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What we do – and don't – know about the Smart Home: An analysis of the Smart Home literature

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Abstract

Technological innovations, from ubiquitous computing, augmented reality, telecommunication to intelligent appliances and robotics, bring new possibilities to the Smart Home domain, which has led to an increase in the number of academic publications in this domain. To date, no comprehensive overview and clustering of the core concepts used in these publications have been produced. Based on an extensive review of existing literature on the Smart Home, this paper visualizes the state of the art in the Smart Home research in a systematic way and outlines future research challenges. To do so, a business model framework is applied that helps researchers place their work within a broader context and identify gaps in the existing body of knowledge in this area. In order to move from the exploration towards the exploitation of Smart Home concepts, it is essential to contribute to a coherent body of knowledge that not only is technology driven, as it is the case now, but also pay attention to the non-technological aspects, i.e. social-organizational, economical, organizational, law/legislation and entrepreneurial topics, from both a strategic and an operational perspective.

Keywords

Smart Home, Qualitative meta-analysis, Literature review, Service-Technology-Organization-Finance model (STOF)

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Introduction

Along with technological advancements over the past 30 years, an exponentially growing interest from industry has caused the concept of Smart Home to evolve from Domotica, to the Smart Home, later to Internet of Things, and more recently to Smart Living. Energy providers see opportunities for information and communication technology (ICT) enabled smart energy applications. Telecom, cable and media companies, as well as hardware and content providers, see opportunities for an environment where the home will become an entertainment experience and gaming centre. Access providers see opportunities for in-home managed IT services. Security providers see distant surveillance, control and safety equipment as an option for new business. Healthcare providers recognize opportunities for sensor networks connected to smart devices that enable the elderly and people with a chronic disease to stay in their personal environment longer, the aim being to cut costs in the medical care and health care domain. In addition, it may be needless to say that several disciplines (e.g. robotics, artificial intelligence, service engineering, mobile computing) are involved in this domain, while various perspectives (e.g. users, system, organization) are considered to identify and study a myriad of (design) issues (e.g. usability, affordability, privacy and security, interoperability and standardization, collaboration).

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The immensity and diversity of attention that Smart Home (or Smart Living) developments and market has received (and will receive) has caused an ever-growing, yet dispersed, body of literature. Although the concept has the unanimous goal of promoting comfort, convenience, security and entertainment of home residents, the burgeoning literature on Smart Home is utterly incoherent. In addition, the few well-structured review publications with the aim of representing the Smart Home body of knowledge either focus on specific technology aspect or on sector-specific developments. Examples are reviews on assistive technologies,[1] e-health projects,[2–4] design requirements,[5] laboratories,[6] technologies for ageing societies,[7] energy management,[8] location-based systems[9] and user studies in healthy Smart Home.[10]

This paper argues that to move from the exploration towards the exploitation of Smart Home concepts, research needs to be based on a coherent body of knowledge that covers technological, organizational, economical and business (entrepreneurial) perspective. The intended contribution of this paper is twofold: (1) to analyse the existing mainstreams of Smart Home research topics, and (2) initiate a discussion on research topics that warrant further attention. To this end, first an extensive number of publications on the Smart Home is collected and analysed, and subsequently, areas that are frequently investigated and those that have thus far been neglected by researchers are identified and discussed. For the analysis, an inductive research strategy as proposed by Miles and Huberman[11] is adopted. The literature analysis starts from the four business model domains, i.e. service, technology, organization and finance (STOF), as distinguished by Bouwman et al.[12] In this paper, the STOF framework serves as a comprehensive starting point from which the Smart Home literature is analysed.

First, this paper provides a short discussion of the Smart Home concept and proposes a working definition to determine the scope of the research domain, after which the diversity of the Smart Home domain is discussed. Next, the methodology for the literature review is described. Finally, the results are discussed, future challenges are outlined and the main conclusions and research limitations are presented.

