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This is the published version of a paper published in *Journal of Cleaner Production*.

Citation for the original published paper (version of record):

Jagtap, S. (2019)

Key guidelines for designing integrated solutions to support development of marginalised societies

Journal of Cleaner Production, 219: 148-165

<https://doi.org/10.1016/j.jclepro.2019.01.340>

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:bth-17698>

Author's Post-print

Jagtap, S. (2019). Key Guidelines for Designing Integrated Solutions to Support Development of Marginalised Societies. *Journal of Cleaner Production*, 219C, 148-165.

Key Guidelines for Designing Integrated Solutions to Support Development of Marginalised Societies

Abstract

Marginalised societies face a wide range of deprivations and constraints at individual, institutional, economic, and technological levels. To satisfy unmet or underserved needs of poor people living in these societies, it is essential to address all the relevant constraints in the target context through the design of integrated solutions. Many studies have explored the design of integrated solutions for these societies using approaches and concepts such as holistic design for low-resource settings, Base of the Pyramid, product service systems, subsistence marketplaces, etc. We perform a systematic review of a broad range of literature on integrated design solutions for marginalised societies, gleaned ten guidelines to support design practice in this field. The derived guidelines cover different phases of the design process and life cycle stages of the solution. Each guideline is supported by findings of several studies. We have also included a detailed, illustrative example for each guideline. Additionally, the review allowed us to offer recommendations for how to use each of the ten guidelines. Finally, we discuss the guidelines relating them to constraints in marginalised societies and unfamiliarity of practitioners about these societies.

Keywords: Marginalised societies, design guidelines, integrated solutions, product service systems, design process, life cycle phases

1 Introduction

Poverty, a multidimensional issue, has variously been defined in terms of poor-health, high mortality rates, lack of freedom, or as a monetary issue with low and irregular income (e.g., Anderson and Markides, 2007; Rivera-Santos and Rufín, 2010; Johnson, 2007). The marginalised people living in poverty face a multitude of problems, including, among others, lack of income generation opportunities, weak access to financial services, social isolation, psychological stress due to illiteracy, fatigue from physical drudgery, and weak or non-existent access to basic facilities such as education, healthcare, infrastructure, energy, clean drinking water, and sanitation (e.g., Jagtap et al., 2014; Nakata and Weidner, 2012; Aranda-Jan et al., 2016; Prahalad, 2004).

Design, with its central idea of changing an existing situation into a desired situation (Simon, 1996), is essential to alleviate problems faced by marginalised societies. Appropriately designed solutions, tailored to the needs of marginalised individuals and the wider context in which they live, have potential to effectively satisfy their needs, making significant contributions towards their betterment (e.g., UNDP, 2008; Jagtap and Larsson, 2013; Prahalad, 2004; Devisscher and Mont, 2008). Such design solutions include, for example, solutions providing access to water and sanitation facilities, systems offering access to energy, solutions providing access to healthcare, or any other solutions that support social and human

development of these marginalised societies (e.g., Aranda-Jan et al. 2014; Hussain et al., 2012; London and Esper, 2014; Jagtap and Kandachar; 2010; Velamuri et al., 2015; Ambole et al., 2016).

Designing solutions, aimed at satisfying needs of marginalised people, demands addressing a wide range of constraints and deprivations such as weak physical infrastructure, lack of formal institutions and stable regulation, severe shortage of resources, illiteracy and innumeracy of marginalised people, and their low and irregular income (UNDP, 2008; Jagtap et al., 2013; Prahalad, 2012; Jagtap, 2018). Therefore, in addition to satisfying core functions, these solutions must fulfil many other requirements, resulting from a multitude of deficiencies in these societies. As a result, solutions, aiming to improve life circumstances of marginalised societies, manifest in the form of integrated, holistic solutions. For instance, such solutions may include appropriate ways to tackle the issue of limited distribution channels or they may require designing contextualised systems to repair, maintain, and recycle the implemented products and technologies (e.g., Jagtap and Larsson, 2013; UNDP; 2008). Many authors have emphasised the necessity of integrated solutions for marginalised societies (e.g., Devisscher and Mont, 2008; López et al., 2017; Ramesh et al., 2016; Aranda-Jan et al., 2016). The term ‘integrated solutions’ is often used in other areas of research such as those related to high-cost capital goods or those associated with solutions in business-to-business transactions (e.g., Davies, 2004). Therefore, to avoid potential confusion with the use of the term ‘integrated solutions’ in other areas, we use the term ‘solutions’ in this paper. Henceforth, the term ‘solutions’ is used to refer to solutions that address all the relevant constraints and deprivations emerging from the broader context of marginalised societies, to satisfy some unmet or underserved needs of marginalised individuals, supporting their social and human development.

There is a broad range of literature related to the design of solutions in the context of marginalised societies. This subject is discussed using approaches and concepts such as holistic design for low-resource settings, Base of the Pyramid, product service systems for marginalised societies, and bottom-up design for subsistence marketplaces, etc. (e.g., Prahalad, 2004; Aranda-Jan et al., 2016; Sousa-Zomer and Miguel, 2016a; López et al., 2017; Prahalad and Hart, 1999; Viswanathan and Sridharan, 2012). Although many studies have been undertaken to examine the design of solutions for marginalised societies, they are not reviewed to derive guidelines in order to support design practice in this field. There is absence of reviews on the subject of design guidelines in this field. Consequently, many of the findings presented in the literature have remained fragmented despite their value in guiding design practice aimed at supporting the development of marginalised societies. This can lead to failure in appreciating the significance of many studies in this field. In this research, we perform a systematic review of a wide variety of literature on the design of solutions for marginalised societies with the aim of articulating guidelines to support design practice in this field. The design guidelines are gleaned from the repeating themes and conclusions of the reviewed studies. Based on the review, we provide an illustrative example for each design guideline. In addition, the review offers recommendations for how to use each guideline. In addition to supporting the practice and education of design in this field, the guidelines also enhance the understanding of how solutions are designed for marginalised societies, contributing towards research in this field.

Following this introduction, the rest of this paper is structured as follows. Section 2 provides an overview of research on the design of solutions for marginalised societies. Section 3 provides details of the review methodology. Section 4 lists the ten design guidelines, and presents details of each guideline, together with supporting literature, an illustrative example, and recommendations for how to use each guideline. Finally, Section 5 presents concluding thoughts, collectively discussing the guidelines and their implications for practice, education and research of designing solutions for marginalised societies. This section also presents limitations of this study, offering recommendations for further research. The paper will be useful for experts as well as for novices and students interested in this field.

2 Design solutions and marginalised societies

In the context of developed countries, the design of holistic solutions is variously discussed using terms such as functional sales (Sundin and Bras, 2005), integrated solutions (Davies, 2004), hybrid value bundles (Annarelli et al., 2016), functional economy, integrated products and services (Jagtap and Johnson, 2011), and product service systems (Mont, 2002; Beuren et al., 2013; Manzini and Vezzoli, 2003). The design of such holistic solutions predominantly focuses on satisfying final users' needs rather than on specific elements or aspects of the solution, while aiming at radically alleviating negative impacts through the design of 'need-satisfying system' (Annarelli et al., 2016). The drivers and benefits of designing such solutions in the context of developed countries include, among others, efficient use of assets and resources, creating unique selling propositions, building and nurturing relationships with customers, and alleviating environmental impact (e.g., Hannon et al., 2015; Mont, 2004). In the context of marginalised societies, the characteristics of designing solutions differ from those in developed countries (e.g., López et al., 2017; Jagtap and Larsson, 2013). The design of solutions for marginalised societies is largely driven by the necessity to respond to a large number of constraints and deprivations, with the aim of satisfying unmet or under-served needs of marginalised people (e.g., Jagtap and Larsson, 2013; Devisscher and Mont, 2008; Prahalad, 2004).

Just as the subject of designing holistic solutions in the context of developed countries is discussed using many names, it is discussed using several approaches and concepts in the context of marginalised communities. One such concept in the context of marginalised societies is known as Base of the Pyramid (BOP) concept (e.g., Dembek et al., 2018; London, 2010). The BOP concept was articulated by C. K. Prahalad and his colleagues (e.g., Prahalad and Hart, 1999). Whilst Prahalad's original BOP concept advocated that MNCs can design appropriate solutions for marginalised societies in developing countries on a mutually positive basis, the concept has grown significantly, with the inclusion of solutions developed by non-profit organisations, social enterprises, social entrepreneurs, etc. (Jagtap et al., 2018; Kolk et al., 2014; Panum et al., 2018). In parallel to the BOP approach, an alternative but complementary concept, namely, 'subsistence marketplaces' concept evolved (e.g., Viswanathan, 2016; Viswanathan and Rosa, 2007; Viswanathan et al., 2011). Under this 'subsistence marketplaces' concept, Viswanathan (2016) has developed a bottom-up design approach, which starts from the life-circumstances and needs of marginalised individuals.

The research on the design of solutions for marginalised societies is also discussed using names such as Product Service Systems (PSS) and holistic design for low-resource settings (e.g.,

Devisscher and Mont, 2008; Aranda-Jan et al., 2016; Sousa-Zomer and Miguel, 2016b; Schafer et al., 2011). In addition, related research in this field is carried out using terms such as social entrepreneurship and social innovation (e.g., Nielsen and Samia, 2008; Goyal and Sergi, 2015). Although there is a wide variety of literature examining the design of solutions in the context of marginalised societies, it has not been reviewed to derive design guidelines. In the present paper, we perform systematic review of a broad range of literature in this field, gleaning ten guidelines to support design practice in this field. These guidelines are not rigid prescriptions or automatic procedures, but they should be considered as they guide the design practice to an intended impact on the lives of marginalised people, through the design of solutions. Each guideline is supported by providing references to the findings of several studies. In addition, the review allowed us to include a detailed, illustrative example for each of the ten guidelines, while offering recommendations for how to use every guideline.

