AN ABSTRACT OF THE DISSERTATION OF

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Public housing (PH) provides a substantial portion of the housing in both developed and less developed countries, and the demand for it is increasing. The PH projects, however, are facing many challenges that are affecting their performance and cause their failures. The United States has demolished large portions of their PH projects because of their inherited social, environmental, economic, and political problems that affect their performance. The federal government has stopped funding new development and turned to the private sector to provide PH, which has increased the PH crisis in the US, increasing the concern that PH in the US will lose its affordability. Other less developed countries are still struggling with their PH programs, such as Libya.

Lack of a comprehensive understanding of the complex interaction of different aspects that influence PH in general. The absence of a comprehensive framework to assess and ensure its sustainability have led to unsuccessful PH projects across the world. There is a need to enhance the performance of PH to increase its sustainability in order to improve the living environment of its residents. The overall goal of this research was to develop an applicable framework for PH to ensure its sustainability.

This research adapted a sustainability approach based on the Triple Bottom Line +1 (TBL+1) to develop a solution for PH throughout its lifecycle. Sustainability is a new concept in project management that arises from attention to the social aspects of a project and stakeholders' satisfaction throughout the project lifecycle. The application of sustainable management techniques based on TBL+1 criteria is becoming an imperative approach to achieve project success.

This research answers the following questions: (1) what sustainability indicators can be extracted from the evaluation of the literature concerning the PH programs based on TBL+1?; (2) what sustainability performance indicators can be defined from the residents' perspectives based on TBL+1?; (3) how can sustainable public housing (SPH) be achieved through an integrated framework, and what is the process of applying such a framework?

The research provides potential leading indicators for SPH based on the TBL+1 aspect by evaluating PH programs in the USA and Libya. Explores the main opportunities to look forward and challenges to face in order for PH to be more sustainable. It also defines the key performance sustainability indicators (KPSIs) related to TBL+1 from residents' perspectives based on the post-occupancy evaluation (POE) across various groups at three projects: two are in the USA (Camas Common, Corvallis, OR, and Oregon State University Family Housing, Corvallis, OR) and one in Tripoli, Libya (Hay Al-Andalus). Finally, an integrated conceptual framework for SPH was developed, and a project sustainable performance checklist criterion for project stages was introduced in order to evaluate and achieve a SPH.

The integrated framework covers six project stages; project scope, planning, design, construction, occupancy, and demolition includes measurable criteria for each project stage to ensure its sustainability while the project is evolving. The framework and project sustainable performance checklist criterion are a start toward developing an integrated management plan for SPH that housing authorities can incorporate in their local sustainability approach toward a more sustainable built environment.

An Integrated Conceptual Framework for Sustainable Public Housing

by

Asma Sharafeddin

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Asma Sharafeddin, Author

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CONTRIBUTION OF AUTHORS

Dr. Jason Anderson contributed to the statistical analysis of the survey. He explained, reviewed, and edited the modeling process and results.

TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

DEDICATION

This dissertation is dedicated to my parents and family.

For their endless love support and encouragement

1. Chapter 1: General Introduction

Public housing (PH) provides a substantial portion of housing in both developed and less developed countries, and the need for it is increasing. The PH dwelling as an architectural, structural, and social unit significantly affects its users' lives and their society. By providing a large portion of the community with a decent home at an affordable price, it is anticipated to promote the social, environmental and economic well-being of the society (DCLG 2007).

However, criticism of PH in most countries persists because of quantity and quality issues. Some countries, such as the United States, have demolished large portions of their PH projects because of problems such as distressed housing, lack of maintenance, and discrimination and segregation. The federal government has stopped funding new development, which increases the crisis of PH in the US. The federal government also has been empowering the private sector in providing PH, which has raised the concern that PH in the US will lose its affordability. Other less developed countries, such as Libya, are still struggling with their PH programs and have not yet attempted to developed solve the problems.

Many studies have found that applying standards and specifications that do not meet the users' needs and expectations in planning and designing PH has been leading to dissatisfied residents and "sick building syndrome" (e.g., Morris and Winter 1975; Kian et al. 2001; Kim etal 2005; Mitterer et al 2012; Ibem et al. 2013; Zabawa and Krzypkowska 2018). Residents tend to adjust to their living conditions, to make adaptations such as remodeling the residence to meet their aspirations, or to move to another unit (Gibson 2007; Mohit et al., 2010). Such forced adaptations have caused many social, environmental, economic and political problems. Obviously, there is a need to enhance the performance of PH; it is imperative that PH be sustainable in order to promote the living environment of its residents.

Creating sustainable public housing (SPH) – that is, housing that is environmentally, economically, and socially sustainable and governed by regulations that empower its sustainability (Rahman et al. 2005; UN 1983; UN 1992) – is the ultimate aim to enhance living conditions for people in need. The Triple Bottom Line (TBL) model is one of the models that have been introduced to provide some integration of requirements at the conceptual level between affordability and sustainability (Pullen at el. 2010a). Rahman et al. (2005) also applied the TBL in housing and he expanded the term to TBL + 1", by adding a fourth dimension, "governance", which points to laws and regulations that govern such housing throughout its life cycle.

Applying TBL+1 as a balanced approach to assess sustainability of existing PH programs and identifying critical indicators of PH performance from the residents' perspective are the fundamental steps in enhancing PH living conditions. Because PH is a unique project that has serious constraints and required certain features, having an effective management plan for PH is critical to have successful SPH projects which is the overall goal of this research.

1.1 Purpose of Research

This research aims to provide a holistic framework to assess the sustainability of PH and to address the importance of residents' satisfaction indicators for SPH. TBL+1 has been adapted through this research as a framework to approach SPH. Its ultimate contribution is to develop an integrated management plan for SPH projects. This plan will include the critical elements throughout the project lifecycle that would enhance PH performance and provide satisfactory housing for its low-income users.

The research sheds light on the complexity of PH problems, which interweave many fields and the absence of applicable an integrated approach to tackle those PH problems. A large number of PH projects are facing social, performance, economic, environmental and political complications. For example, defective housing has led to many consequences that affect social, environmental, and political aspects of the neighborhood and society in addition to residents' lives. This research provides a thorough approach to address PH problems and introduces an integrated applicable management plan to promote living conditions of PH in particular and enhance neighborhood and society in general.

1.2 Problem Statement

A sustainable approach is anticipated to provide a solution for PH from different disciplinary perspectives; for instance, sustainable development is considered as a key to solve affordable housing (in particular PH) dilemmas (Choguill 1993, Worika 2002; Chiu 2003; Arman 2009, Wheeler 2013; Ihuah & Fortune 2013; Sinha et al. 2017). Sustainable housing is a significant component of the sustainable community and a way to enhance the quality of life (DCLG 2007; Gan et al 2017). In addition, sustainability is a new concept in project management that arises from attention to social aspects of a project and stakeholders' satisfaction throughout the project lifecycle (Silvius 2017). Applying sustainable management, based on TBL criteria, to a project is arising as an imperative approach to enhance its social and environmental impacts and achieve project success (Carvalho and Rabechini 2017).

Lack of a inclusive understanding of the complex interaction of different aspects that influence PH in general, absence of a comprehensive framework to assess its sustainability, and deficiency of creating an integrated management plan to ensure their sustainability have led to unsuccessful PH projects cross the world. For instance, PH programs in the USA and Libya are considered failures and criticism of their quantity and quality are increasing constantly, even though the two governments have made different decisions pertinent to their PH, based on their circumstances, to cope with emerging problems and reduce criticisms of their programs.

In the USA, housing shortages and the number of families needing affordable housing are increasing. In addition, most PH projects in the US have been severely distressed, especially the high-rise projects, and the number of PH units demolished with HUD approval is always increasing. Which increases the housing crisis because of displacements of the project residents (Goetz 2013; Austen 2018). The superblock format of PH in particular has suffered from many problems and has negatively burdened the built environment. This PH format is European modern architecture that differs from the image of single-family housing, where 75% of American families were living at the time the projects were designed (Plunz 1990; Pommer 1978; Hoffman 1996). Projects built in this format have been demolished because of their inefficient performance environmentally, economically, and socially.

The housing crisis in Libya, is growing, especially as a result of the Arab Revolution (2011) and the current Civil War. The failure of the Libyan government to use standards extracted from the traditional architectural design, instead following a European standard to design and construct PH, have increased the problems (Belgasem 1992; Azlitni 2009). The Libyan PH projects represent European architectural design (Kadora, 1995), which lack compatibility with the local environment (Elwefati, 2007; Sharafeddin & Hammad 2009) and users' needs (Belgasem 1992, 2007; Kadora, 1995; Sharafeddin & Belgasem 2009). Adaptations to defective PH projects has resulted in numerous problems affecting the biological, psychological, social, and cultural needs of the inhabitants' daily lives (Elkatani, 2004; Ham mad 2006).