Smart Home: definition and perspectives

Since the first official announcement of Smart Home in 1984 by the American Association of House Builders,[13] the concept has been applied in different industries. As far as the healthcare sector is concerned, a Smart Home is interpreted as a residence that provides disease prevention possibilities, monitoring health and/or assisting with health-related issues of its inhabitants with the purpose of improving quality of health and healthcare.[2,14] Chan et al.[3] discuss a number of e-health projects in the Smart Home area. In the construction (Domotica) sector, a Smart Home is seen as a house or living environment that contains the technology to allow devices and systems to be controlled automatically.[15] Several Smart houses have been built to investigate smart technologies in urban dwellings.[16] The energy sector associates the Smart Home with the efficient provision, co-production and consumption of energy.[17] Examples are Smart Meter projects that can be found all around the world.[18,19] In line with the concept of Internet of Things, the ICT sector focuses primarily on innovative ICT-enabled solutions designed to improve the connectedness of people and things, while also looking at entertainment and teleworking solutions. Barlow and Venables,[20] for instance, provide an overview of projects dealing with mobile applications for Smart Home environments.

In short, different industries use different definitions of Smart Home. In this paper, we use the broad definition provided by Aldrich[6]:

> A Smart Home can be defined as a residence equipped with computing and information technology which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through the management of technology within the home and connections to the world beyond

and add *healthcare, education* and *communication* to his definition. The last part of Aldrich's definition, 'connection to the world beyond', stresses the notion of the 'informational' home, where existing and new information services are interactively connected to the outside world, rather than the mere 'automation' of home appliances.[21] The notion that Smart applications are not limited to the dwelling or home as such makes it clear that the term Smart Home is limited, and that the term Smart Living may be more accurate, indicating that smart applications serve and focus on an intelligent living instead of a home environment. For instance, the Smart Communities,[22] Smart Cities[23] and Smart Factories,[24] which expand the concept beyond the residential home. Accordingly, from this point, the term Smart Living will be used throughout the paper.

Recent rapid-paced developments in technology, including ubiquitous computing,[25] intelligent appliances,[26] telecommunication,[27] robotics,[28] wearable sensors,[29] gerontechnology[158] and so on, have created a new wave of interest in the Smart Living concept. A majority of Smart Living projects and publications adopt a technological perspective. Technology push clearly plays a role.[21,30] Others look at the Smart Living area from a user-centric perspective and see context and user demand as the leading factors for the development and provision of Smart Living concepts.[6,20,31] In addition, a variety of critical design issues (CDIs) have to be considered by researchers and practitioners in the development and provision of Smart Living concepts. CDIs are defined as variables that are perceived (by practitioners and/or researchers) to be of eminent importance to the sustainability of the service of product under development.[5]

In short, Smart Living can be characterized as a research area that includes various industries, disciplines, perspectives and CDIs. This paper aims to provide a comprehensive overview of how the body of knowledge in this domain has evolved and, moreover, what areas are in need of more attention from both scholars and practitioners.

Research method

Data sources

Publications on Smart Living were identified through searches of three search engines, i.e. Google Scholar, Scopus and Web of Science, between 1991 through 2013 (starting from the publication year of the Mark Weiser's seminal work on intelligent interconnected devices). The search terms that were used were 'smart homes', 'smart living', 'ambient intelligence', 'intelligent homes', 'connected homes' and 'ubiquitous computing'. Publications from a wide variety of academic publishers, such as Elsevier's Science Direct, Emerald Library, Springer, JSTOR, Association for Computing Machinery/Institute of Electrical and Electronics Engineers (ACM/IEEE), Wiley InterScience, Information Society, Human Technology and Institute for Computer Science, Social-Informatics and Telecommunications Engineering, were identified. The result was an extremely large sample of publications (Table 1). However, there is a large overlap between search engines and publications. On one hand, the search engines index (almost) the same set of publications based on the search terms. On the other hand, the search terms result in an overlapping set of publications. To deal with the overlap and select relevant publications in accordance with the earlier discussed research goal, a set of selection criteria was formulated.

Publication selection

The selection was based on three criteria. First, publications were selected that contain at least one of the search terms in the title, abstract and/or list of keywords. This criterion ensured the relevance of data collection as to be directly related to Smart Living domain. Second, only publications were selected that consider and explicate Smart Living as their unit of analysis. This criterion ensured the relevance of the data collection by including only those publications that aim at contributing to Smart Living literature, which led to exclusion of publications with a highly technical nature that essentially contribute to various technical disciplines such as information technology, telecommunication and network computing. And finally, to ensure scientific reliability of the data collection, only reviewed journals, book chapters and conference proceedings with more than 50 citations were selected. The Smart Living literature contains several broadly accepted and

Table 1. The service dimension.