Numerous terms such as poverty, BOP, subsistence, etc. are used to define and explain multidimensional problems faced by marginalised people. These terms typically refer to significant challenges faced by marginalised people. Henceforth, we use the term ‘marginalised’ to refer to people or societies (e.g., ‘marginalised people’, ‘marginalised societies’, etc.) facing wide range of deprivations and constraints at individual, institutional, economic, and technological levels and problems in satisfying basic needs such as food, shelter, and clothing. These marginalised societies lack access to basic facilities such as education, public health, sanitation, security, infrastructure, etc.

3 Methodology

To address the aims of the present research, we applied systematic literature review approach (e.g., Tranfield et al., 2003). This approach helps to systematically select research articles, avoiding an ad hoc collection of randomly gathered articles (e.g., White and Schmidt, 2005; Seuring and Müller, 2008). The systematic literature review involves a number of steps such as formulating the review aims, searching for literature, selecting and de-selecting research articles, and analysing the literature (e.g., Tranfield et al., 2003). Following such steps, we selected the articles for review through a multistage, systematic procedure after formulating the need and aims of the review regarding guidelines for designing solutions for marginalised societies, as described in the introduction section. The steps in the systematic review as employed in this research are described more fully in the paragraphs that follow.

Of the major well-known bibliometric databases such as Scopus, Web of Science, and Google Scholar, Scopus is the largest database of peer-reviewed literature (e.g., Prasara-A and Gheewala, 2017). Scopus includes a wide range of publications such as journal articles, book chapters, and conference papers. Furthermore, there is a large overlap between the search results of the Scopus and Web of Science databases (e.g., Gavel and Iselid, 2008). For these reasons, we decided to employ Scopus for searching the literature. Recent studies employing systematic literature review have used Scopus as the only database for searching the literature (e.g., Roy and Singh, 2017).

We used several terms to search for the literature in Scopus. Search field included either the article title, abstract, or keywords of the references. We did not impose any date limitations when we searched for the literature. Whilst we decided to primarily include journal articles to

address the issue of article quality, we also considered a secondary criterion to include documents such as conference papers and book chapters based on their relevance for addressing the review objectives. The subject of designing solutions for marginalised communities has been published in several document types in Scopus, potentially containing important insights relevant for design practice in this field and for addressing our review aims. In a similar vein, as the research in this field has been undertaken by scholars from multiple disciplines, we did not impose any limitations on the subject areas in Scopus.

Initially, searching the literature using the terms – design AND poverty – resulted into 8646 references. We then attempted to narrow down the search results by using combinations of a range of search terms. The full list of search terms used in this research is included in Appendix 1. The search terms mainly consisted of combining two types of terms. The first type of terms is related to the aspects of design or design solution, and included terms such as “integrated design”, “holistic design”, etc. The second type of terms mainly considers aspects related to the context of marginalised communities, and include terms such as “poverty”, “resource limited”, “poor people”, etc. Each of the terms in the first type was combined with each term from the second type using the Boolean operator AND in Scopus. In the case of the search term “design”, we only considered search results with one context related term as results with other context related terms were large as exemplified above. In total, 41 searches were undertaken using such combinations of terms. In addition, we included three searches using the terms – “Base of the pyramid”, “Bottom of the pyramid”, and “Subsistence marketplace”. Thus, the final number of searches was 44.

In total, 1071 articles were retrieved from the search results (see Figure 1). Of these, 79 were duplicates and were eliminated, resulting into 992 unique articles. In the next stage of the procedure, we reviewed the titles and abstracts of these unique articles and eliminated articles that were not relevant for the present study. This is in line with previous studies using systematic literature reviews (e.g., Prasara-A and Gheewala, 2017). We eliminated 915 articles which were not relevant for addressing the review aims, and selected 77 articles for the review after ensuring their suitability for addressing the research aims. Table 1 presents the article selection and de-selection criteria, together with other review parameters. In the review process, we identified additional 12 references that were either cited in the reviewed articles or were found by searching for the details of some information in the reviewed articles, and were deemed suitable for inclusion in the review. Therefore, the final number of articles reviewed in the present study was 89 (i.e. 77 + 12). Appendix 2 presents the list of these 89 articles.

The content analysis of the 89 articles using inductive evaluation followed a conventional approach by thoroughly reading the articles and highlighting text that captured key ideas and concepts relevant for addressing our research aims. This is a common approach followed by review papers to glean themes based on detailed reading and analysis of articles (e.g., Armstrong et al., 2012). This approach of considering findings and discussions in the articles as data was useful in this research. In the present study, ten guidelines emerged from the repeating themes and conclusions in the articles. In the iterative analysis, we placed an emphasis on identifying these themes and conclusions for their relevance to the design of solutions in the context of marginalised societies. We considered underlying meaning of various terms and concepts used in the articles to investigate aspects of designing solutions in

marginalised settings, allowing us to assimilate them based on their design significance. The analysis stabilised on the ten guidelines that are presented in the paper. Supporting findings, illustrative examples and recommendations for using the guidelines were identified in the articles. The review outcomes are presented in the next section.

Figure 1 Steps in the selection of articles

Review parameter	Description
Search agent	Scopus
Article type	All document types in Scopus (e.g., articles, conference papers, book chapters, etc.)
Search fields	In article title, abstract, and keywords
Article selection criteria	An article should be relevant for addressing the aims of this review. Therefore, only those articles are considered, which reflect a focus on the design of solutions or aspects of it in the context of marginalised societies.
Article de-selection criteria	The articles not relevant for addressing the review aims were de-selected. For example, the articles related to nanostructures, nanocrystals, electron tomography, surface texturization, spectroscopy, medicine, etc. were all eliminated. Further, the articles with a tangential reference to the solutions in marginalised settings were eliminated.

Table 1 Parameters of the review

4 Guidelines for designing solutions for marginalised societies

While in Section 3, we have included details of how the ten guidelines emerged from the analysis of the articles, in this section, we present details of these guidelines aimed at supporting design practice in the context of marginalised societies. The following guidelines are in their shortened form, and are elaborated further in this section.

1. Developing holistic understanding of the context
2. Co-design with marginalised people
3. Adapting solutions to the local context
4. Building on local strengths
5. Designing appropriate training plans
6. Embodying income generation opportunities in the solution
7. Designing contextualised awareness programmes
8. Identifying and implementing life cycle requirements
9. Cross-sector collaborative design
10. Avoiding biases and adapting project management

The ten guidelines cover various stages of the process of designing, developing, and implementing solutions, such as: (1) project planning and task clarification, (2) conceptual and detail design, and (3) realisation and implementation of the solution. Some of the ten guidelines are mainly applicable to a single stage of the process, whereas others are applicable to multiple stages. While this section presents details of the guidelines, they are discussed in relation to the stages in the design and development process further in Section 5, establishing their order of applicability in various stages of the process.

The following subsections are dedicated to each of the above ten guidelines. In each subsection, we state and support the guideline, include an illustrative example, and provide recommendations for how to employ the guideline in designing solutions for marginalised communities.

4.1 Developing holistic understanding of the context

Developing holistic understanding of the wider context of marginalised societies and patterns of daily life of the marginalised individuals is an essential part of design in this field.

4.1.1 Support

The problems faced by marginalised communities are multidimensional in nature. While some scholars classify these problems into individual, institutional, technological, and infrastructural categories (e.g., Aranda Jan et al., 2016), others have organised them into economic, physical, psychosocial, and knowledge related categories (e.g., Nakata and Weidner, 2012). Taken together, these studies show that the marginalised individuals face a multitude of interconnected problems at various levels. Satisfying unmet or underserved needs of these people demands addressing many different value chain gaps in the target context (e.g., Jagtap et al., 2013; Devisscher and Mont, 2008; Briceno and Stagl, 2006). Previous research has established that solutions for marginalised societies must be based on the holistic understanding of the target context, taking into account broader socio-cultural, institutional and structural issues in these societies (e.g., Jagtap and Larsson, 2013; López et al., 2017; Aranda Jan et al., 2016; Halme et al., 2016; Letaifa and Reynoso, 2015). For example, Sousa-Zomer and Miguel

(2016a, 2017), based on their case studies in the design sectors – transportation and water – in Brazil, suggest that solutions aimed at supporting social and human development of marginalised societies need to be based on holistic, comprehensive understanding of the target context. Likewise, by drawing on examples of designs from several developing countries, covering many design sectors, Nakata and Weidner (2012) emphasise the importance of gaining deep understanding of different deprivations in the target context. This is also supported by Bengo and Arena's (2013) case studies in energy sector in developing countries, highlighting the critical role of broader understanding of the target context in designing solutions for achieving intended impact.

Other studies have suggested bottom-up learning from marginalised people in order to develop holistic understanding of the target context (e.g., Whitney, 2010; London and Hart, 2004; Viswanathan, 2017). These studies typically argue that grounding solutions in the patterns of daily life of the marginalised people is crucial for sustained adoption and use of the designed solutions (e.g., Whitney, 2010). Holistic immersion in the marginalised communities is critical for nuanced understanding of the target context, as there can be many differences across such contexts (Viswanathan, 2010). Holistic and nuanced understanding of the context helps outsiders to overcome their unfamiliarity about low resource settings, while supporting them to make personal connection with the marginalised people. Bottom-up learning from marginalised individuals, while taking into account the broader context in which they live, helps gaining insights into their living conditions, their social networks, their ways of making things, their ways of thinking and planning, and their ways of handling environmental issues (Sridharan and Viswanathan, 2008; Viswanathan, 2016).