Libyan users of PH projects have felt alienated by the units' designs and tended to make many modifications to make them more acceptable. These modifications were unhealthy because they blocked the natural ventilation and daylight from the unit while increasing energy consumption (Sharafeddin 2004); in addition, they affected durability, performance, and the visual features of the building (Azlitni, 2009). Some of these modifications also affected the structural integrity of the building, which could result in the waste of public money.

The PH programs in these two countries are uesd as case studies in this research. Even though the two countries have different political systems, social structures, economic status, and level of environmental development, comparing these PH projects will yield rich insights on general PH program patterns. The two governments have made different decisions pertinent to their PH, based on their circumstances, to cope with emerging social, environmental, economic, and political problems that are facing their PH projects and to reduce criticisms. Such comparison will provide some specific mechanisms of providing residential satisfaction across various groups in a developed and a less developed country. Additionally, it will deliver a more comprehensive understanding of the complexity of the problems facing PH programs and allow for design of more realistic outcomes.

1.3 Research Questions

This study has adopted TBL+1 as a framework to evaluate sustainability of PH programs, assess their performance and develop an integrated SPH management plan by answering the following questions:

1. What sustainability indicators can be extracted from evaluation of the literature concerning the PH programs in the two countries based on TBL+1? ()
2. What sustainability indicators can be defined from residents' perspective based on TBL+1?
3. How can SPH be achieved through an integrated management plan, and what is the process in applying such a plan?

1.4 Research Objectives

1. To draw conclusions about how the TBL+1 aspects influence PH programs across different countries (Manuscript#1, 2)
2. To determine the main opportunities and challenges that must be faced in order for PH in general to be more sustainable (Manuscript#1)
3. To examine how less developed countries, benefit from the experiences of developed countries and vice versa (Manuscript#1, 2)
4. To provide a potential leading indicator for SPH (Question 1) (Manuscript#1)
5. To obtain a better understanding of residents' satisfaction based on TBL+1 across various groups in different countries (Manuscript#3)
6. To reveal the key performance indicators of each project and provide a thorough theoretical framework of SPH indicators that meet residents' expectation in general. These indicators will be critical in leading policymakers, designers, planners, and project managers to satisfy end users' needs (Question 2) (Manuscript#3)
7. To develop an integrated management plan for SPH that provides a process to enhance PH sustainability throughout the project life cycle (Question3) (Manuscript#4)

1.5 Conceptual Framework for Study

This section includes the literature pertinent to the research, the context of related theory, the definition of important terms in the research and the research gap.

Literature Review

An extensive review of the literature has been conducted to cover different aspects of the study, including PH in the USA and Libya (history, standards, success and failure, and policies), sustainable affordable housing, sustainability assessment frameworks, sustainability indicators, management frameworks, key performance indicators, and lean construction in affordable housing. The search was conducted in the following databases: ScienceDirect, Web of Science, Directory of Open Access Journals, Wiley Online Library, Google Scholar, and governmental websites, in both English and Arabic. Resources related to PH, including journal articles, governmental and non-governmental reports, books, conference proceedings, dissertations, theses, and policy documents have been reviewed.

In these resources, a sustainability approach has been introduced as a solution for PH in different areas including architecture, planning and, engineering. However, a critical limitation in previous studies is facing application of sustainability as a holistic approach to achieve SPH. The following sections categorize the literature related to sustainability in PH.

1.5.1 Triple Bottom Line (TBL) Sustainable Framework

The literature provides a vast collection of frameworks that have been developed to assess sustainability of PH. For instance, the Queensland Department of Public Works (QDPW 2008) coined the term “Triple Bottom Line” (TBL), which defined sustainable housing as housing that is environmentally, socially, and economically sustainable. Ibem and Azuh (2011) created a framework that includes four dimensions (environmental, technological, economic, and social and cultural aspects); the study aims to fill the gap between theory and application regarding a sustainability approach as a solution to PH problems. The authors suggest using a specific parameter to assess PH sustainability and highlights the limitation of utilizing an environmental base to assess PH sustainability. Yip et al. (2017) developed a conceptual framework for sustainable housing development that includes physical, social, environmental, and economic dimensions. Burford et al. (2013) explored the theoretical and practical frameworks to assess sustainability. They examined missing pillars that include cultural-aesthetic, political-institutional, and religious-spiritual and recommended political-institutional as a fourth pillar for sustainability assessment. Adding governance to the TBL is related not only to involvement of other stakeholders in making the decisions, but also to include a set of norms, laws, and regulations that govern this interaction among those stakeholders (Sharifi and Murayama 2013; Sharifi and Murayam 2014; Mulliner et al. 2016). Governance has been chosen as a fourth dimension in this study.

1.5.1 Sustainability Indicators

Significant global attention has been paid to defining a key indicator contributing to measuring sustainable affordable housing (Emsley et al 2008; Ibem and Azuh 2011; Mulliner and Maliene 2015; Gan et al, 2017; Sinha et al 2017). Indicators are intended to be tools to measure and express important qualitative and quantitative conditions over time (Sinha et at. 2017). Numerous sets of indicators have been created based on the TBL concept to evaluate affordability and sustainability of affordable housing (Blair et al.2003, 2004; Pullen et al. 2010b; Blair et al. 2010b; Ibem and Azuh 2011; Oyebanji et al. 2017).

Most of these studies have been conducted based on the perception of different stakeholders to identify critical indicators. Gan et al. (2017) developed a set of key sustainability performance indicators related to TBL and validated it from governmental agencies, developers and academic professionals related to affordable housing in China. Mulliner and Maliene (2015) used a TBL set that includes 20 indicators to identify important criteria contributing to sustainable housing affordability based on the work of housing and planning professionals across the UK. Oyebanji et al. (2017) defined eight, four, and nine success indicators related to economic, environmental, and social aspects, respectively, to achieve sustainable social housing based on social housing practitioners in the public and private (nonprofit) organizations in England and the housing authorities that owned and managed public social housing stock in England.

The residents' perspectives to define sustainability indicators for affordable and PH have been used by many scholars (Blair et al. 2003; 2004; Emsley et al. 2008; Meir et al. 2009; Aribigbola 2011; Jiboye 2012; Tapsuwan et al. 2018). Blair et al. (2003) used the TBL as a framework, defining 37 main indicators and almost 100 sub-measure indicators to assess affordability and sustainability outcome of 'greenfield' suburban development and master planned communities based on residents' perspective. Tapsuwan et al. (2018) evaluated 67 neighborhood and 38 home features to identify important sustainable characteristics of housing and neighborhood from the residents' perspective.

In a more specific context, some studies have highlighted the social consequences of bad living conditions in PH projects for instance, discrimination and segregation, the stigma of poverty, and isolation and less social cohesion. Such social problems have adversely affected the physical and psychological health of residents and negatively affect the society (Gifford 2007, Weisman 2016;

Hoffman 1996; Jonsson 2013). Oyebanji (2014) highlighted that social sustainability of housing is about satisfying different residents' cultural backgrounds and lifestyles. Pattinaja and Putuhena (2010), expanded social sustainability of housing to include social cohesion, security level, accessibility and suitability to surrounding services. Dixon and Woodcraft (2016) added other factors such as residents' participation and community involvement.

1.5.2 Sustainability in Project Management

Mir and Pennington (2014) point out that project management is effective in achieving a successful project. However, measuring success of construction projects continues to be a challenge, and many sets of key performance indicators (KPIs) and critical success factors (CSFs) have been used. Indicators in construction projects are critical to monitoring development, ensuring that the projects' performance complies with the established goals and allowing for corrective actions as needed. Orihuela et al. (2017) argue that the vast combination of construction indicators do not provide effective monitoring of construction projects. Project management success is hard to measure exactly because of many reasons: (1) it produces both tangible and intangible benefits (Radujković & Sjekavica 2017a), (2) it is difficult to reduce the factors to a manageable number (Langston et al 2018), and (3) no model including all CSFs has been created to measure project management success (Mir and Pennington 2014), and such a model may be impossible (Radujković & Sjekavica 2017b).

The Project Management Body of Knowledge (PMBOK) Guide expands the project manager's responsibility to incorporate scope, human resources, communication, risk, and procurement management (Radujković & Sjekavica 2017a; PMBOK 2013). Project success is more than satisfying the clients; it implies involvement of a wide range of integrated stakeholders at all stages of the project. Gathering the stakeholders' requirements is the right way to meet project targets. Silvius (2017) discusses the relation between sustainability and project management and declares that sustainability is a new school of thought in project management that pays attentions to social aspects of a project, satisfaction for all stakeholder, application of TBL criteria, and a values-based approach to projects and project management. Carvalho and Rabechini (2017) highlight the importance of applying sustainable management to a project to enhance social and environmental impacts and achieve project success.

Ihuah & Fortune (2013) assert the importance of creating a post-construction management strategy to assure sustainable social housing in estates in Nigeria. They cite Franks (2006), who emphasizes that sustainability is crucial in any project management. Ihuah et al (2014) list critical project management success factors for sustainable social housing in Nigeria, highlighting the importance of creating housing policies that are sustainable with all stakeholders and ensuring that changes in government do not affect or alter such policies.