Clusters	Topics	Instantiations	References
Service specification	Service value	Value proposition	20,37
	Service types	Generic/specific services, living space, social space, physical space, etc.	21,38
	Service quality	Service quality requirements	35
	Service flexibility	Reusability, expandability, etc.	39,40
Service design	Service usefulness	Service adoption and control	41
		Service or product personalization	42
		(Ethnographic) understanding of user context	33,34,43,44
		User experience	45
Service provision	Service demand	User service requirements	40
		User expectation	46–49
	Service delivery	Environmental-friendly service provisioning	50
		Service distribution channels	21

highly cited conference proceedings. Exclusion of these conference proceedings skews the representation of literature. A threshold of 50 citations was chosen to exclude the less prominent proceedings. Obviously, a higher or lower threshold would have been possible, leading to inclusion or exclusion of more or less publications (see research limitations in the final section).

After the selection round, an initial set of 138 publications was identified. Next, the publication references were screened (i.e. snow-ball sampling), yielding a total sample of 154 publications.

Data structure

The final collection of publications was subjected to a full-length screening. All the papers were thoroughly scrutinized by the authors and the core concepts discussed in these publications were then summarized in a large database. (*The complete database of the selected Smart Living publications is available upon request*.) As recommended by Cochrane review approach,[32] the database includes all the key information that enables the authors to analyse the current landscape of Smart Living literature. The database includes seven columns including: (1) publication reference (including year of publication), (2) number of citations, (3) domain of study (e.g. security, energy efficiency, laboratory, interface), (4) research hypothesis or questions, (5) methodology, (6) theoretical concepts used in the publication and (7) the design issues discussed throughout the paper (e.g. usability, context-awareness, adaptive middleware, unobtrusive). The authors filled in the database using the terminology and structure consistent with the reviewed papers.

Abstraction process

In line with the main goal of this study, to analyse the existing publications various foci of analysis need to be taken into account. As discussed in the previous sections, it is only through a comprehensive view on Smart Living literature, that the existing knowledge gaps can be identified and an effective research agenda can be articulated. To this end, we borrow a generic and comprehensive framework that aims at reconstructing the logic of a business and its surrounding ecosystem. The framework enables a high level and holistic representation of STOF.[12] The *service domain* offers a description of the value proposition (added value of a service offering eventually enabled by new products) and the market segment at which the offering is targeted. The *technology domain* describes the technical functionality and architecture required to realize the service offering. The *organization domain* offers a description of the structure of the multi-actor value network required to create, manage and distribute the service, and to describe the focal firm's position within this value network. The *finance domain* gives a description of the way a value network intends to generate revenues from a particular service offering and of the way risks, investments and revenues are divided among the different actors in a value network. The main merit of this framework is its multidimensional view that includes both technological and non-technological aspects.

The STOF four domains were used as the starting point to 'cluster'[11] existing Smart Living literature. To do so, first off all the papers were categorized into one or more dimensions of STOF, i.e. service, technology, organization and finance (which added a new column to the database indicating the focus of the paper). The categorization is based on research objectives and topics addressed in the papers. Next, the papers were coded based on research subjects, questions, domain and method. In a hierarchic structure, the authors divided and subdivided the labels whenever a new category or subcategory was identified. Gradually, the STOF classification of publications evolved into a more detailed tree of topics, with branches and sub-branches. As suggested by Miles and Huberman,[11] each article forces the researchers to reconsider the tree and its branches, and adapt (i.e. modify, refine or detail) where needed. Although an attempt was made to distinguish unique clusters, some clusters were strongly interrelated or even overlapping. Therefore, in some cases clustering is based on the central theme of the paper at hand, i.e. the codes that were frequently stressed in the paper. To minimize researcher bias, the authors structured the tree of topics in accordance with the structure of the original papers (i.e. terminology, position of concepts within the tree and the hierarchy of the concepts). To increase the internal validity, the publications, codes and clusters were reviewed by the authors and discussions took place to reconcile conflicting views of the authors and to reach a consensus on the final clustering, design and the hierarchical order of the tree.[11]

Results

In this section, the clusters for the four domains are discussed. In total, 15 core clusters and 52 sub-clusters were identified. For the sake of readability, Figure 1 illustrates a concise representation of the clusters (a larger mind-map is available upon request). Note that defining and providing extensive discussion on various concepts lies beyond the scope of this paper. Instead, the paper aims to reflect a comprehensive representation of the existing structure of Smart Living literature.