4.1.2 Illustrative example

The impact of solutions designed for marginalised societies depends, to a large extent, on the degree to which they are based on the broader and nuanced understanding of the target context. Consider the following example of a project called 'Warana Wired Village Project', implemented in a rural district of the state Maharashtra in India. The project provided the Internet access to about 40000 famers in the rural district, with the aim of supporting them to access information on crops and markets prices, so that they can sell their produce competitively (Toyama et al., 2007). A team of researchers from Microsoft Research India, the University of Berkeley, and the London School of Economics used surveys, interviews, observations, and ethnography to assess the project impact. This impact assessment revealed that the Internet kiosks were not used as intended due to weak access to electricity, farmers' unfamiliarity with the technology, and poor maintenance of the kiosks, indicating the low extent of embedding the project in the holistic understanding of the target context. In response, a project called 'Warana Unwired' was launched, founding it on the in-depth understanding of the context. The project used mobile phones as a communication tool in the system. The farmers were familiar with mobile phones, and could use them at any location and any time. They perceived the new project as more useful than the previous project which used kiosk computers.

4.1.3 Recommendations

Given the critical role of developing holistic understanding of the marginalised societies, some studies have offered related recommendations and methods (Themaat et al., 2013). For

example, Aranda-Jan et al. (2016) developed a holistic design framework to collect information on marginalised settings in the initial phase of the design process. The framework includes four major categories and related sub-categories of factors at individual, institutional, economic and technological levels. In a similar fashion, London et al. (2010), based on their analysis of 64 case studies, developed a framework of constraints faced by marginalised people in operating their businesses. The framework includes two major categories of constraints: the first category is related to productivity constraints that hinder marginalised producers' value creation and the second category is related to transactional constraints that inhibit their potential to capture value, e.g., by selling their products in local or non-local markets. These two categories and associated subcategories in the framework support the development of holistic understanding of the problems and constraints faced by the marginalised producers. Likewise, the POEMS (people, objects, environments, messages, and services) framework, used by Whitney and Kelkar (2004), in designing solutions for people living in slums in Mumbai, is also a potentially useful alternative to develop holistic understanding of the target context.

Whilst the above studies have developed frameworks to collect broader level information on the target context, Viswanathan (2016) developed an approach called 'bottom-up approach' to design solutions for marginalised societies. Some of the initial steps in this bottom-up approach rigorously support gaining holistic understanding of the target context. The first step in this approach called 'virtual immersion' employs multiple methods and media (e.g., textual, audio-visual media, transcripts of interviews with marginalized people, etc.), offering participants simulated exposure to living conditions of marginalised people. Following this virtual immersion, participants engage in 'emersion' to reflect on the insights gleaned from 'virtual immersion'. In addition, participants engage in 'actual immersion' by undertaking field research in the target context. Besides the above methods, organisations and individuals can benefit from traditional methods such as interviews, field observations, shadowing, role playing, ethnography, etc. (e.g., Boradkar and Kulkarni, 2010; Halme et al., 2016).

4.2 Co-design with marginalised people

Co-designing with marginalised people offers many advantages, supporting a range of activities in the design process and enhancing the acceptance and continued adoption of the designed solution.

4.2.1 Support

There is a sharp contrast between marginalised and non-marginalised settings (Jagtap et al., 2013), resulting into greater unfamiliarity of outsiders about marginalised societies (Jagtap et al., 2014). Therefore, these outsiders, living in developed countries or relatively affluent areas of developing countries, need to engage in bottom-up learning from marginalised people (e.g., Viswanathan and Sridharan, 2012). Solutions that are externally designed, either in developed countries or in non-marginalised areas of developing countries, without involving marginalised people in design activities, fail to effectively address a variety of constraints in the target context. These remotely designed solutions are not adopted and used by the marginalised people on sustained and continued basis. Such externally conceived designs fail to create a positive and sustainable impact on the lives of marginalised people when the outsiders leave the community or begin to work on other projects (e.g., Nieusma, 2004; Thomas, 2006). Several solutions designed by using remote or top-down design approaches have been

unsuccessful to support the development of low-income individuals, since they are typically disconnected from the target communities (e.g., Viswanathan et al., 2009).

Engaging with marginalised people in every phase of the design process not only helps to learn about their problems and the wider context in which they live, but also supports many design activities such as understanding their needs, concept generation, concept selection, etc. (e.g., Murcott, 2007, Kaulio, 1998; Prahalad, 2013; Ramani et al., 2012; Jagtap, 2018). The social approach of co-designing solutions with marginalised people supports gaining deep insights into the target context, while allowing the involved partners to understand social and cultural aspects, not just technological aspects of the solution (Jagtap, 2018). Co-design with marginalised communities helps to alleviate socio-cultural and knowledge differences between marginalised people and outsiders. Whilst co-design is beneficial for outsiders in learning about the target context, it is also valuable for marginalised people. Co-design has the potential to build and enhance design capability of marginalised individuals, while empowering them for participatory activities. Furthermore, co-design supports the marginalised people in developing a feeling that they own the project. Co-design also improves the acceptance of designed solutions (Brubaker et al., 2017). Co-design, with its collaborative and non-paternalistic nature, ensures effective customisation of solutions to the local context.

Many other studies support co-design with marginalised communities, highlighting successful performance of solutions or associated benefits of co-design activities for both outsiders and marginalised people. These studies, for example, have investigated co-design in sectors such as energy (e.g., Bengo and Arena, 2013), healthcare (e.g., Hussain et al., 2012), and sanitation (e.g., Ambole et al., 2016).

4.2.2 Illustrative example

Cemex, a Mexican company, founded Patrimonio Hoy to address housing needs of low-income individuals (London, 2008). Initially, Patrimonio Hoy faced a number of challenges. It just listened to the low-income people, without involving them in the design process, with the aim of adapting its existing solutions to their needs. The solution, developed without using co-design activities, consisted of the adapted versions of its existing products (e.g., smaller bags of cement) and community saving groups. This solution, developed without using co-design activities, was unsuccessful. The company then changed its design approach; it encouraged participatory activities and actively engaged low-income individuals in the design process. This supported the company to gain deeper understanding of the deprivations faced by the marginalised people such as their limited constructions skills and their weak access to various resources. Such co-design activities encouraged the company to design solutions, away from selling cement to building homes. The resulting successful solution provided access to microloans and technical assistance for construction with do-it-yourself plan, without requiring any collateral or burdensome paperwork.

4.2.3 Recommendations

The literature has offered a number of recommendations for effective co-design with marginalised communities. Some recommendations centre on the unique characteristics of resource-limited settings and different deprivations faced by the marginalised people, suggesting designers and outsiders to recognise that the marginalised individuals are experts in

living in low-resource settings, with an in-depth understanding of the local context, networks, and available resources (Murcott, 2007). When co-designing with marginalised people, the outsiders must be aware that they will be co-designing and working in different conditions and environment than those typically found in affluent regions of developing countries or in developed countries (e.g., Jagtap and Larsson, 2018; Hussain et al., 2012). In co-designing with marginalised societies, it is crucial to recognise that they are not a homogeneous group of people; therefore, designers should not generalise their needs, preferences, problems, and capabilities across marginalised societies (e.g., Jagtap et al., 2013). Some studies suggest co-designing with marginalised individuals rather than with those working in academic or non-profit organisations because people working in such organisations typically lack direct experience of living in marginalised societies (e.g., Nieusma and Riley, 2010). It is also crucial to co-design with marginalised people throughout the design process, covering phases such as context understanding, concept generation, concept evaluation, etc. (e.g., Jagtap and Larsson, 2018; Nieusma and Riley, 2010). Pictures, drawings, communication using narrative methods are potentially effective methods to engage with marginalised communities (e.g., Jagtap and Larsson, 2018; Ambole et al., 2016). Bharti et al. (2014) have identified several factors driving co-creation of value with marginalised people. These factors can be considered for ensuring effective co-design with marginalised people.

4.3 Adapting solutions to the local context

Adapting solutions to the local specificities and living conditions of people in the target context is fundamental for their continued adoption and use by the marginalised people.

4.3.1 Support

Many different constraints and deprivations, typically present in the marginalised societies, are absent in non-marginalised contexts where availability of suppliers, marketing channels, distribution network, electricity, roads, and financial channels can be taken for granted (e.g., Wheeler et al., 2005; Anderson and Markides, 2007). A multitude of deprivations and specific socio-cultural characteristics of marginalised societies demand rigorous adaptation of the solutions to local specificities and living conditions of the marginalised people (e.g., Hammond and Prahalad, 2004; Ausrod et al., 2017; Gebauer et al., 2017; Jagtap et al., 2013; Pai and Hiremath, 2016). Adapting solutions to local conditions of a marginalised community is critical for lasting and sustainable impact of the designed solutions (Prahalad, 2012).

A recent large scale empirical study, carried out by Ernst et al. (2015), offers a compelling support for adapting solutions to local conditions and specificities of marginalised societies. They analysed 103 projects targeted at these societies in many countries, covering a broad range of design sectors. This large-scale, cross-region study found robust empirical support that adaptation to local conditions leads to superior performance of solutions designed for marginalised societies. This suggests that contextualising solutions to the target context by satisfying the needs of marginalised people and addressing the requirements emerging from the broader context in which they live is key. Another large-scale study called ‘Growing Inclusive Markets’, undertaken by the United Nations Development Programme (UNDP), covering many different sectors such as energy, healthcare, agriculture, water, transportation, and sanitation in several developing countries, also highlights the key role of adapting solutions

to the local context for their continued adoption and use by the marginalised people (UNDP, 2008).