Johnson (2007) discusses the opportunities and challenges facing application of different engineering-base methods in designing and planning affordable housing, and community development. He explains how decision modeling contributes to design of housing and community development throughout architecture, urban and regional planning. He highlights the importance of developing housing policies that promote social principles, technology applications, and utilizing best practices in planning a neighborhood that is affordable and sustainable.

Indicators based on sustainability are used by construction engineers to define the construction technologies to provide affordable housing. Wallbaum et al. (2012) assess the construction technologies based on the key challenges of affordable housing, conducting interviews with experts in development of affordable housing programs to rank selected and accepted indicators. They highlight the importance of combining multiple top-ranking technologies that have been identified to tackle affordability and sustainability of low-income housing. They suggested assessing environmental impacts, availability and other regional factors, and socio-economic performance of the selected solutions.

1.5.3 Sustainable Project Success Framework

Diverse sets of sustainability frameworks have been developed to evaluate project management and achieve successful projects. Silvius and Schipper (2015) assert that the evolution of sustainability and project management of a specific project should be compatible with its characteristic and context. Marcelino-Sádaba (2015) provides a conceptual model for managing sustainable projects based on the TBL approach. Orihuela et al. (2017) propose a biaxial control panel to control the housing project during its life cycle that takes into consideration the TBL sustainability aspects. They provide a set of five indicators for the design phase of housing projects. Orihuela et al. (2011) clarify that the aim of any project is to satisfy the needs and values of the its owners and users. They provide a specific matrix that include both owners and users' needs and values. They suggest combining users' needs and values criteria with the Post Occupancy Evaluation (POE) results of previous projects to identify and understand users' needs.

Gomes & Romão (2016) proposed a framework to achieve a successful project based on project management; they point out that management success and satisfactory conditions are critical to fulfilling the project goals. They indicate that the Iron Triangle (cost, time, and quality) is not enough to attain a successful project, and they consider the customers' satisfaction and organization goals to be critical in attaining successful projects. Their study findings articulate that the quality of the proposed solutions that includes customers' satisfaction has increased the annual rate of customer satisfaction. Serrador & Turner (2015) state that there is a connection among project success, project management success and satisfaction of stakeholders. Both project success and the satisfaction of stakeholders contribute to successful project management, contributing 60% and 56% respectively. Radujković & Sjekavica (2017) create a framework for enhancing success of management activities at three hierarchical levels in the organizational structure and link project management success and project success. Langston et al. (2018) created a framework (i3d3) to measure the success of construction projects based on the project time phases, where i3 indicates three' generic phases of projects: (initiate, implement and influence), and the d3 refers to the projects' generic objectives of the three phases: (design, deliver, and delight). This frame considers stakeholders' communication throughout these phases to be critical to achieve successful project.

1.5.4 Theoretical Context

SPH is a complex topic that requires an interdisciplinary approach covering social sciences, planning, architecture, economics, policies and management, environment, sustainability, sociology, psychology, health, history, and other academic and professional disciplines. The relevant theories to SPH used in this study include Maslow motivation theory, theory of family housing adjustment, socio-technical theory, investment theory, justice as fairness theory, regime theory, and the integration of sustainability into project management as a new school of thought in project management.

The Maslow motivation theory considers housing as one of the most important elements in satisfying people's needs because it provides secure shelter where they carry out basic activities, interact socially, and achieve self-actualization. Miller-Lane (2007) mentions that housing articulates the users' self-esteem and self-actualization while motivating them to construct a physical space that fulfills their expectations for a satisfying living environment. Zavei & Jusan (2012) highlight that "Maslow's Hierarchy of Need" is fundamental to achieving satisfactory housing. Baqutayan et al (2015) provide a theoretical framework that demonstrates the relationship between the affordability, livability, and sustainability of the house and Maslow's motivation theory. They define affordability as the first level of the hierarchy, livability, which it concentrates on individual safety and security as the second level, and sustainability, which is related how the residents form satisfactory relationships with their surrounding community as the third level.

According to the theory of family housing adjustment by (Morris and Winter 1975), satisfactory housing meets its residents' needs and aspirations; however, unsatisfactory housing indicates a 'housing deficit' that pressures its residents to correct the deficit. They used housing deficit theory to understand residential adaptation or residential mobility as adjustment of families to their undesirable built environment, and they explain how family housing adjustment is linked to cultural/normative theory to guide the adjustment action. Wolpert (1966) also used adjustment theory and housing needs theory to explain how residents deal with stressful living conditions.

Shove (2003, 2004) raise the point that family and cultural norms affect energy consumption of a household because it is related to social and evolving norms that control everyday practices based on perceptions of comfort and convenience. Such issues highlight the importance of providing an adequate standard of socially comfortable units and designing economically and environmentally responsible SPH. Shove points out that residents' expectation is a social phenomenon, is not fixed, and can be shaped as part of social factors. Hwang et al. (2009); however, found that it is difficult to convince residents to sacrifice their thermal comfort in order to save energy costs. Thus, it is important to implement an energy efficient housing criterion in PH projects.

Hall and Berry (2002) apply the investment theory to define efficient housing assistance options that lower risk and increase the efficiency of housing policy. They point out that improving housing efficiency is critical to boost long-term return. Additionally, they state that studying systematic risk associated with such investment will enhance the long-term return. Susilawati (2009) found the risks associated with housing projects from non-government investors to be financial risk and the risk of community rejection. He highlights the importance of develop risk management for PH because of its low return as an investment, especially for the private sector.

Meyrick (2013) applied the Justice as Fairness theory of (Rawls 1972, 2001) to housing policy and provides a new insight that broadens the housing policy debate to cover economic, social and environmental aspects. He provides an intellectual framework for housing policy that includes sustainability, affordability, and housing based on justice. His insights into development policy encompass environmental policies that support sustainability and housing policies that support affordability and sustainability tied to the needs of future generations.

Koschinsky & Swanstrom (2001) raised the point that regime theory reflects the interaction of public, private, and nonprofit sectors in the USA, where the federal government provides subsidies for low-income housing and housing policy. They coined ‘subregime’ to specify housing and community development, and they analyzed the dynamic among those sectors and federal housing policy. They further pointed out such decentralization policy has increased the competition among housing nonprofit agencies of neighborhoods with other neighborhoods rather than cooperation between them at a regional level. They suggested engaging housing nonprofit agencies at the local and state level.

Silvius et al. (2013) identified the integration of sustainability into project management practices as a comprehensive incorporation of the TBL pillar of sustainability into project delivery systems and project management practices in order to achieve effective project management. Many studies have indicated that, as a result of the lack of application of sustainability practice in developing countries, establishment of an integration of sustainability into management systems can be view though the innovation diffusion process (Johansson 2012; Mollaoglu et al. 2016; Banihashemi et al. 2017). Banihashemi et al. (2017) use the innovation diffusion theory as the point of departure to develop a conceptual model for project management based on integration of sustainability into project management practices. Their conceptual model includes five stages: identification, evaluation, commitments, preparation and implementation. Each stage has its own critical success factors (CSFs) based on the nature of the stage. Such applications will enhance the capacity of innovation methodology (Slaughter, 2000) and provide a strong tool to empower integration of sustainability and project management implementation (Mahajan and Peterson, 1985). Additionally, Banihashemi et al. (2017) suggest prioritizing decision-making in consideration of sustainability (Liu et al. 2016).

1.5.5 Definition of terms

Triple bottom line plus 1 (TBL+1) is the four sustainability pillars that have evolved by The United Nations. In 1983 the United Nations identified three dimensions to promote sustainability---environmental, economic, and social---and later in 1992 added a fourth dimension, governance (UN 1983; UN1992). The fourth dimension was added because decision makers and implementation of policy have huge effects on improving sustainability and on the culture, rules, and values of the society (Spangenberg et al. 2002; Maliene et al. 2008; Burford et al. 2013).

Sustainable public housing (SPH) in this research has been defined by the term TBL+1, which means housing that is environmentally, economically, and socially sustainable and governed by laws and regulations that empower its sustainability. Features related to environmental sustainability include housing quality, a comfortable and healthy indoor environment, availability of green public spaces, adaptability and flexibility, and reliability and durability. Economic sustainability features include affordable price/rents, reduced life cycle costs, energy efficiency, and provision of human resources for economic development, such as convenience to employment opportunities. Social sustainability features of SPH include community participation, sense of community, suitability, social interaction and inclusion, safety and security level, accessibility to public transport services, and good quality education. Such features require a thorough structure of law and regulations that govern and empower sustainability, as well as, a strategic integrated management plan to ensure its sustainability throughout its life cycle.