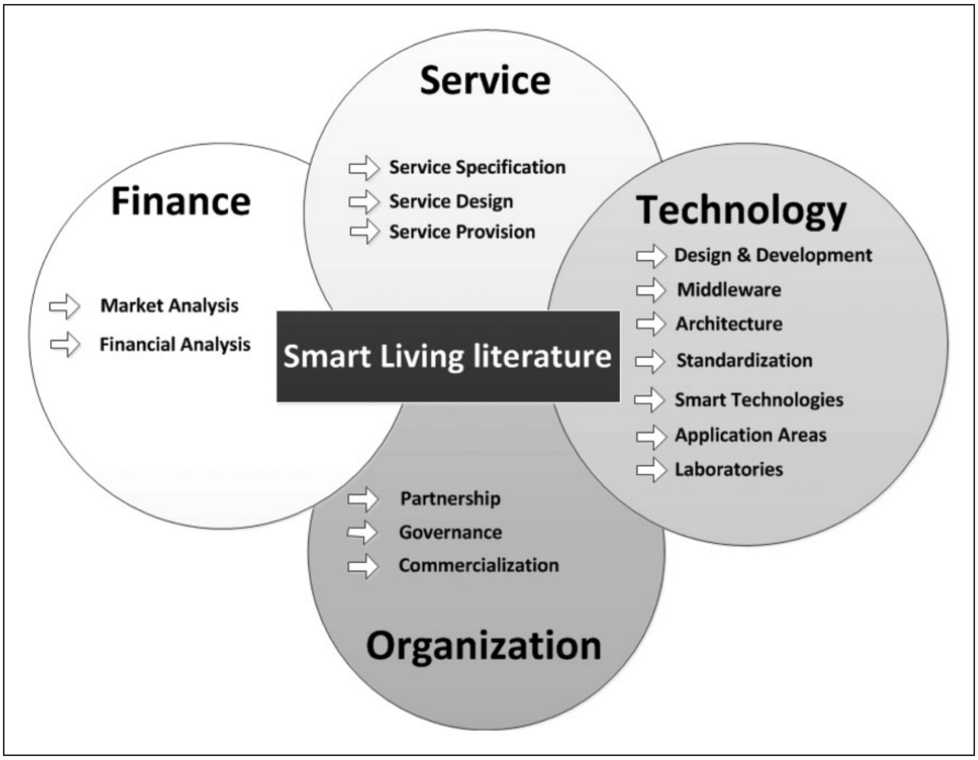

Figure 1. A concise representation of the current Smart Living literature.

Service domain

The service domain describes the customer value of a product of service offered by (a) provider(s). The customer value is determined by non-technical elements, like value proposition, service delivery and distribution channels or after-sales services. Within the service domain, three main clusters are identified: service specification, service design and service provision. In general, publications within the first cluster, service specification, are concerned with service definition or engineering (i.e. what services should be delivered?), service design focuses on non-technical analysis of user demand, while publications in service provision aim at answering 'how services should be delivered (and what can be expected)?' Table 1 presents the identified topics related to each cluster, the related concepts and the application area for each topic. A number of sub-branches, such as usefulness and ease of use are typical design/development (i.e. usability) topics, which is discussed in the next section. However, the emphasis on the non-technical topics distinguishes the service from the technology perspective. For instance, usability in terms of understanding the user context based on ethnographic observations,[33,34] instead of developing context-oriented sensors or architecture; or users service non-functional requirements,[35] instead of system technical requirement.[36]

Technology domain

The technology domain contains the largest number of publications and discusses a large number of technical-related topics. These topics are the enablers or driving force behind many Smart Living innovations. The seven central clusters that are identified in this domain are design and development, middleware, architecture, standardization, smart technologies, application areas and laboratories (Table 2). The first cluster focuses on various design issues, discussing various issues related to usability including usefulness, ease of use, user context and design methods and principles. The middleware cluster focuses on various types of middleware technologies applicable in various environments such as service-oriented, goal-oriented, agent-based and location-based. In a same way, various architectural approaches are proposed to deal with software, services, middleware, networks, systems, etc. Standardization is another cluster that includes a high-level discussion on the importance, limitations, impact or consequences of (a lack of) standardization, as well as, technical discussion on various standards and protocols. In addition, several publications emphasize various promising smart technologies and areas where these technologies may be applied. Finally, several publications present Smart Living laboratories, experiments conducted in these

Table 2. The technology dimension.