Besides the above large-scale studies of Ernst et al. (2015) and UNDP (2008), many other studies have suggested that adaptability of solutions to the local context is a key determinant of positive impact of solutions on marginalised communities. For example, Sousa-Zomer and Miguel's (2016b) analysis of a Reverse Osmosis (RO) water system to deliver purified water to the people in southern region of Brazil suggests that adaptation of the entire solution to address different constraints and requirements in the target context is critical for successful performance of the solution. Another example is about the lighting solutions developed by D.light. By employing solar and LED technology, D.light developed solutions for rural households and off-grid schools (Emili et al., 2016). These solutions were tailored for each of these contexts (rural households and off-grid schools), by adapting products, distribution strategies, and financial channels to effectively address the requirements emerging from these different contexts, indicating the crucial role of solution adaptation to the target context.

There is a great deal of diversity across developing countries and across rural and urban areas (e.g., Ireland, 2008; Díaz-Pichardo et al., 2017; Dahana et al., 2018). For instance, there are differences in occupation and geographic spread of people living in rural and urban areas. Population density is higher in urban slums, as compared to rural areas where marginalised communities are geographically dispersed (Johnson, 2007). In addition, there are differences between social networks of marginalised people living in rural and urban areas (Sridhar, 2015). This diversity demands solutions contextualised to specific requirements of communities in rural and urban areas, as exemplified by Whitney and Kelkar's (2004) proposal of a design solution for slum dwellers in Mumbai to provide access to clean water. The design solution was entirely contextualised to the living conditions of slum dwellers and the broader context of slums in the city.

4.3.2 Illustrative example

Whitney's (2010) case study of a refrigeration system designed for the people in rural India highlights the importance of contextualising solutions to the specificities of the target context. He has analysed the design of 'Chotukool' – a solution for satisfying domestic refrigeration needs of low-income people in rural India. All parts of this solution were fully adapted to the target context and life circumstance of the people in rural areas. For example, products in the solution were designed to be lightweight and mobile, employing solid-state induction plate instead of a compressor. They were also designed to endure hot, dusty climate and sustain voltage fluctuations. The entire cooling system was housed in the lid which was designed to be replaceable in the event of any malfunction caused by fluctuations in the quality of electrical input power or by unintended use. The final design of the product allowed basic maintenance and repair services to be undertaken by unskilled rural entrepreneurs. This was possible as the product was adapted to the local context, taking into account socio-cultural characteristics and literacy level of the people. The business model adaptation included, for instance, distribution through an entrepreneurial network of local people. The contextualised solution not only satisfied the refrigeration needs of low-income consumers, but also created livelihood opportunities through its business model and delivery process.

4.3.3 Recommendations

Just as gaining holistic understanding of the marginalised societies is important, implementing this understanding to adapt solutions to the living conditions of marginalised individuals and to the broader context in which they live is equally important (e.g., Jagtap et al., 2013). Grounding solutions in the insights gleaned from the bottom-up learning from the marginalised communities and ensuring suitability of the developed solutions for the target context is recommended to enhance solution adaptability (Aranda-Jan et al., 2016). Another recommendation is to synergistically adapt different parts of a solution (e.g., products, services, necessary networks, supporting infrastructure, etc.) to contextualise the entire solution for the marginalised communities (e.g., Devisscher and Mont, 2008). Solution attributes such as visual comprehensibility, affordability, interpersonal marketing, flexible payment schemes, and atomized distribution can improve solution adaptability to the marginalised societies (e.g., Nakata and Weidner, 2012).

4.4 Building on local strengths

Solutions for marginalised communities have greater impact when they are designed by leveraging strengths of marginalised people and resources available in the target context.

4.4.1 Support

People living in marginalised societies possess skills in surviving in deprived and resource-limited conditions. They are typically dominated by informal economies, resulting from the weak access to traditional economic and political capital or from the uncertain and turbulent environments, such as food shortages (e.g., Reynoso et al., 2015; Nakata and Weidner, 2012). As a result of their unique circumstances, marginalised communities tend to exhibit many peculiar characteristics. For example, the culture of sharing products and resources is common across marginalised societies (e.g., Jagtap and Larsson, 2013; Clark et al., 2009). In contrast to developed countries, where autonomy and individual well-being dominate, collective needs and group goals prevail in marginalised communities (Nakata and Weidner, 2012). People in these communities tend to invest in building trusting relationships among themselves; for instance, when they negotiate in the marketplace, the relationship becomes more important than the transaction (e.g., Viswanathan, 2010). These societies, with their traditional views, are largely governed by the pre-existing, trust-based cultural norms, such as religion, kinship, or race, rather than by the formal and institutional agencies (e.g., Faure and Fang, 2008; Rivera-Santos and Rufin, 2010).

Identifying and leveraging social-cultural strengths of marginalised communities, rather than only focusing on overcoming their weaknesses, leads to superior performance of solutions designed for them (e.g., Nakata and Viswanathan, 2012; London and Hart, 2004). Building on social patterns and networks in these communities, while focusing on their welfare, relationships, and social fabric, is an essential component of designing solutions for their betterment (e.g., Jagtap et al., 2013; Letaifa and Reynoso, 2015). London and Hart (2004) carried out a study over a period of three years, analysing factors that contribute to the success of solutions designed for marginalised people. Their research, employing many data sources such as archival material, original and existing case studies, and interviews with key informants, performed in-depth analysis of 24 cases. The findings from this large-scale study reveal that leveraging the strengths of the target marginalised societies contributes to the

success of developed solutions. Another large-scale study, investigating a large number of solutions, also found that leveraging the strengths of marginalised communities is an important design strategy in this field (UNDP, 2008).

In addition to leveraging existing socio-cultural strengths of marginalised societies, many studies support building on existing infrastructure, products, and resources available in these societies. Building on local resources can potentially reduce material and product costs, while enhancing affordability of the designed solutions (e.g., López et al., 2017; Prahalad, 2004). Existing products in these societies can also be used to satisfy other functions and needs of the marginalised people; for example, ubiquitously available mobile phones can be used as vehicles to address informational and educational needs of marginalised individuals (e.g., Viswanathan, 2010). Ernst et al.'s (2015) empirical study, analysing a large number of projects, revealed that bricolage, i.e. creative use of scarcely available resources to generate novel solutions to solve problems and explore opportunities (Halme et al., 2012), positively affects the development of solutions for marginalised societies.

4.4.2 Illustrative example

Based on the data collected using multiple methods such as interviews and site visits, Devisscher and Mont (2008) analysed a solution designed to support low-income coffee producers in Yungas region of Bolivia. Prior to the implementation of this solution, the coffee producers processed coffee individually in a rudimentary manner, resulting into weak demand for their coffee in the international market. While there were weaknesses in their coffee processing, their sociocultural context embodied numerous strengths. In both urban and rural areas of Bolivia, people tend to organise themselves to establish businesses and manage communities to address their needs. The concept of collectivism is deeply embedded in the rural communities in Bolivia. The Director of Central of Coffee Cooperatives (CENCOOP) developed a solution to support coffee producers in the Yungas region by leveraging the socio-cultural strengths in the region. CENCOOP built a shared processing system consisting of small-scale pulping machines, fermentation tanks, and cleaning and drying facilities, all designed to process coffee from each member of the cooperative. Additionally, CENCOOP supported activities of coffee production, for example, by introducing better production practices, by renewing old coffee plants, and by starting a 'Fair Trade' programme. As a consequence of the solution, which is built on numerous strengths of the communities, CENCOOP exports almost 100% of the coffee it produces.

4.4.3 Recommendations

Leveraging strengths of marginalised communities requires identifying their strengths. Several studies suggest that social embeddedness supports gaining deeper understanding of socio-cultural and other strengths such as available infrastructure, materials, and existing products in the target communities, while helping to mobilise resources (e.g., Sousa-Zomer and Miguel, 2016a, 2016b; Ausrød, 2017). Local embeddedness in marginalised communities supports gleaned insights about existing social patterns, interactions between individuals, how they develop trust-based relationships, etc. (Letaifa and Reynoso, 2015; Rivera-Santos and Rufin, 2010). Some studies suggest creatively leveraging the identified strengths, e.g., using sharing culture, social control, and available products in designing solutions or in addressing other functions in the life cycle of the solution (e.g., Jagtap et al., 2013). Building on the strengths of

informality and local social networks in the marginalised communities, rather than trying to replace them with dominant logic and ways of working in non-marginalized settings, is crucial for continued adoption of designed solutions by marginalised people.

4.5 Designing appropriate training plans

Appropriately designed training programmes are imperative to overcome marginalised individuals' and other actors' deficiencies in their knowledge and skills required to perform a range of activities in the design process and life cycle stages of the solution.

4.5.1 Support

Designing, implementing, and maintaining solutions for marginalised communities demands a wide range of knowledge and skills, with inputs from many different actors (e.g., Letaifa and Reynoso, 2015; Sousa-Zomer and Miguel, 2016a; Jagtap et al., 2013). Whilst some of these actors, e.g., marginalised individuals and local NGOs, are socially embedded in the marginalised societies and are knowledgeable about the local context, other actors such as companies and professionally trained designers are not embedded in these societies, but can be knowledgeable in design, technology or preferences of consumers in non-local markets (e.g., Jagtap et al., 2013). Although these actors bring in their existing strengths, they typically lack all the requisite knowledge, skills, and competencies that are essential to design solutions and to perform many other activities in its life cycle. The gaps in skills and abilities of these actors demand training to build and enhance their knowledge and skills in some required areas (e.g., López et al., 2017; Esposito et al., 2012; Akula, 2008; Bengo and Arena, 2013). For example, marginalised people typically lack technological information and know-how, and can face difficulties in understanding the process of installing and maintaining the designed solutions (e.g., dos Santos et al., 2014). Training programs may need to overcome barriers associated with marginalised people's illiteracy, innumeracy, and lack of requisite knowledge, so that they can contribute towards necessary functions such as implementing, using, or maintaining the solution. Likewise, other actors such as NGOs and local governments can require appropriate training to build and enhance their skills and competencies in requisite areas.