1.5.6 Research Gaps

Different attempts to assess and apply a sustainability approach in PH projects have been made. No integrated sustainability assessment tool has been used to evaluate PH programs globally to provide a comprehensive understanding of program changes and developments. Despite the rich body of existing POEs and residents' satisfaction research, there is (1) little empirical study relevant to residents' satisfaction in PH, (2) a critical limitation of POE studies across countries and among groups in different cultures, and (3) a lack of applying a holistic approach as a diagnostic POE approach to identify more realistic leading indicators for SPH.

Even though attention to applying sustainability in project management has been increasing; no clear integrated management plan has yet been created in general or for SPH in particular. The purpose of developing an integrated management plan for SPH is to fill the gaps associated with PH. However, recent researchers in different disciplines have provided a good starting point toward developing a SPH integrated management plan (Alshuwaikhat et al 2006; Ewing and Knapp 2009; Ali et al 2016). Such a management plan will be critical for measuring and monitoring the success of existing and new pH projects to ensure their sustainability.

1.6 Significance of the Research

This study bridges gaps in the literature by providing rich insights on the general patterns of PH movements through comparing programs in two countries, using the TBL+1 approach. In addition to extracting the significant lessons learned in order to achieve SPH having significant sustainability indicators, the research explores the obstacles that have faced each program and the strategies used to cope with them and provides some recommendations to achieve SPH.

Even though the topic of residents' satisfaction with PH projects has been studied, this study evaluates the satisfaction level among the residents of PH across various groups in different countries, which will provide a better understanding of residents' needs. The satisfaction levels found in the POE indicate building performance from the users' point of view and lead to socially, environmentally, and economically sustainable housing that meets the user's expectations. They also provide a source of valuable information that designers, planners and policy makers can depend on when making future decisions about PH. Comparison of leading indicators among different groups in the USA and Libya will serve as the second step toward creating an integrated management plan for SPH.

Finally, the study will provide an integrated management plan based on TBL+1 as a multidisciplinary approach to enhancing residential satisfaction and creating a successful SPH. The indicators extracted from the two previous steps (assessment of PH programs and significant indicators from residents' perspective) will be used as the basis of an integrated management plan for SPH. In addition, incorporating a sustainability tool kit in project management will lead to an integrated management plan for SPH.

1.7 Research Procedure

The research involved three steps. First, PH programs in the USA and Libya were evaluated based on the conceptual framework (TBL+1) to highlight the main opportunities and challenges and extract the important lessons learned as indicators for SPH based on the systematic analysis of the literature review. Lessons extracted from PH programs in the USA and Libya based on TBL+1 will be used as a basis of SPH an integrated management plan. A more detailed analysis of social aspects of PH projects in the USA and Libya was conducted using the systematic analysis of the literature review, with emphasis on PH and neighborhood features in the two countries, and opportunities to enhance the social aspect of PH living conditions.

Second, three existing case studies of PH projects in the USA and Libya were analyzed based on a multi-dimensional approach that includes: a POE survey, observations of the physical traces, and sim-structured interview. Additionally, it uniquely employed a multi-dimensional approach to explore the three case studies and uses an (Ordered Probit model) to statistically determine significant satisfaction indicators of residents of PH projects across the two countries and their effects on residents' reporting a specific level of satisfaction.

Finally, an integrated management plan based on the TBL+1 approach is developing that includes critical criteria of each stage of PH project life cycles in order to achieve successful projects that can meet users' need and expectations and assist housing authorities to ensure providing successful SPH.

1.8 Research Scope and Limitation

The study will cover

- Evaluation of PH programs in the USA and Libya based on TBL+1
- Identifying critical indicators for SPH from residents' perspective of three PH projects in the USA and Libya
- Establishing a SPH management plan for SPH

The study is limited to three low-rise housing projects. Two are located in Corvallis, OR, in a fairly affluent areas and the other one in Tripoli, where it is now located in an affluent area, although when the project was built the area was an undeveloped suburb. The data for the USA projects were collected by the author, those for the Libyan project were collected by her contacts in Libya and by internet communications.

1.9 Research Flow

Figure 1 below shows the research flow.

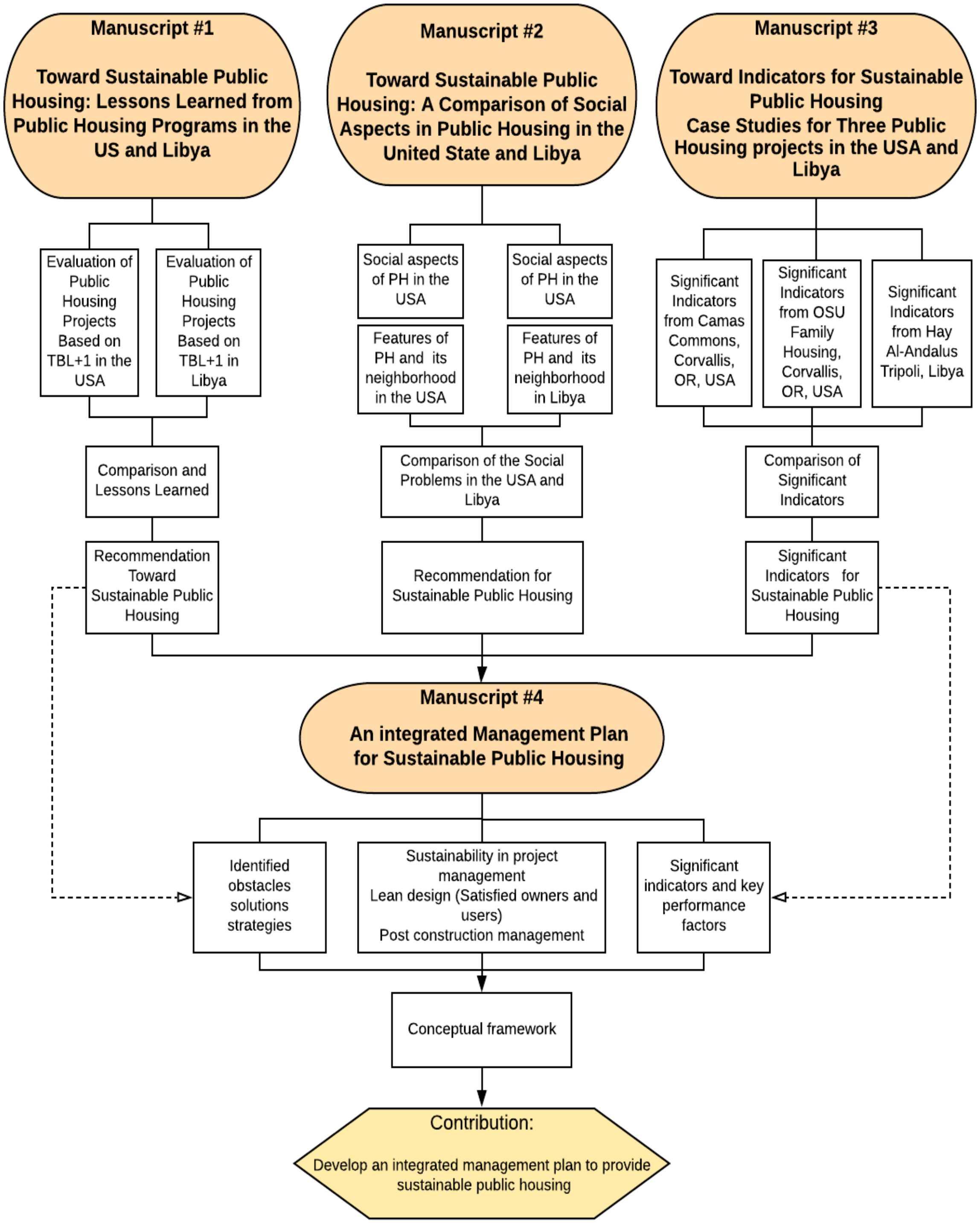

Figure 1: Dissertation Research Plan

1.9.1 Manuscript #1

Manuscript #1 focuses on assessment of the existing situation of PH projects in the USA and Libya to extract the important lessons that help to achieve SPH. This paper discusses the primary environmental, economic, social, and governance aspects that have influenced PH programs in the United States and Libya. The aims are (1) to compare, analyze, and extract the lessons learned from PH experiments in both countries that pertain to TBL+1 and (2) to provide potential leading indicators in order to achieve SPH; in addition to providing specific recommendations to design and construct of suitable SPH. A systematic review of the literature, including a wide-ranging review of online academic and government report in English and Arabic, was used to identify critical elements in order to achieve SPH. A three-stage research design was used, (Figure 3, page 45). The paper is divided into four parts (Figure 2). The first part was a sustainability assessment for the two PH programs based on the TBL+1 framework. This stage explored the evolution of the PH movement in the two countries, revealing the opportunities and challenges that have been facing each project and illustrating the strategic solutions that have been