Clusters	Topics	Instantiations	References
Design and development	Usefulness and ease of use	Sense of control	28,51
		Accessibility	52
		Local and distance connectivity	33
		Social connectivity	13
		Labor saving qualities and good parenting facilities	53
		Level of assistance	54,55
		Part of life	40,56,57
		Easy installation or control, and satisfaction	21
		Privacy and security	41,58
	User context	Interface (motion tracking, gesture recognition and speech)	59
		Interface personalization	60
		Detection/recognition of human intentions, feelings, situations and activities	61–68
		User habits and personality	69
		User behaviour	70,71
		Requirement elicitation for context-aware design	36,72
	Design methods	A framework for user-centric design	72
		A framework for CDIs	5,73
		A framework for design factors	74
		A framework for human–system interaction	75
	Design principles	Reliability and manageability	53
		Agility consisting of flexibility, upgradability, replicability and adaptability	21
		Extensibility, maintainability	20
		Non-obtrusive, adaptability, anticipatory	50,76
		Scalability	77
Middleware	Location-aware services		26,78–81
	Context-aware middleware		25,80,82–84
	Ontology-based middleware		83,85
	Agent-based middleware		86,87
	Goal-oriented middleware		88,89
	Service-oriented middleware		90–92
Architecture	Software architecture		83
	Interoperability architecture		22,93
	Service architecture		39,91
	Middleware architecture		91,94
	Logical architecture		95
	Network architecture		96
	System architecture		15,97
Standardization	Interoperability	Interoperability benefits	21,26,98,99
	Protocols	OSGi, ZigBee, KNX, IEEE 1451, IEEE 802.11, MAC, P2030, Open Services Gateway Initiative, Bluetooth, etc.	90,100–105

(continued)

Table 2. Continued

Clusters	Topics	Instantiations	References
Smart Technologies	Network technology	Body area network	106
		Personal area network	22,107
		Cloud computing network	16,92
	Communication and control	Home-remote control, energy management	26,94,100,105,108–111
		Alarm systems	54
		Authentication system	112
	Sensor technology	Wearable technologies	29,47,113–115
		Pattern, emotion, or biometric recognition	67,68,116,117
		Motion sensor, object tracing	118,119
	Artificial intelligence	Robots	28,120,121
Application areas	Healthcare	Assistive care, social care, physical care, Gerontechnology	2,3,9,14,54,55,95,122–124
	Medical	Schizophrenia, Alzheimer	118,125,126
	Energy andsustainability	Smart metering, energy control, energy management, smart grid, sustainable-energy technologies	18,19,70,84,97,105,109,127–132
	Education	Tele-education	133
	Home automation	Air quality and thermal comfort	134,135
	e-Commerce	Shopping, Smart Factories	27,24
	Gaming	Indoor pervasive games	136
	Telecommunication	Mobile applications	27
Laboratories	Laboratory development	Design methods	34,137–139
	Laboratory experiments	Aware Home	140
		comHome	137
		MavHome	61,86
		Orange at Home	13
		LIVEFutura	141
		PlaceLab	142,143
		The Gator Tech Smart House	94
		Vallgossen	144
		iHome	91
		House-n-Consortium	145
		Ubiquitous Home	62
		Easy ADL Home	139
		Chicago Greenhouse	146

laboratories and the way these laboratories are developed.

It is striking that, despite the large number of publications on architecture, almost nothing could be found with regard to business or enterprise architecture. The same applies to business operations, including business process modelling, management and optimization.