Many studies stress the need of suitable training programs for marginalised people, and, if required, for other actors to fulfil a broad range of functions in the value chain (e.g. Rahman et al., 2016). For example, Jagtap et al.'s (2013) large-scale study analysing 50 design solutions aimed at the betterment of marginalised communities in many developing countries, identified that the vast majority of cases used training to address the issue of knowledge and skills of the involved stakeholders. Another large-scale study revealed that training and providing technical assistance to the marginalised producers is essential to alleviate their productivity and transactional constraints (e.g., London et al., 2010). In addition, the critical role of training has been identified in studies of coffee processing systems in Bolivia (Devisscher and Mont, 2008), solar home systems in Africa and Asia (Friebe et al., 2013), Do-It-Yourself (DIY) furniture for low-income people in Brazil (dos Santos et al., 2009), energy systems in countries such as Nicaragua, India, Nigeria, and Colombia (Bengo and Arena, 2013), rural electrification systems in Zambia (Lemaire, 2009), and a system to support handloom artisans in India (Ramachandran et al., 2012). Training programs tailored to the specificities and local conditions of the target context not only support addressing a wide range of requirements, but

also contribute towards building and enhancing knowledge and skills of marginalised individuals to create, strengthen, and maintain their capacities and abilities over time.

4.5.2 Illustrative example

Bengo and Arena (2013) analyse the solution designed by DESI Power, a for-profit company in India, to provide electricity in rural areas. DESI Power's energy generation relies on using renewable energy and agro-residues. The company designs its solutions combining various renewable energy alternatives and tailoring them to the needs of a target rural area. Micro-enterprises, seeking access to the company's energy solution, are provided with technical solutions based on renewable energy, biogas plant, and micro-generators. To address gaps in knowledge and skills in the value chain, DESI Power has designed a training scheme tailored to the needs and requirements of the recipients. This training scheme, called DESI Power Mantra, trains local communities to build and enhance their capacity to operate plants. The company trains a local cooperative to manage all the activities in the installation and maintenance of the plant. The company allocates about 10% of the cost of an installation for training and capacity building purpose. DESI Power's solutions are affordable for the people in rural areas, satisfying their energy needs.

4.5.3 Recommendations

Based on the analysis of solutions designed for marginalised communities, some studies recommend training a few local people in the initial phase, and then employing these trained local people to share their acquired knowledge and skills with others in the community (Devisscher and Mont, 2008). These local trainers bring in their native language skills and acceptable socio-cultural norms, enhancing effective delivery and acceptance of the training programmes (e.g., Whitney, 2010). The design of training programmes must consider living conditions of the trainees, including criteria such as their educational level, age, gender, etc. (e.g., Jagtap et al., 2013; Devisscher and Mon, 2008). Training programs aimed at marginalised people need to be concrete (e.g., concretising education and communication for their low literacy levels), local (e.g., using local language), and social (e.g., leveraging their socio-cultural strengths) (Viswanathan, 2010).

4.6 Embodying income generation opportunities in the solution

Increasing income of marginalised people is an effective way to alleviate their problems. Design solutions that create income generation opportunities are preferred by marginalised people, and have greater impact on their lives.

4.6.1 Support

Low and unpredictable income is one of the most tenacious deprivations faced by marginalised people (e.g., Chakravarti, 2006). Most of their income is spent on satisfying basic needs such as food and shelter. As compared to non-marginalised people, little of their income is truly disposable, as they suffer from persistent unemployment or underemployment (e.g., Nakata and Weidner, 2012). Since income is a crucial dimension of scarcity in resource-limited settings, it is used as a key measure to quantify problems faced by marginalised people. Karnani (2011) argues that an effective way to alleviate problems of marginalised people is to raise their income. This is also highlighted by the inclusion of the target – 'full and productive

employment and decent work for all’ – in the Sustainable Development Goals (SDGs) set by the United Nations (UN, 2015).

Income generating solutions are highly sought after by the marginalised people. For instance, López et al. (2017), in their study of renewable energy sector in rural areas of Bangladesh, investigated key parameters in designing solutions for marginalised people, including their preference for various solution attributes. The study revealed that the marginalised people give higher importance to the ‘income generation opportunities’ provided by a design solution. Their higher preference for livelihood opportunities or economic benefits afforded by a solution has also been identified in Thomas’s (2006) analysis of designs aimed to serve low-income people. His analysis of a design solution to alleviate physical burden of washerwomen revealed that the washerwomen gave higher preference to economic gains. Ness and Xing (2010), based on their analysis of many successful design solutions, also found that solutions helping marginalised people to directly increase their income or indirectly raise their economic benefits are valued. Income generating design solutions can also motivate marginalised individuals to invest in the solutions or enhance their willingness to pay. For example, Amanco’s design of irrigation systems, aimed at enhancing productivity of low-income farmers and consequently their income, motivated the farmers to participate in the implementation of the irrigation systems (e.g., Jagtap and Kandachar, 2010). In addition to the marginalised individuals’ higher preference for livelihood and employment opportunities created by a design solution, the partners providing economic contributions to design and implement such solutions also assign higher importance to the livelihood opportunities resulting from the solutions (e.g., Kebir, 2009).

4.6.2 Illustrative example

Chowdhury (2006) reports a design project called ‘Women as Solar Power Entrepreneurs’, undertaken by The Energy and Resources Institute (TERI), aimed at supporting rural people living in and around the Sundarbans of the West Bengal in India. The project trained local women to assemble a range of products such as DC mobile chargers, solar lanterns, LED lamps, and home-lighting systems. Furthermore, they were trained to install, maintain, and market the products, creating livelihood opportunities for these women. In addition to these livelihood opportunities, the use of solar lanterns supported the local people in enhancing their income by improving the quality of their farm yield. The use of solar lanterns helped them in the cultivation of betel leaves – a major source of income in the region. As the use of kerosene lamps during leaf plucking at night caused the betel leaves to smell like kerosene, replacing them with solar lanterns improved the quality of their produce. The solution designed by TERI created income generation opportunities in the region.

4.6.3 Recommendations

In designing solutions for marginalised societies, it is recommended to create livelihood opportunities by employing marginalised people to fulfil some functions in the life cycle of the solution, e.g., manufacturing, marketing, distribution, installation, and maintenance, while taking into account their literacy and skill levels (e.g., Letaifa and Reynoso; 2015; Bacchetti, 2017; Bengo and Arena, 2013). Another suggestion in the literature to raise their income is to focus on them as producers and to develop appropriate solutions to address their productivity and transactional constraints (e.g., Karnani, 2007; Webb et al., 2015; London et al., 2009). In

addition, some authors have suggested developing solutions that facilitate income generation activities of marginalised people. For instance, access to electricity or lighting solutions can support their entrepreneurial activities (e.g., Lemaire, 2009).

4.7 Designing contextualised awareness programmes

Contextualising the design of awareness programmes to the life circumstances and literacy level of marginalised individuals and the broader context in which they live enables successful dissemination and acceptance of designed solutions.

4.7.1 Support

Knowledge deprivations and high illiteracy rates are common among marginalised individuals (Nakata and Weidner, 2012; Vachani and Smith, 2008; Ahmed et al., 2010). They typically lack access to schooling, face problems due to short-changed education, and suffer from many other problems such as hunger and ill health, resulting into cognitive difficulties, for example, in retrieving information from memory and recalling available product options (e.g., Jagtap et al., 2013; Chakravarti, 2006). As a result of such deprivations, they face numerous problems in performing daily activities such as reading information on product labels and choosing a more appropriate option to satisfy a specific need (Viswanathan et al., 2005). Furthermore, they have weak or non-existent access to conventional awareness and promotion programmes, resulting into the lack of knowledge, for instance, about effective and affordable ways to enhance agricultural productivity, benefits of a specific healthcare practice, or advantages of using environment-friendly solutions (e.g., Prahalad, 2004; UNDP, 2008). Awareness about availability or potential benefits of a solution is critical in the process of acquiring and using the solution.

The process of designing and implementing solutions for marginalised people demands awareness programmes that are suitable for their life circumstances, knowledge deficiencies, and their ways of pictographic and concrete thinking resulting from their illiteracy, innumeracy, and other cognitive barriers (e.g., Viswanathan, 2010; UNDP, 2008; Payaud, 2014; Weidner et al., 2010; Jagtap et al., 2013). The profound need of developing awareness programs for marginalised communities has been supported in many studies. For example, Sousa-Zomer and Cauchick-Miguel's (2016a) examination of solutions in water and transportation sectors in Brazil, Bengo and Arena's (2013) analysis of energy systems in countries such as India and Nicaragua, and Ramachandran et al.'s (2012) analysis of a solution supporting handloom artisans in India support the need of designing awareness programs suitable for marginalised communities. In addition to these studies, Jagtap et al.'s (2013) analysis of a large number cases from many developing countries also reinforces the critical need of designing programs to make marginalised people aware of relevant information. Studies show that appropriate awareness programs enhance diffusion of solutions in marginalised societies, resulting into their sustained acceptance and usage (e.g., Jagtap and Kandachar, 2010). Suitable awareness programs also support marginalised people in contributing towards design activities or towards accomplishing some relevant functions in the life cycle of the implemented solution (e.g., Jagtap and Kandachar, 2010).