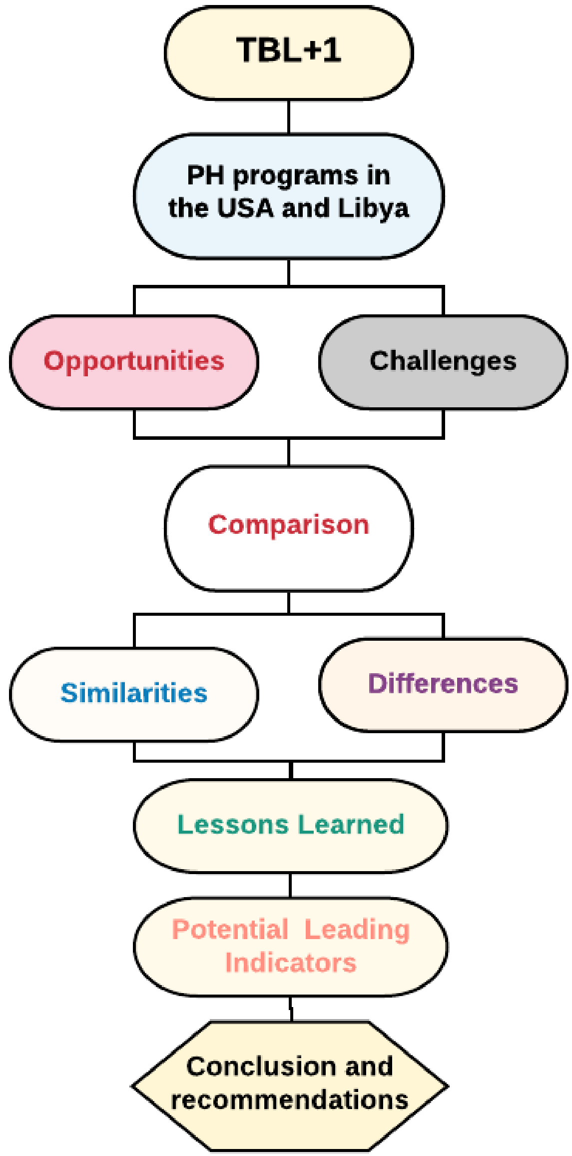

Figure 2: Organizational structure of

applied. The second part presents the similarities and differences between the two programs. The third part reveals the lessons learned related to TBL+1 aspect as a result of the evaluation. (Figure 4, page 46) summarizes the three first parts of the paper. The fourth part presents study findings. The research finding indicated that in the US PH programs have undertaken steps to solve arising problems. In Libya, political decisions and a shortage of social studies and local standards are the main obstacles faced by PH. In addition, the current difficult political and economic situation in Libya will make it hard to overcome the PH problems.

Recommendations pertaining to aspects of TBL+1 are provided to enhance PH programs. For instance, some recommendation regarding to environmental aspect include: incorporating new sustainability strategies to existing and new PH programs, applying practices such as green building standards, passive housing concepts, and studying traditional housing in the specific area to determine the characteristics needed, conducting periodic assessments to measure and monitor housing performance and reporting the results. Pertinent to the economic aspects, conducting the feasibility studies that support life cycle operation costs of SPH projects are a successful way to reduce waste and save government and residents' money. The money saved by the government can be used to enhance and increase PH units. The money saved by the families can be used to enhance health, standards of living and on children's education. In addition, the research recommends that SPH should not be free; the practice in Libya of allowing the residents to own their unit eventually has not been successful in improving the life quality for low-income families, which supports the practice of rental-only access to PH in the US.

Recommendations related to the social aspects includes empowering social services for PH residents in order to eliminate some of their social problems, as suggested by National Commission on Severely Distressed Public Housing (NCSDPH) in 1989 in the US. In addition, promoting research related to socioemotional health of inhabitant of PH projects would provide a background for decision makers to use in enhancing the PH sector. Some recommendations related to governance highlight the role of government in supporting PH sustainability such as enacting housing standards, laws and regulations that empower PH to be sustainable. Additionally, support non-governmental organizations (NGOs) role in enhancing the PH environment should be support especially in Libya, because the NGOs and PH advocates in the US have improved living environments in PH there. The study addresses the role of community involvement in bringing up PH problems and discussing their solutions. In addition, pre-involvement of community and anticipated residents at the beginning of the projects is highly recommended because it guarantees that the newly constructed PH will meet the community's expectation and will fulfill their residents' needs. Enhancing research related to policy application and periodically updating these regulations to include new improvements related to SPH are crucial.

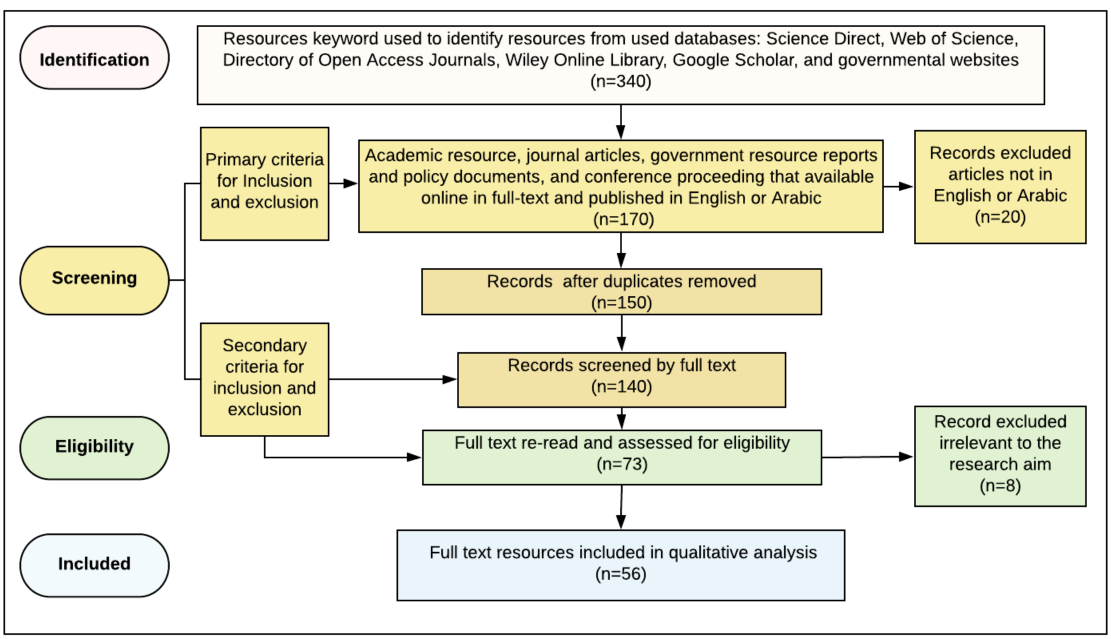

Figure 3: Flowchart for the literature selection procedure after [Yigitcanlar (2018)].