Organization domain

Generally speaking, the design, development and provision of a service or product require the involvement of organizations from various sectors, each with their specific resources and capabilities. The providers involved work together, not only to complement each other, but also to create value for their customers in a way that would otherwise not be possible. The organization domain focuses on topics that are relevant to emergence and governance of such value networks. As presented in Table 3, within the scope of this domain, two main clusters are identified: partnership and governance. Partnership focuses on the creation of collaborative networks, and governance focuses on managing the project or maintaining and sustaining the networked providers. Existing literature appear not to include any discussion on business modelling,

Table 3. The organization dimension.

Clusters	Topics	Instantiations	References
Partnership	Coordination	Tight versus loose	30
		Multidisciplinary projects	147
		Collective action	148
		(Common) service platform	90,149
	Joint R&D	Companies joint R&D activities	55
		Academia–industry relationship	150
Governance	Social implications	Ethical and legal issues	2,126
		Privacy and security	22,41,151
	Ecosystem management	Responsibility and dependency created by services	125
		Technological and organizational alignment	152
		Role division	20
		Key players	129

Table 4. The finance dimension.

Clusters	Topics	Instantiations	References
Market analysis	User lifestyle	The structure of families and their daily routines	41,57,63,153
	User demographic characteristics	Working-class neighbourhood, etc.	20
		Ageing population	29
	User type of housing	Rental home, new or old housing, elderly home, etc.	21
	User spending power	Dual or single income, number of inhabitants, etc.	43,51
		Service/product affordability (e.g. legacy systems, modular services, the initial costs)	6,20,46
Financial analysis	Investment impact	Short- and long-term effects	48
		Efficiency (cost reduction)	17,69,98, 154
		Green investment	110,132,155
	Financial feasibility	Risk management	20
		Cost/benefit analysis	46,48,156
		Cost saving	29,54,155,157

the exchange of resources and capabilities and processes in networked settings, and the alignment in-between.

Finance domain

The financial arrangements between all actors of the ecosystem (e.g. providers, suppliers, manufacturing, customers) are the foci of interest in the finance domain. Topics such as revenue, cost, investments, financial risks and pricing are some of the typical elements of the finance domain. Within this domain, two core clusters are identified: market analysis and financial analysis (Table 4). The first cluster focuses on the market demand and financial dynamics. Although this domain shows a strong similarity with the service domain, particularly service specification cluster, the core interest of market analysis is the financial analysis of business market, including customers and competitors. The second cluster is the provider's internal financial arrangement with regard to the intended services or products and the impact of its investments combined with the analysis of risks and threats. Although the first cluster focuses on the external factors and the second on the internal structure of company (or network), both clusters are strongly interrelated.

Discussion

At a first glance, the disproportionate distribution of the four clusters attracts attention. The technology domain is by far the most prevalent domain characterized by a high level of detail, as indicated by the multi-layered clusters and multiple publications on the same or similar topics. By contrast, non-technological topics have attracted far less attention from Smart Living researchers. Most of the topics in non-technological domains are covered as side issues, mainly in a few publications. This means that, in line with the repeated reminder of several researchers, the Smart Living domain is still primarily dominated by *technology push*.[6,21,157] However, there is one exception. From service engineering perspective, the literature on user-centric design occasionally performs social and psychological analysis on users' behaviour. However, even this stream of literature is often closely related to, if not dominated by, technical requirements analysis and technology development.[40,51,145] A chart is generated based on the collected publications (Figure 2). The chart shows an exponential growth of studies and publications on technology-related topics, in the last decade. However, attention to the organizational and financial domains is relatively scant. The expectation is that the actual recent growth is even greater, as journal articles need time to be reviewed and accepted, and conference papers need to be cited.

Various explanations can be offered for the lack of attention to more socio-technical and socio-organizational issues. First of all, the Smart Living domain is still the domain of technicians, and therefore, the technical-related challenges have a higher priority. Next, it is easier to acquire funding to conduct technical research and experiments. The EU-FP7 program, for instance, funds a number of projects regarding Smart Living and e-Health with a strong focus on technology, mainly to be accepted by mono-disciplinary technical publications. In addition (or consequently), there are more technical-oriented conferences and conference tracks, which again further stimulates a focus on technical issues, experiments and publications about technology. This is a typical example of positive network externalities. Finally, Smart Living projects and experiments are predominantly conducted within a R&D environment. The fact that Smart Living is still in its exploratory phase[158] can explain the relative absence of socio-technical, socio-organizational and economic studies. On the other hand, the fact that Smart living concepts are not commercially exploited makes it clear that there must be plenty of strategic, organizational and financial issues that require further attention.