4.7.2 Illustrative example

A for-profit company called Amanco developed irrigation systems for underprivileged farmers from the La Testaruda community in Mexico (UNDP, 2008; Jagtap and Kandachar, 2010). To design, develop, and implement the irrigation systems, the company collaborated with a wide range of partners, including an NGO called ‘Sustainable Farmers Network’ (RASA). Amanco designed awareness programmes, taking into account requirements and conditions in the La Testaruda community. Several methods were designed under these programmes such as exhibitions, meetings, and word-of-mouth promotions. Exhibitions, designed to demonstrate and explain how irrigation systems work and what benefits they offer, were set on plots lent by a few farmers. A key idea used in designing various aspects of the promotion programmes was not to directly sell the irrigation systems to low-income farmers, rather it was to support them in identifying and understanding their daily problems, farming inefficiencies, and benefits afforded by the irrigation systems to overcome their problems. In these promotion programmes, RASA benefited from already existing farming cooperatives, and actively supported their development when such cooperatives did not exist. As a result of the irrigation systems, agricultural output increased, with three times increase in the farmers’ income. These efficient irrigation systems helped reduce water consumption, land erosion, and irrigation time, allowing farmers to devote more time to other farm duties.

4.7.3 Recommendations

Since concrete and pictographic thinking is common among marginalised individuals, some studies suggest designing awareness programs that consider such aspects of their thinking styles (e.g., Jagtap and Larsson, 2013). Other studies suggest that demonstrating potential benefits of a solution and how it works is a suitable method in developing awareness programs for marginalised societies. For example, Godrej and Boyce employed such demonstration-based methods in their programs to make people from rural India aware about the benefits offered by the refrigeration solution designed by the company (Whitney, 2010). They also found that social methods and conversations within the community, for example, a neighbour explaining product benefits to others, can usefully promote designed solutions. Awareness programs can benefit from using local language, existing social interactions, word of mouth strategies, road shows, collaboration with opinion leaders, and dialogue with the marginalised people (e.g., Viswanathan, 2010; Marinakis et al., 2016).

4.8 Identifying and implementing life cycle requirements

Identifying and implementing life cycle requirements in the design is essential for continued use of the solution by marginalised communities.

4.8.1 Support

A wide range of deficiencies in marginalised societies hinder many important activities in a solution’s life cycle such as maintenance, repair, refurbishment, recycling, etc. (UNDP, 2008; Kamp et al., 2015). When a product fails, it can become extremely difficult to bring it back to operational condition, due to absence of requisite management processes, limited infrastructure, lack of spares and consumables, and shortage of trained personnel to repair the product. Examples of deteriorated or failed healthcare devices, agricultural equipment, and household products are commonplace across marginalised societies (e.g., Aranda-Jan et al., 2016; Jagtap and Kandachar, 2010). Likewise, there are many examples of Distributed

Renewable Energy (DRE) systems remaining in failed or dysfunctional state, either due to lack of corrective maintenance required after their failure or due to absence of preventive maintenance required to avoid their breakdown and to prolong their life (e.g., Emili et al., 2016). In designing solutions for marginalised societies, designers must devote conscious and deliberate efforts towards identifying and addressing life cycle issues such as maintenance, repair, refurbishment, and recycling, taking into account a broad range of deficiencies in these societies (e.g., Ramani et al., 2012).

Some studies, based on their analysis of design solutions in sectors such as transportation, water, and energy, stress the profound need of implementing life-cycle requirements in designing solutions for marginalised communities. For example, in their analysis of a bike-sharing solution in Brazil, Sousa-Zomer and Cauchick-Miguel (2017) found that addressing a range of life cycle issues, with effective implementation of preventive and corrective maintenance management processes, is essential for sustainable, positive impact on the target context. In a similar fashion, Jagtap and Kandachar (2010), based on their analysis of a case study about irrigation systems designed for low-income farmers in Mexico, suggest that many different life cycle issues need to be considered in designing solutions for marginalised communities. Likewise, several other case studies carried out in energy sector highlight the need of addressing a range of life cycle issues to ensure sustained and continued adoption of the implemented solutions by marginalised communities (e.g., López et al., 2017; Bacchetti, 2017; Bengo and Arena, 2013).

Whilst the above studies argue for addressing a broad range of life cycle issues in designing solutions for marginalised communities (e.g., Jagtap and Kandachar, 2010; Aranda-Jan et al., 2016), other studies highlight additional benefits gained by implementing such life cycle requirements. For instance, Bacchetti (2017) and Jagtap et al. (2013) suggest that addressing requirements about maintenance, refurbishment, and recycling is not only useful for continued adoption of solutions by the marginalised people, but it also offers benefits such as risk reduction, economic and environmental gains resulting from extended product lifetime, and reduction in resources required to manufacture new products. Kamigaki et al.'s (2017) study of reuse, refurbishment, and remanufacturing activities in Asian countries (e.g., Indonesia) found that these life cycle activities reduce consumption of material resources, enhance affordability by reducing prices, and create employment opportunities for the local people.

4.8.2 Illustrative example

Sousa-Zomer and Cauchick-Miguel (2017) analyse a water purification solution in Brazil. In this solution, an equipment for water filtering is installed at some specific locations, and can be accessed by subscribing to the service by paying monthly fees. The company offering the solution has addressed a broad range of life cycle issues, and thus, has complete control over the life cycle of the solution. The equipment is designed to be reliable, durable, and repairable. The company offers many services, covering a diverse range of life cycle activities such as equipment installation, preventive and corrective maintenance, and end-of-life arrangements. The company has implemented a reverse logistics process in which it manages end-of-life issues by collecting the products and its components, with responsibility for recycling. The monthly subscription fees cover all these services, assuring availability of purified water. The scheduled maintenance of the system not only prolongs the equipment lifetime, but also

enhances customer loyalty and trust. The preventive maintenance activities help the company to establish regular contact with its customers and to understand consumption patterns by collecting data and information on the various parameters of the system.

4.8.3 Recommendations

Some studies have suggested to design robust, reliable, and durable products that can sustain hot, dusty, or other environmental conditions in marginalised societies (e.g., Aranda-Jan et al., 2016; Jagtap et al., 2013). These studies typically recommend designing easy-to-maintain products, while taking into account available maintenance facilities and skill level of the people in target marginalised communities. Testing the solution in actual resource-limited setting can usefully support assessment of maintainability and identification of potential problems in the life cycle of the solution. Other studies have suggested to address life cycle issues by employing suitable businesses models, for example, service provider retaining ownership of the solution, while remaining responsible for the entire life cycle of the solution, covering activities such as installation, maintenance, repair, refurbishment, remanufacturing, and take-back (e.g., Kamigaki et al., 2017; Lemaire, 2009; Ness and Xing, 2010). A further group of studies has suggested to consider life cycle issues early in the design process (Jagtap and Larsson, 2013; Aranda-Jan et al., 2016). These studies, for example, have developed taxonomies of requirements, including those related to life cycle issues, that ought to be considered in designing solutions for marginalised societies (e.g., Aranda-Jan et al., 2016).

4.9 Cross-sector collaborative design

Cross-sector partnerships between NGOs, local governments, and for-profit companies enable more effective and efficient performance of activities in the design process and life cycle stages of solutions aimed at supporting development of marginalised societies.

4.9.1 Support

Designing solutions for marginalised societies requires a wide range of inputs and resources from many partners, since it is highly unlikely for a single partner to provide all the inputs to address a multitude of value chain gaps in marginalised societies (Aranda-Jan et al., 2016; Seelos and Mair, 2007; Surie, 2017). A large-scale study, analysing many design solutions from several developing countries, found that the collaboration between a broad range of partners is essential to design solutions for marginalised societies (UNDP, 2008). The study revealed that the vast majority of solutions are collaboratively designed and implemented by a range of stakeholders, including, among others, non-traditional partners such as NGOs and governments. Partnerships between a range of actors are useful to pull together their knowledge, skills, and resources, with the aim of overcoming different barriers and constraints in marginalised societies (e.g. Hahn and Gold, 2014). Many other studies have highlighted the critical role of partnerships between for-profit companies, NGOs, and governments in designing solutions for marginalised communities (e.g., Rivera-Santos et al., 2012; Bacchetti, 2017; Vögel, 2014; Ramesh et al., 2016; London and Hart, 2004; Rosca et al., 2017).

NGOs are deeply and informally embedded in local communities (e.g., Rivera-Santos and Rufín, 2010; Reed & Reed, 2009; Chesbrough et al., 2006; Teegen, 2003). Therefore, they can contribute towards understanding local needs and aspirations of the marginalised people, and can usefully assist other actors in gaining deep insights and knowledge about the local context

(López et al., 2017; Anderson et al., 2010; Ansari et al., 2012; Webb et al., 2010). Furthermore, NGOs play a crucial bridging role at the beginning of a project, and can support for-profit businesses and other outsiders in establishing initial trust with the local communities (e.g., London et al., 2010; Arnould & Mohr, 2005). In addition, NGOs can provide access to local resources, and contribute towards marketing and distribution activities (e.g., London and Hart, 2004; López et al., 2017). London and Hart's (2004) study indicates that successful strategies to design solutions for marginalised societies rely heavily on non-traditional partners such as NGOs.

Governments have the responsibility to support social and human development of all individuals in the country, including marginalised communities. Therefore, besides NGOs, governments can provide important inputs in designing, implementing or undertaking other activities in the life cycle of the solutions aimed at satisfying needs of marginalised people (e.g., Goyal et al., 2016; Palomares-Aguirre et al., 2018). Governments can facilitate dissemination of knowledge about the designed solutions (Sousa-Zomer and Miguel, 2016a) or they may provide funds, subsidies, and advice (Wheeler et al., 2005 in Rivera-Santos and Rufín, 2010; Marconatto et al., 2016). In addition to NGOs and local governments, for-profit businesses can heavily contribute towards designing solutions. Businesses are efficient, with knowledge, skills, and resources in management, technology, and financial assets (Bengo and Arena, 2013). They have access to knowledge in design and technology, and can implement modern technologies and deliver services. They can link marginalised societies with non-local markets, for instance, to sell locally developed products in global markets (Wheeler et al., 2005).