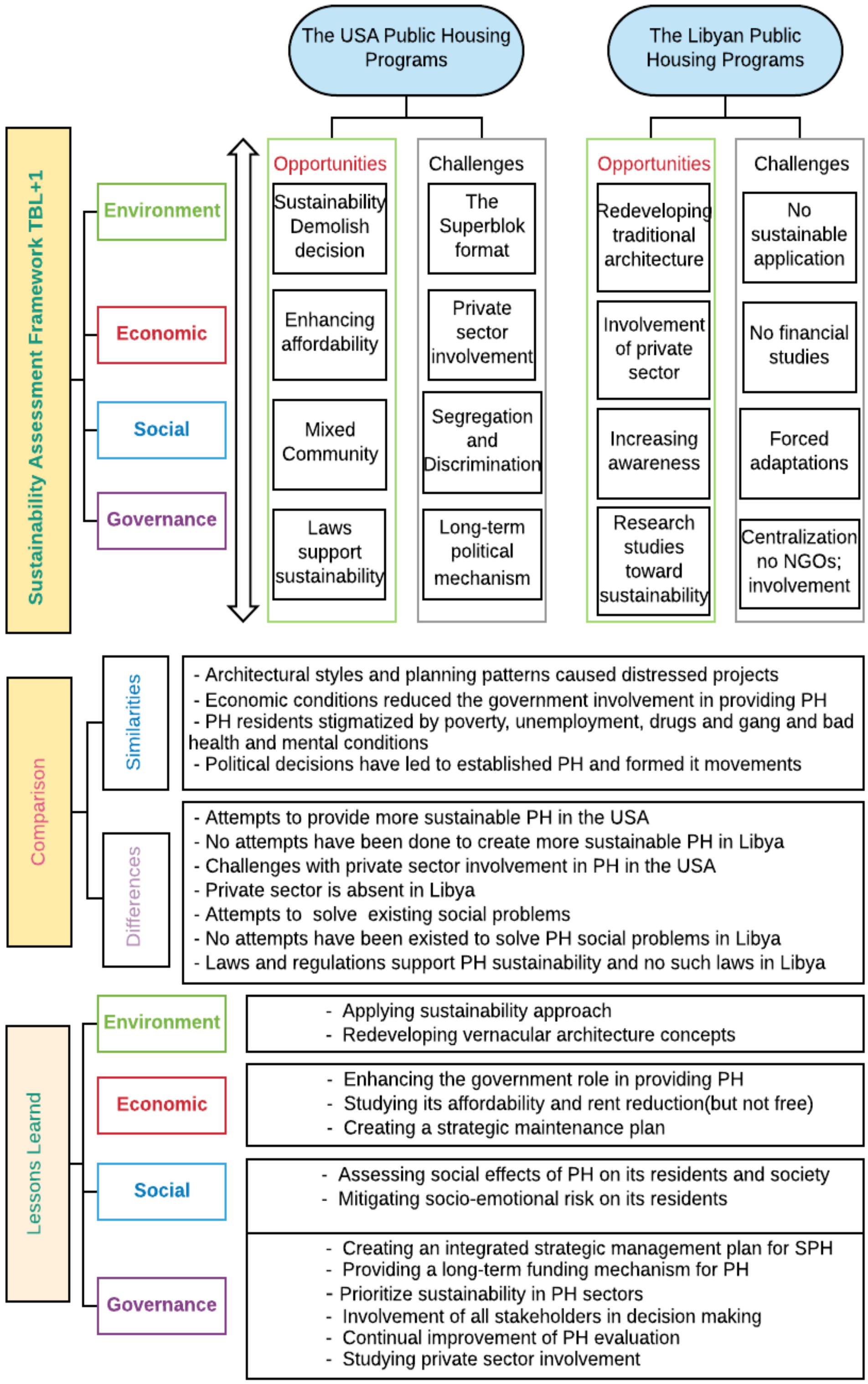

Figure 4: Summary for the first three parts of the manuscript #1

1.9.2 Manuscript # 2

Manuscript #2 focuses on exploring the current social aspects of PH in the USA and Libya. Comparing the social aspects of PH project in the USA and Libya will reveal a clear understanding of the social role in PH performance and its influence on the residents of PH and the quality of life in those societies. The aim is to identify social criteria that could be considered to achieve the SPH in a sustainable community. A systematic review of the literature, including a wide-ranging review of online academics in English and Arabic, was used to identify critical social aspects that affect PH performance in order to achieve SPH. A three-stage research design was used, (Figure 6, page 48). The paper is divided into five parts (Figure 6). The first part is a review of the social aspects of PH, at this stage, reviewing relevant literature to social problems and their effects on the residents and society were conducted (Table1, page 49). The second part presents features of PH and neighborhood in the USA, attempts to enhance the sustainability of PH in the USA, and the social aspect of PH in the USA. The third part presents features of PH and neighborhood in Libya, attempts to enhance the sustainability of PH in Libya, and the social aspect of PH in the Libya. The fourth part includes the comparison between the social problem in the PH in the USA and Libya. The fifth part is the conclusion. The comparison reveals that similar social problems related to architectural style and neighborhood planning have been facing the two countries' PH projects. Identified social problems include

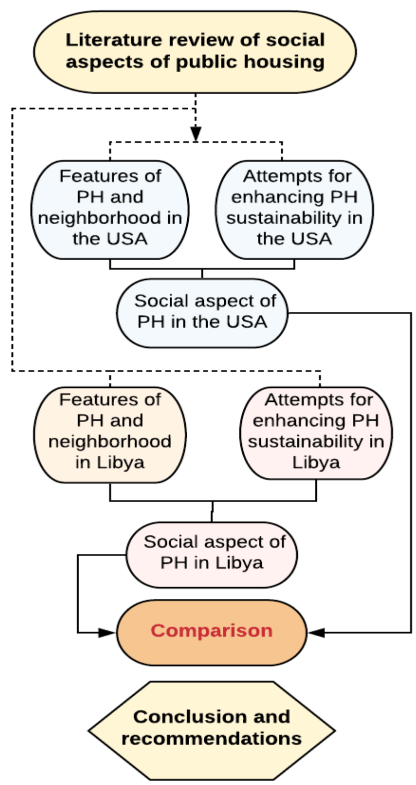

Figure 5: Organizational structure of manuscript #2

unsafe living conditions, poor psychological health, poverty and unemployment, alienation and an absence of community sense. In the USA, solutions for socially distressed neighborhoods are provided by both governmental and private institutions, and there were many successful examples that have been achieved. In Libya, the attempts to improve PH have to begin with and come from the government. The housing ministry in Libya should start an assessment plan to evaluate existing PH, as has been done in the USA. A strong clear decision to demolish current PH having many social problems and to renovate projects with fewer physical and social problems would improve the existing situation of PH in Libya. Returning to regional and local traditional patterns, incorporating traditional designs such as the Tripoli courtyard house, and planning to design new PH that is more suitable for its users is called for. It will be necessary to develop standards compatible with vernacular architecture (architecture used local materials, traditional methods of construction that built during pre-industrial) and New Urbanism concepts and set up a plan to manage and evaluate this type of PH projects. In developing the PH designs, it will be particularly important to get feedback from current and perspective residents about their needs and preferences.

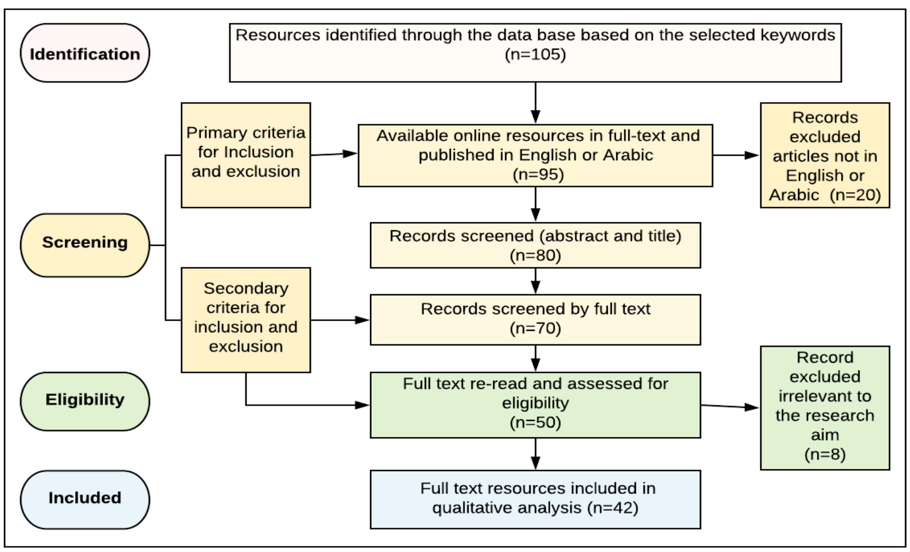

Figure 6: Flowchart for selection of review articles format from [Yigitcanlar et al. (2018)].

Table 1: Social Problems Facing Sustainability of Public Housing Projects in Previous Studies

No	**Social problem**	**References**	**Themes of health consequences on residents**
1	Discrimination and segregation	Weisman 2016; Hoffman 1996; Jonsson 2013; Hanlon 2014; Jensen 2009; Leavitt 1993; Dreler and Atlas 1994	Fear, insecure, poor psychological health, depression, negative social interaction
2	Crime level and insecure living conditions	Pattinaja & Putuhena 2010; Jensen 2009; Leavitt 1993; Dreler and Atlas 1994; Gifford 2007; Belgasem 2007	High violence behavior, fear, poor psychological and physical health
3	Incompatible PH format (High-rise) and bad neighborhood conditions	Bothwell, et al. 1998; Gifford 2007; Sweatt et al 2002; Evans et al. (2003); Ellen & Glied 2015	Alienation, neuroticism, negative social interaction, mental and socioemotional problems for children and adults; injuries and homicide
4	Isolations and disrupts social cohesion	Harraka, 2002; Bohl 2000; Passell 2013; Bothwell 1998; Manal et al. 2004; Evans et al. 2003	Alienation, children's emotional development problems, complexity of social contact with neighbors, and depression
5	Mobility and instability	Coley et al 2013; Jensen 2009; Marcal & Fowler 2015	Negative socioemotional performance within parents and children, less academic performance for children, negative social interaction, and depression
6	Force adaptation	Marcal & Fowler 2015; Hammad 2006; Gabril 2014	Socioemotional problems among family members, behavior changes, mental disorder and psychological disease
7	Lack of visual and acoustic privacy level	Memarian & Ranjbar-Kermani 2011; Hammad 2006	Negatively emotional behaviors, negative social interaction, complexity of social contact with neighbors.
8	Low quality and discomfort living conditions	Hanlon 2010; Cubbin et al 2008; Hecht 2016; Coley et al 2013; Jensen 2009	Behavioral problems and less cognitive function; inadequate health care; teen motherhood, injuries and homicide especially among children
9	Modifications	Hammad 2006; Kim& Kim 2010	physical and emotional health problems, performance difficulties and depression, complexity of social contact with neighbors
10	Poverty stigma	Coley et al 2013; Jensen 2009; Hammad 2006	Anxiety and depression, parents' stress, interrupts the child learning, low self confidence among family members
11	Detached to the place and disability of self-display	Belgasem 1992; Shawesh 1996; Azlitni 2009.	Stress, children low academic performance which negatively affects their emotional behaviors., and social interaction
12	Low residents' participations and involvement	(Bothwell 1998).	Alienation, negative social interaction, complexity of social contact with neighbors

1.9.3 Manuscript # 3

Manuscript # 3 focuses on defining significant indicators that can be applied to achieve SPH, based on a multi-dimensional approach to three case studies of PH in the USA and Libya. Conducting this study among different projects across various regions and cultures will enhance understanding of the significant indicators of SPH in general. This paper examines the existing situation in three PH projects, two in the USA (Camas Commons, and Oregon State University Family Housing, Corvallis, OR) and one in Libya (Hay Al-Andalus, Tripoli). Residents' perspective is considered as a substantial tool to determine the success or failure of PH performance. The aims are (1) to define significant indicators of residents' satisfaction and determine their statistical significance, (2) to compare defined significant indicators among the three PH projects, and (3) to provide recommendations pertinent to a set of indicators that can be used to reach SPH.

