden cost of ownership.

## Results

The main finding of this paper is the existence of three TCO models that can support the assessment of AAL technologies (Hurkens et al, 2006; Carr and Ittner, 1992; Ellram 1995; Benton and Shin, 2007). In addition, this research reveals strategic roles for TCO models that go beyond their initial purpose; providing data for negotiations, identification of cost reduction opportunities, supplier performance expectations, supplier selection criteria, advantages of expensive, high quality items and forecasting for future performance. Finally, it was found that existing models do not incorporate adequate collaboration between public and private entities.

## Discussion and conclusion

A limitation of this paper is the lack of extant literature relating to TCO models. Furthermore, there is limitations in the methodology employed, future studies should consider qualitative interviews with practitioners.

Although research exists on TCO models it should be noted that there is little analysis existing on its application in the context of AAL technologies to be diffused on a European-wide scale across varying health care systems. There is an opportunity for further research to develop this area particularly with regard to public and private sector collaborations. It is recommended that future TCO models be developed in conjunction with industry partners. It is also recommended that the TCO process be developed into a key award criterion when conducting AAL technology assessment and procurements, thus aiding long term strategic decision making.

## References

1. Benton, W.C., Shin, H. (2007), "A quantity discount approach to supply chain coordination", *European Journal of Operational Research*, Vol. 180 No. 2, pp. 601-616.
2. Bryman, A., Bell, E. (2007), *Business Research Methods*, Oxford University Press.
3. Caldwell, N., Bakker, E., Read, J. (2007), "The purchasing process in public procurement", In Knight, L., Harland, C., Telgen, J, Callender, G. and McKen, J. *Public Procurement International Cases and Commentary*, England, Routledge.
4. Carr, L.P., Ittner, C.D. (1992), "Measuring the cost of ownership", *Journal of Cost Management*, Vol. 6 No. 3, pp. 7-13.
5. Central Statistics Office (2012), *Profile 2: Older and Younger*, Dublin: Stationery Office.
6. Ellram, L., (1995), "Total cost of ownership: An analysis approach for purchasing", *International Journal of Physical Distribution and Logistics*, Vol. 25 No. 8, pp. 4-23
7. Ellram, L., Siferd, S. (1998), "Total Cost of Ownership: A key concept in Strategic Cost Management Decisions", *Journal of Business Logistics*, Vol. 19 No. 1, pp. 55-84.
7. Eurostat (2011), "Population projections, European Commission, available at: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/Population\\_projections](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Population_projections) (03 February 2017)
8. Hurkens, K., Wynstra, F. (2006), "The concept "Total Value of Ownership": A case study approach", available at: [www.iimm.org/knowledge\\_bank/IFPSM](http://www.iimm.org/knowledge_bank/IFPSM) (12 March 2017)
9. Jacquemard, T., Novitzky, P., O'Brolcháin, F., Smeaton, A. F., Gordijn, B. (2014), "Challenges and opportunities of lifelog technologies: a literature review and critical analysis", *Science and Engineering Ethics*, Vol. 20, pp. 379-409.
10. Leenders, M., Johnson, F., Flynn, A., Fearon, H. (2006), *Purchasing and Supply Management* (13th edition), New York, Irwin McGraw Hill.
11. Novitzky, P., Smeaton, A. F., Chen, C., Irving, K., Jacquemard, T., O'Brolcháin, F., ... Gordijn, B. (2014), "A Review of Contemporary Work on the Ethics of Ambient Assisted Living Technologies for People with Dementia", *Science and Engineering Ethics*, available at: <https://doi.org/10.1007/s11948-014-9552-x> (11 February 2017)
12. SBJ (2011), *Statistical handbook of Japan 2011*, Statistics Bureau and the Director-General for Policy Planning of Japan, available at: <http://www.stat.go.jp/english/data/handbook/index.htm> (02 March 2017)
13. World Health Organisation (2016), *From Innovation to Implementation: eHealth in the WHO European Region*, available at: <http://www.euro.who.int/en/publications/abstracts/from-innovation-to-implementation-ehealth-in-the-who-european-region-2016> (03 March 2017)
14. World Health Organisation (2017), *Health technology assessment*, available from: [http://www.who.int/medical\\_devices/assessment/en/](http://www.who.int/medical_devices/assessment/en/) (11 April 2017)

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Prof Regina Connolly has significant expertise in healthcare technology impact assessment as well as eHealth business model development and is a Lead Investigator in several international Ambient Healthcare Technology research projects that were awarded over €8.43 million in funding from the European Commission in 2014. She is also a lead investigator in a pre-commercial health technology procurement proposal that was awarded over €5.1 million in European funding in 2015. In 2016, the H2020 public health research project (MIDAS) which she co-leads with Ulster University was awarded €3.1 million in European funding. Author can be contacted at [regina.connolly@dcu.ie](mailto:regina.connolly@dcu.ie)