4.9.2 Illustrative example

Afrique Initiatives, a company focusing on investing in SMEs in Africa, founded Pésinet, with the aim of developing solutions to monitor health conditions of children from marginalised families (since 2014, Pésinet works under the name Djantoli). To fulfil this aim, Pésinet implemented the solution in a marginalised region called Coura near Bamako, the capital and largest city of Mali (Jagtap and Larsson, 2013). The solution was collaboratively designed and implemented with inputs from the following partners: an NGO called Kafo Yeredeme Ton from Mali; two universities – ESSEC Business School and Ecole Centrale Paris; two large telecommunications companies, namely Alcatel-Lucent and Orange; Medex, a drug distributor; the people from the region Coura; and local hospitals. A key principle in the Pésinet's solution is to remotely inspect changes in a child's weight as an indicator of its health. A child's mother subscribes to Pésinet's services simply by paying affordable fees. Following this, a Pésinet representative weighs her child(ren) two times a week and registers symptoms such as fever and diarrhoea, and transmits the weight reading and these symptoms (if any) to a local database using SMS function of a mobile phone. Doctors at local healthcare centres have access to this database. After examining the changes in the weight of the child, the doctor sends an SMS to the community-based Pésinet representative requesting the visit of the mother and child to the healthcare centre, if any problems are identified. The families, subscribing to the solution, sought care more frequently – three times the local average (Djantoli, 2016).

The knowledge, skills and resources of Alcatel-Lucent and Orange were instrumental in designing the requisite technical systems. The design of business plan by the students of

ESSEC Business School and Ecole Centrale, plus the inclusion of local hospitals in the developed system, addressed constraints related to economic capacity of the marginalised families. The local embeddedness of the NGO 'Kafo Yeredeme Ton' allowed gaining an in-depth understanding of the local context, permitting appropriate design of the awareness programmes. A key factor contributing to the success of the solution was the collaborative work of a diverse range of actors such as for-profit businesses, NGOs, and local governments.

4.9.3 Recommendations

In developing partnerships, it is important to ensure that the collaborating partners have the right skills, strengths, and expertise for contributing towards designing solutions for marginalised societies (e.g., Jagtap et al., 2013; Devisscher and Mont, 2008). Identifying, devising, and deploying context-specific methods to involve and communicate with a diverse range of partners, while recognising and respecting socio-cultural differences between them, is an essential component of collaborative design in this field (e.g., UNDP, 2008). Inclusive interactions among stakeholders, building local legitimacy, developing long-term relationships, and establishing trust-based ties help to overcome cultural barriers and lack of knowledge, supporting coordinated processes and effective partnerships between NGOs, local governments, and for-profit businesses (Sousa-Zomer and Cauchick-Miguel, 2017; Sanchez and Ricart, 2010; Rivera-Santos and Rufín, 2010; Sharma et al., 1994). The involved stakeholders ought to recognise that developing and sustaining partnerships can require longer operating horizons when designing solutions for marginalised societies (e.g., Jagtap et al., 2013).

4.10 Avoiding biases and adapting project management

Avoiding biases and adapting project management to the local specificities of marginalised societies enables effective and efficient accomplishment of design and life cycle activities.

4.10.1 Support

The unfamiliarity of outsiders about the needs of marginalised people, together with their dominant logic and ways of working typically grounded in non-marginalised or relatively affluent societies, can lead to negative stereotypes. For example, a study comparing how designers develop solutions for the people in developed countries and marginalised societies in developing countries revealed a bias in their requirements handling behaviour (Jagtap et al., 2014). The designers involved in developing solutions for marginalised people did not give enough attention to the requirements regarding aesthetics and ergonomics as compared to those designing solutions for people in developed countries, despite the applicability and importance of these requirements in marginalised societies. The designers or those born and raised outside the context of marginalised societies may think that the marginalised individuals primarily have basic survival needs, with a tendency to overlook their other needs, e.g., needs associated with aesthetic qualities of solutions (Jagtap et al., 2015).

Besides basic survival needs, the marginalised people can have other needs (Jagtap et al., 2015; D'Andrea et al., 2006; Subrahmanyam and Gomez-Arias, 2008; Chopra and Narayana, 2012; Viswanathan, 2010). A study in Bolivia found that marginalised individuals consumed status products before fulfilling their basic physiological needs (Van Kempen, 2009). Similar findings are revealed in a design project undertaken by The Water Initiative (TWI), a venture

aiming at developing solutions to fulfil drinking water needs of marginalised people. TWI launched a project in a region near the city of Torreon in Mexico, to address the issue of arsenic contamination, a severe drinking water problem (Hart, 2010). TWI initially assumed that the people in the region need a water purification system that is as affordable as possible. However, by working with the community, TWI realised that the local people aspired for a water purification system that they could be proud of. They not only preferred clean drinking water, but also aspired for good-tasting and cold water (Hart, 2010). These above studies suggest that it is crucial to avoid assumptions or biases about the needs of marginalised people in designing solutions for them.

Designing solutions for marginalised societies necessitates a broad range of inputs from actors such as governments, private businesses, and NGOs (Jagtap et al., 2013). Therefore, biases can also result from how these actors view each other (e.g., Karnani, 2017). Karnani (2011) suggests that prejudices may lead these actors to view each other in a biased manner; for example, businesses may be considered as 'venal and exploitative', governments as 'corrupt and inefficient', and NGOs as 'naïve and ineffective'. To design solutions that can create lasting and positive impact on marginalised communities, these actors need to view each other more positively; for example, businesses are efficient, governments have the power, and NGOs are passionate and energetic (Karnani, 2011).

Whilst it is necessary to avoid biases in designing solutions for marginalised societies, the complexity and ambiguity that is inherent in design projects aimed at these societies demands adapting project management to the specificities of the local context, while developing requisite skills and competencies (e.g., Jagtap et al., 2014; George et al., 2011). The role of each actor involved in the project needs to be explicitly stated, and they need to understand differences in culture and communication between different actors including marginalised individuals. The actors need to learn skills to listen to marginalised people, and use suitable research methods to gain insights into their needs (e.g., Viswanathan, 2016; Dos Santos et al., 2009). They ought to take a longer-term view as it takes time to see the results of a solution.

4.10.2 Illustrative example

Viswanathan and Sridharan (2012) developed an approach called 'bottom-up approach' to design solutions for marginalised societies. The bottom-up approach supports stakeholders to avoid biases and adapt their ways of managing projects to the local conditions and specificities. The approach helps to analyse the needs and issues in marginalised societies from the viewpoints of marginalised individuals, supporting stakeholders not to view their needs through the lens of stereotypes. The bottom-up approach includes a number of steps such as 'virtual immersion' (e.g., simulated exposure to the marginalised societies using textual and audio-visual media), 'emersion' (e.g., reflection on what is learned in virtual immersion), 'preparation for field research', 'actual immersion' (e.g., multiple methods are used to gain actual experience and understanding of the target context), and 'reflections about immersion' (e.g., reflecting on understanding gained from actual immersion and correcting preconceptions). Many steps in this approach not only help designers to avoid prejudices and biases, but also support them to adapt their ways of managing projects to the local context. The bottom-up approach has been successfully applied to design solutions in many sectors such as

healthcare, education, energy, etc. – see Viswanathan and Sridharan (2012) for related examples.

4.10.3 Recommendations

Stakeholders involved in designing solutions for marginalised societies ought to engage in cultural education, with humility and respect. Planning for longer-term involvement, selecting project participants who are willing to contribute towards social change, explicitly stating responsibilities of everyone involved in the project, devoting time and efforts to develop an understanding of problems in the target context, and adapting communication styles to local circumstances are some of the recommended activities (e.g., Jagtap et al., 2014; George and Shams, 2007). It is important to recognise that building trust and relationships takes time, and this is particularly critical in the case of marginalised societies. In addition to the above recommendations, Viswanathan's (2016) bottom-up approach can usefully assist in correcting preconceptions, while supporting stakeholders to appropriately adapt project management to the local conditions.

5 Discussion and conclusions

One of the fundamental aspects of satisfying unmet or under-served needs of marginalised societies is the essential design of solutions aimed at supporting their social and human development. In this paper, we systematically reviewed the insights and experiences of many scholars and practitioners, covering a broad range of literature on the design of solutions for marginalised societies. This reveals recurring themes in the analysed work, which are summarised in the form of ten guidelines for effective design of solutions in this field. The ten guidelines are listed in Table 2, together with some references supporting each of them.

The solutions, aimed at creating intended impact on these communities, need to be contextualised to the target context by founding them on the holistic understanding of the context. To improve acceptance and adoption of the solutions, their design must leverage the resources available in the local context, and they need to be co-designed with marginalised individuals throughout the design process. In designing such solutions, different constraints and deprivations in the target context must be addressed, requiring the design of appropriate training programmes, contextualised awareness programmes, and income generation opportunities for the marginalized individuals, while rigorously maintaining life cycle perspective throughout the design process to ensure that activities such as maintenance, repair, etc. are appropriately implemented. Designing such solutions requires partnerships of a diverse range of actors such as businesses, locally embedded NGOs, and governments, with a profound need of avoiding biases and adapting project management to the local specificities.

Table 2. Guidelines, supporting references, constraints addressed, and strengths leveraged (the table is continued on the next page.)