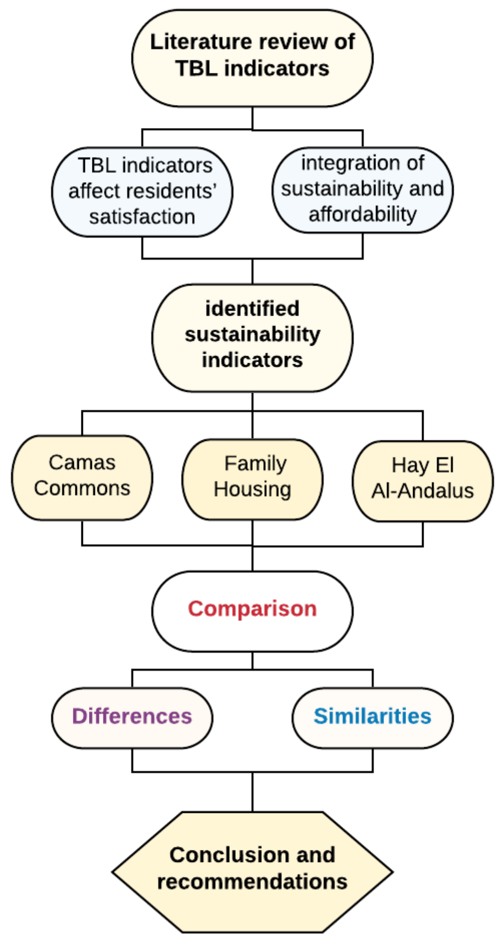

Figure 7: Organizational structure of the manuscript #3

The multi-dimensional approach included quantitative and qualitative data analysis to examine the performance of existing case studies. The quantitative data analysis included a post occupancy evaluation (POE) survey. The qualitative data analysis included an observation of physical traces and a semi-structured interview. A total of 144 responses from the USA (72 responses from residents of Camas Commons and 72 responses from the residents of Family Housing at OSU) and 89 responses from residents of Hay El Al-Andalus project were obtained. An ordered probit model was used to identify statistically significant indicators that impact a person's probability of reporting a specific level of satisfaction. The 50 semi-structured interviews included 16 in the Camas Commons, 16 at the Family Housing, and 27 at Hay Al-Andalus. Each interview lasted approximately 30-45 min. A total of 45 observation rounds were carried out, 15 counts for each project.

The paper is divided into four parts (Figure 7, page 50). The first part summarizes the literature related to the relation between integration of sustainability and affordability, and TBL indicators that affect residents' satisfaction and provide four categories to present residents' satisfaction that are residents' characteristics, social, environmental, and economic indicators. The second part includes the results analysis and discussion of the categories have been identified throughout the best-fit model for each project. The interviews and observations trace results utilized to empower the analysis of the study findings for the three projects. The paper flow diagram represents in (Figure 8).

The third part represents the similarities and differences among the significant indicators. The seven similar and seven different categories related to the sustainability indicators of the four investigated aspects are represented in (Table 2, page 53). The fourth part represent the study findings. The study identified a set of significant indicators related to TBL indicators. Paying high attention to those indicators could provide policy makers, planners, designers, engineering project and property managers, and developers with a clarification of significant factors that affect residents' satisfaction. Dissatisfaction indicators require more attention in order to improve the built environment. Recommendations are provided to lessen the unsatisfactory aspects of housing performance and enhance affordable housing in general.

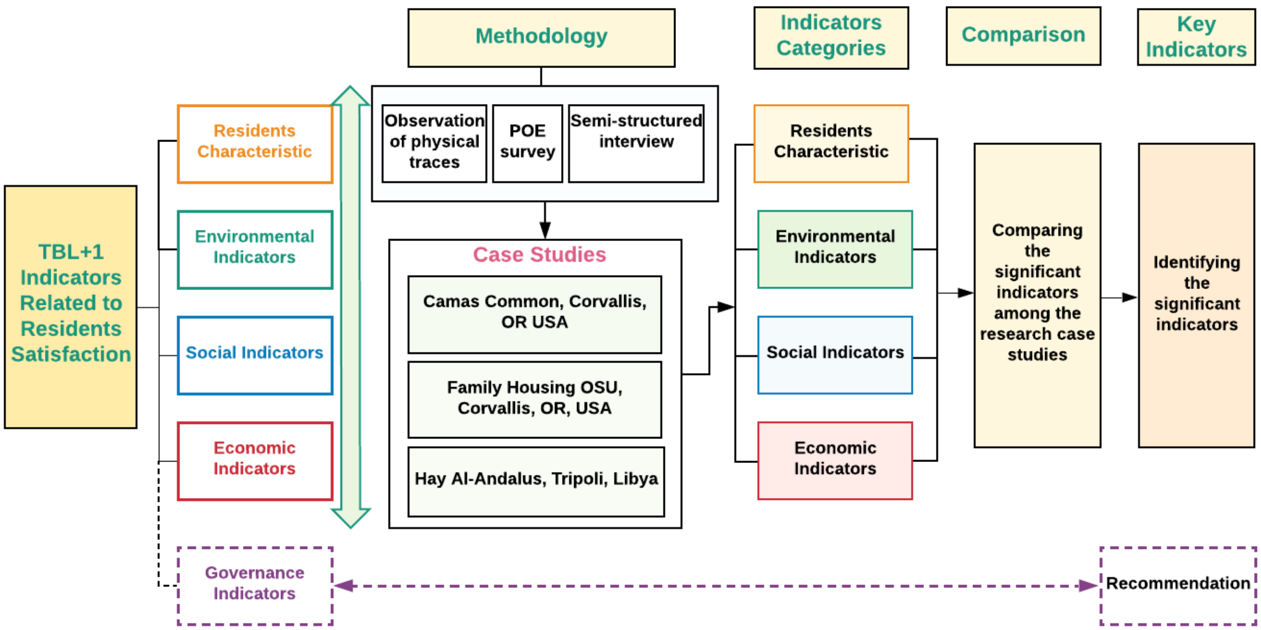

Figure 8: Manuscript #2 research flow diagram

Table 2: Comparison of sustainability indicators among the three public housing projects

Aspects	Category	Sustainability indicators	Public Housing Project		
	Similarities		Cams Commons	Family Housing	Hay Al-Andalus
Residents' Characteristic		• Family size	✓		✓
Social Sustainability	Personal and property safety	• Adequate measures against crime	✓		✓
		• Current thievery level	✓	✓	
	Social cohesion	• Community planning in neighborhood as a "we", not "they"	✓		
		• It is unimportant to have social cohesion		✓	
		• Visiting neighbors in their homes			✓
		• Borrowing and exchange favors among neighbors			✓
	Accessibility to services	• Being within walking distance to ballfield	✓		
		• Being within walking distance to a dry cleaner		✓	
		• Being within walking distance to educational facilities			✓
		• Being within walking distance to a public garage			✓
		• Being within walking distance to a grocery store			✓
Environmental Sustainability	Privacy level	• Clear separation between guest areas and family areas	✓		
		• Unit design provides high level of privacy from neighbors		✓	
	The thermal comfort	• Always I felt cold		✓	
		• Intermediate thermal discomfort			✓
		• Usage of coal or fuel heater			✓
Economic Sustainability	Energy consumption	• Average of using electrical heater 6-12 hours per day	✓		
		• Average of using electrical heater 12-18 hours per day			✓
	Differences				
Residents' Characteristic		• Number of children with age from 5-17 years		✓	
Social Sustainability	Job opportunities	• Unemployment rate among the occupants		✓	
Environmental Sustainability	Indoor air quality	• Adequacy of daylight entering the unit	✓		
	Parking	• adequate parking at the residence at Always I felt cold	✓		
	Durability	• Durability of the construction materials of balconies		✓	
		• Durability of finishing materials for kitchen floor		✓	
Economic Sustainability	Housing type	• the importance to have different housing types		✓	
	Modifications	• expanding the living areas as part of the modification			✓

1.9.4 Manuscript # 4

Manuscript # 4 focuses on developing an integrated framework for SPH and provide a sustainable performance checklist for project life cycle. This paper combines the sustainability development requirement and the needs and values of the end users of three PH projects identified in manuscript #3 with the project management tools (as challenges) with a sustainability approach to promote PH performance and provide SPH (as opportunities). The aims are (1) develop an integrated conceptual framework as a step toward an integrated management plan for SPH that will meet the need of PH residents and add value to PH projects and society, (2) provide fa specific sustainable performance checklist criteria for the project cycle as applicable approach for achieving SPH.