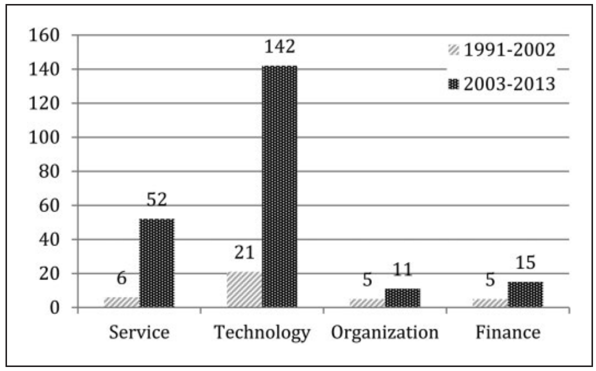

Figure 2. The collected articles divided into four STOF domains (n=154).

The analysis reveals various areas for further research. From an organizational perspective, several promising topics that have thus far been overlooked can be recommended, one of which is the initiation of strategic collaboration in a networked-enterprise setting, for instance to how collective action theories may be useful in networked-enterprise collaborations in the Smart Living domain. How to motivate actors to initially invest time and effort while the benefits can only be reaped in the long run. How do issues like a lack of trust between core actors who have to collaborate to provide Smart Living hinder the realization of Smart Living projects. From a strategic ecosystem perspective, research questions with regard to the role of dominators or key players are relevant. From a business management perspective, it is essential to investigate how viable and feasible business models can be formulated and how these collaborations can be facilitated in such a way that it can be sustained at an operational level as well. Here, the alignment between high-level (collective) business model and the operational business processes of service providers becomes a vital issue. Some relevant questions in this regard are how values and information resources are exchanged between the providers and how the underlying business processes are interrelated. From a service marketing and design perspective, an evaluation of the actual market demand is a fruitful area for investigation. Most studies so far have a design-driven character that is highly focused on user requirements, rather than being interested in the service demand or willingness to pay and other financial issues. Some crucial questions in this regard are how big are the Smart Living target groups, who are actually interested in different Smart Living concepts, and what characteristics can be attributed to these groups? Clearly, there are many areas that require further attention.

Conclusion

Despite the enormous technological advancements in recent years,[157] the vision that Mark Weiser introduced two decades ago, of a world where tons of interconnected intelligent devices and networks serve human in an unobtrusive way,[159] has yet to become a reality. It is rather clear that an anthropomorphic human–machine interaction,[147] where computers are an extension of human beings, remains firmly in the future and has yet to materialize.[30,44,76]

The aim of this paper is to argue that, to live up to expectations and realize a large-scale commercialization, the Smart Living (or Smart Home) domain has to reach a higher level of maturity, which can only be done by identifying, analysing and leveraging a wide range of aspects, from both technological and non-technological domains. This paper performs an exploratory analysis of the Smart Living literature. The paper provides a coherently and comprehensively structured body of knowledge, by collecting, structuring and representing of large number of Smart Living publications. The qualitative analysis indicates that technology-driven publications outnumber those in the non-technology domains. In addition, the paper discusses several relevant, if not decisive, non-technological topics such as social, organization, economic and entrepreneurial, as well as alternative explanations on why the existing literature in the Smart Living domain is predominantly dedicated to the technological topics.

The authors of this paper are fully aware of the limitations, one of which is the fact that the publications that were examined do not include all the existing publications related to the Smart Living. Hence, in all probability, not all the concepts and items are discussed in detail. Furthermore, although the authors attempted to adopt the structure with which concepts are presented in the publications, in some cases the tree of topics and their branches were ordered based on the authors collective interpretation. It means that some clusters and their underlying items could be renamed, replaced or divided into more sub-items. Also the hierarchical structure of branch and sub-branches can be rearranged. Nevertheless, we argue that including more publications; labelling concepts differently or replacing, merging or re-organizing the proposed structure will not lead to a different conclusion. To move from the embryonic stage of exploration to exploitation, the Smart Living researchers and practitioners need to recognize that merely smart technologies are not enough, our attention for social, technological, organizational, entrepreneurial and economical aspects needs to be well proportioned.

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