	Guideline	Some supporting references	Constraints addressed, strengths leveraged
1	Developing holistic understanding of the context	Aranda Jan et al., 2016; London et al., 2010; Nakata and Weidner, 2012; Toyama et al., 2007; Whitney, 2010; Viswanathan, 2016	To overcome unfamiliarity and prejudices (if any) of outside actors about marginalised societies. To understand deprivations and strengths of marginalised societies.
2	Co-design with marginalised people	Bengo and Arena, 2013; Brubaker et al., 2017; Jagtap et al., 2014; Viswanathan and Sridharan, 2012	To leverage knowledge and perspectives of marginalised people. To benefit from their strengths. To address issues related to unfamiliarity of outside actors about marginalised societies.
3	Adapting solutions to the local context	Devisscher and Mont, 2008; Ernst et al. 2015; Jagtap et al., 2013; Nakata and Weidner, 2012; UNDP, 2008; Whitney, 2010	To address a broad range of constraints in marginalised societies. To consider socio-cultural characteristics and norms in these societies.
4	Building on local strengths	Devisscher and Mont, 2008; Jagtap and Larsson, 2013; London and Hart, 2004; Rivera-Santos and Rufin, 2010	To benefit from the strengths and resources in marginalised communities.
5	Designing appropriate training plans	Bengo and Arena, 2013; Friebe et al., 2013; Jagtap et al., 2013; Whitney, 2010; Ramachandran et al., 2012	To address constraints related to low literacy level of marginalised people or to enhance knowledge and skills of outside actors in some requisite areas.
6	Embodying income generation opportunities in the solution	Chowdhury, 2006; Karnani, 2011; Kebir, 2009; Letaifa and Reynoso, 2015; London et al., 2010; López et al., 2017	To address constraints and deprivations related to low-income of marginalised people.
7	Designing contextualised awareness programmes	Jagtap and Larsson, 2013; Nakata and Weidner, 2012; Sousa-Zomer and Cauchick-Miguel (2016a); UNDP, 2008; Viswanathan et al., 2005; Whitney, 2010	To address constraints related to low literacy level of marginalised people, their lack of awareness about existing or newly developed solutions.
8	Identifying and implementing life cycle requirements	Aranda-Jan et al., 2016; López et al., 2017; Sousa-Zomer and Cauchick-Miguel, 2017	To address constraints related to weak physical infrastructure, absence of facilities to undertake activities in the lifecycle of a solution, etc.
9	Cross-sector collaborative design	Ansari et al., 2012; London and Hart, 2004; López et al., 2017; Rosca et al., 2017; UNDP, 2008; Webb et al., 2010	To pull together knowledge, skills, and resources of different partners to overcome a broad range of constraints in marginalised societies.
10	Avoiding biases and adapting project management	Hart, 2010; Jagtap et al., 2015; Karnani, 2011; Viswanathan and Sridharan, 2012; Viswanathan, 2016	To overcome unfamiliarity and prejudices (if any) of outside actors about marginalised societies. To overcome complexity and ambiguity in design projects aimed at marginalised societies.

Whilst some derived guidelines centre on overcoming many different deprivations and constraints in marginalised societies, some emphasis building on the strengths of these societies. For example, addressing constraints and deprivations related to weak physical infrastructure, low literacy level of marginalised people, their low-income, and absence of facilities to undertake activities in the lifecycle of a solution necessitate: developing contextualised awareness and training programmes, creating income generation opportunities, and designing systems to fulfil functions such as distribution, maintenance, etc. On the other hand, guidelines about building on the local resources and co-designing with marginalised people focus on benefiting from the strengths of marginalised communities. For example, co-designing solutions with marginalised people leverages their knowledge and perspectives about the local context.

Just as some guidelines are about addressing constraints or benefiting from strengths in marginalised societies, some are about addressing weaknesses or leveraging strengths of outside actors, who are embedded in non-marginalised societies, but are involved in designing solutions for marginalised societies. For example, these outside actors support the design of solutions by making use of their knowledge and skills in design, technology or some other areas, or by using their networks in non-local markets. On the other hand, unfamiliarity and prejudices (if any) of these outside actors about life conditions of marginalised people are addressed by gaining holistic understanding of the target context, by co-designing solutions with marginalised people, and by avoiding biases about marginalised societies. Table 2 summarises the above discussion.

Whilst the above discussion relates the derived guidelines to the strengths and weaknesses of marginalised societies and those of the outside actors, they can also be discussed in relation to various stages in the design and development process, indicating relationships between the guidelines. There is a plethora of design and innovation process models (e.g., Cross, 1994; Pahl and Beitz, 1996; Roozenburg and Eekels, 1995). While these models differ in their diagrammatic representation and terminology employed to explain different stages in the process, they share several common characteristics, e.g., there is progression from abstract to concrete, there are decision and evaluation points, and there are iterations in the process (McMahon, 2012; Jagtap et al., 2014). In general, the process of designing, developing and implementing solutions consists of the stages: (1) project planning and task clarification (e.g., understanding of the context, identification of needs); (2) conceptual and detail design (e.g., concept generation and evaluation, detail design of the solution); and (3) realisation and implementation (e.g., testing, manufacturing, distribution, life cycle activities such as maintenance and repair).

The derived guidelines cover the entire spectrum of the above stages in the design and development process. For example, as solutions for marginalised societies must be based on holistic understanding of the context, the target context needs to be established and understood at the front end of the process. Therefore, the related guideline (i.e. developing holistic understanding of the context) is mainly applicable in the first stage of the process, i.e. in project planning and task clarification. As engaging with marginalised people helps to understand their problems and supports activities such as concept generation and evaluation, the related co-design guideline is useful in the first and second stages of the process. Implementing understanding gained in the first stage of the process to adapt solutions to the target context, while building on existing strengths of the marginalised societies is crucial. Therefore, the guidelines about adapting solutions to the target context and building on local strengths are mainly applicable in the second stage of the process. Requirements regarding training plans, awareness programmes, income generation opportunities, and life cycle issues such as repair and maintenance need to be considered in generating and evaluating concepts as well as in realisation and implementation of the final solution. The related guidelines are therefore applicable in the second and third stage of the process. The guidelines about cross-sector partnerships, avoiding biases, and adapting project management to the specificities of the local context are related to teamwork and inputs that are necessary for undertaking all the necessary activities in the design process and life cycles stages of the solution. Therefore, the related

guidelines are applicable in all stages of the process. The above discussion shows that some of the ten guidelines are predominantly applicable to a single stage of the process, while others are applicable to multiple stages. The relevance of the guidelines in various stages of the process can help establish their order of applicability in the process; for example, the guidelines about holistic understanding of the context, co-design with marginalised people, cross-sector partnerships, and adapting project management to the local specificities need to be considered in the initial stage of the process. Likewise, the above discussion suggests which guidelines need to be considered in other stages of the process.

The results of this work have important implications for design practice in this field. The results offer insights into strategies that practitioners can employ to respond to a multitude of deprivations and constraints in marginalised societies, as well as to build on the strengths of these societies. The results also offer crucial guidance on overcoming weaknesses and building on the strengths of outside actors embedded in non-marginalised contexts and involved in designing solutions for marginalised societies.

In addition to the potential implications for design practice, the derived guidelines might also be used to support education in this field. Guidelines are considered as important instruments for training novices and students, and they are valued for structuring and delivery of educational activities. The ten guidelines can provide a basis upon which relevant teaching and learning activities can be built. The guidelines, together with numerous examples and recommendations for employing them, might usefully support students and novices interested in designing solutions for marginalised societies. Since many universities have begun to offer courses and are providing opportunities for students to work on projects in this field, the guidelines can support their education by suggesting them to actively engage in activities ranging from gaining holistic understanding of the context, co-designing with marginalised people to maintaining life cycle perspective throughout the design process, while appreciating the critical role of working with locally embedded organisations such as NGOs.

As with any research project, there are some limitations to this research, thus limiting the validity and applicability of the findings. Whilst the ten guidelines are manifestations of repeated themes revealed in the analysis of a wide range of literature in this field, we do not claim that these guidelines are comprehensive. There might be other guidelines that can support design efforts in this field. With the growth of literature in this field, additional guidelines might be revealed. We hope that our present work will motivate and help scholars to undertake further research in this field and to identify other guidelines (if any). Although we employed comprehensive search approach using several search terms, some relevant articles may not have been included in the search results. In addition, some articles might have been overlooked that discuss the design of solutions in marginalised societies using different terms. Furthermore, this research included articles published only in English. The subject of designing solutions for marginalised communities is highly relevant in local contexts, specifically in developing countries, and relevant papers may exist in other languages. Analysis of these papers published in languages other than English might enhance our understanding of designing solutions in the context of marginalised societies.

Future research in this field can gain by overcoming the above limitations of this review; for example, by broadening the literature search using additional search agents and including papers published in non-English languages. Furthermore, research in this field might benefit from the development and evaluation of pedagogical methods, based on the derived guidelines to assess the effectiveness of the guidelines in supporting students to design solutions for marginalised societies. Whilst this research derived the design guidelines aimed at the betterment of marginalised societies, further research can derive guidelines to aid the design of solutions for non-marginalised societies in developing countries, establishing commonalities and differences between design practices aimed at marginalised and non-marginalised societies. This comparison may further enhance our understanding of designing solutions for marginalised societies.

Because problems faced by marginalised societies are multidimensional in nature, they are subjects of research in many domains including, among others, anthropology, development economics, and political science. Therefore, further research efforts in this field can gain by joint projects or multidisciplinary learning with researchers from multiple domains, leading to opportunities for cross-fertilization and developing nuanced understanding of designing solutions for marginalised societies. This can also help in broadening the literature search by using terms that are typically used in other domains to understand and alleviate problems faced by marginalised societies. It is hoped that this work will encourage scholars to undertake further research in this field to support the design of sustainable solutions for the betterment of marginalised societies which are remote in terms of both 'physical' and 'mental' distance for many academics, students and practitioners.

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