The multi-disciplinary nature of research posed a challenge for the review because there was no established integrated framework for SPH guiding in the literature search. The search includes combination of the previous work in the topic in coupling with a literature review of relevant articles alignment with the research topic. The systematic analysis for the literature included three stages review (Figure 10). The multi-dimensions resources were structured in the following sections (1) grouping of selected papers relevant to SPH, (2) Identified recognized dimensions to develop SPH, and (3) generated a logical flow to

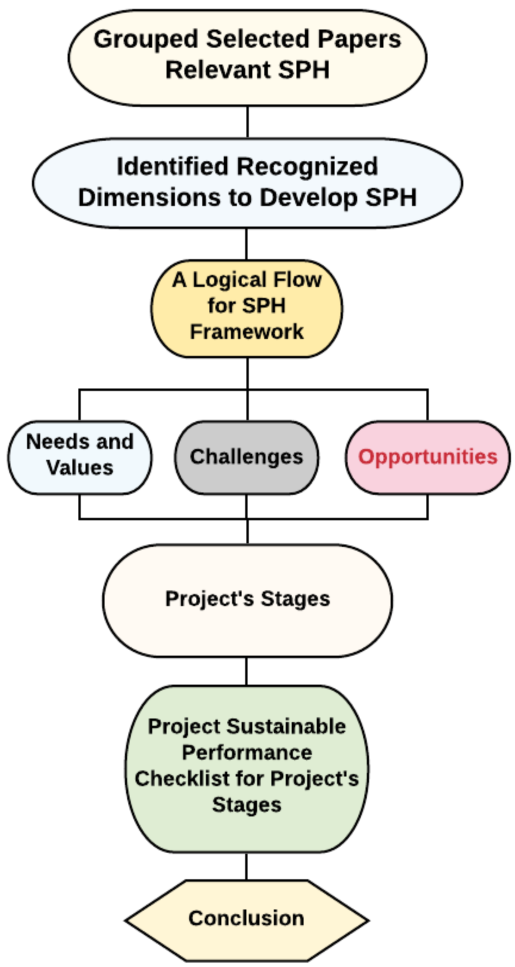

Figure 9: Organization structure of Manuscript #4

develop integrated SPH framework. The discussion of the literature review analysis resulted into developing an integrated framework conceptual framework dimension.

The paper is divided into four parts (Figure 9, page 54). The first part was a review of the relevant literatures to create a logical flow for SPH framework. The second part is developing an integrated conceptual framework for the project life cycle (Figure 11). The dimensions used to develop the framework are SPH requirement, challenges, and opportunities. The third part includes the project sustainable performance checklist for projects' stages. The fourth part included the conclusion and future research. SPH, an integrated conceptual framework that anticipated a step toward the establishment of the SPH management plan, and the basis of plan B (Figure12, page 57).

The study identified the conceptual framework for SPH that includes the sustainable performance checklists for each stage of the PH project. The framework dimensions extracted from the literature and previous work on the topic. The integrated framework builds upon (1) the sustainability development requirement, founded by the TBL+1 pillar and the needs of the users and other stakeholders identified in previous work, (2) the challenges and project constraints and the key sustainability performance indicators, and finally, (3) the construction management tools, comprising feasibility study, innovation, risk management, and lean construction, to cope with SPH challenges. An integrated developed framework covers the project life cycle (project scope, planning, design, construction, occupancy, and finally, demolition). The checklist provided in the integrated framework is the start for creating an integrated management plan for SPH by the housing authorities; future research is needed to explore and adapted the opportunities to achieve the best sustainability performance for PH projects based on the regional requirements. Identification of challenges that expected to face such an integrated management plan will provide based on plan B. Suggested future research also includes the implementation and the report results, along with highlights the study limitation.

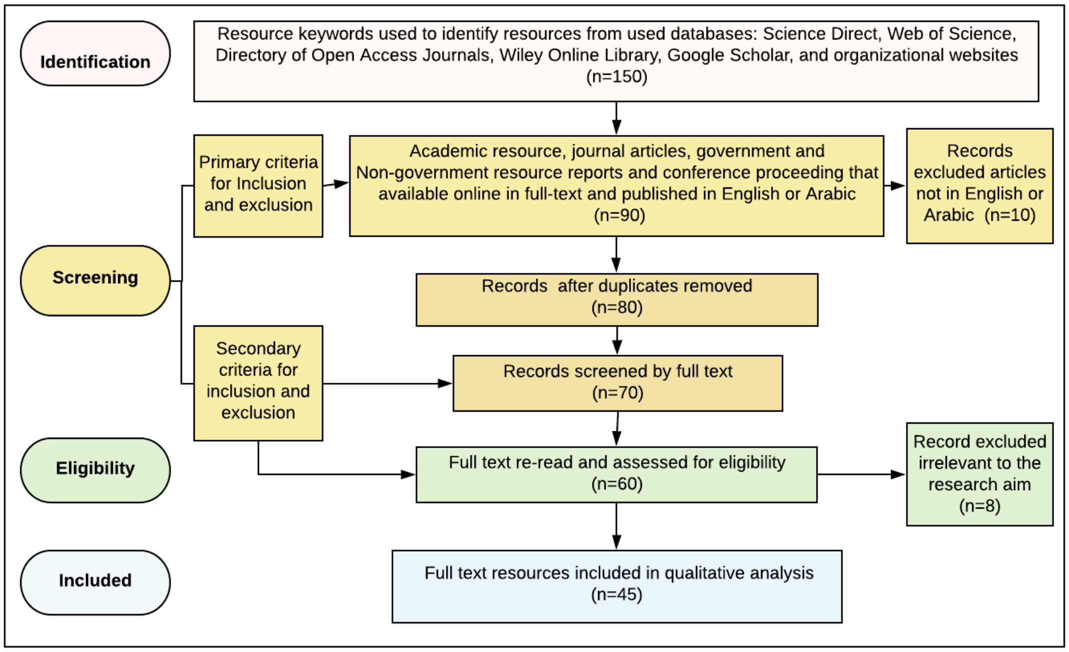

Figure 10: Flowchart for the literature selection (after Yigitcanlar, 2018).

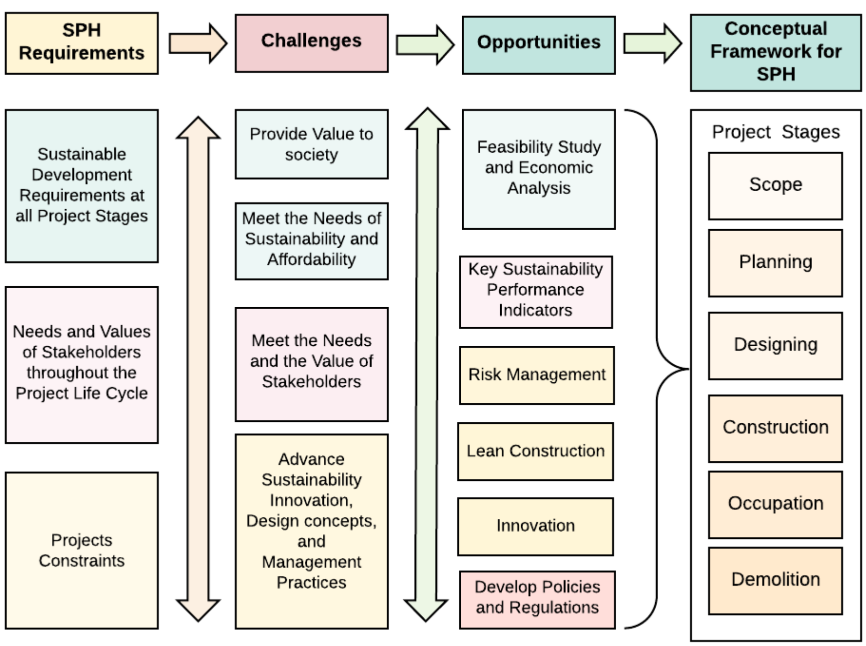

Figure 11: The integrated conceptual framework for SPH.
Note: To simplify understanding of the structure, some arrows are not shown

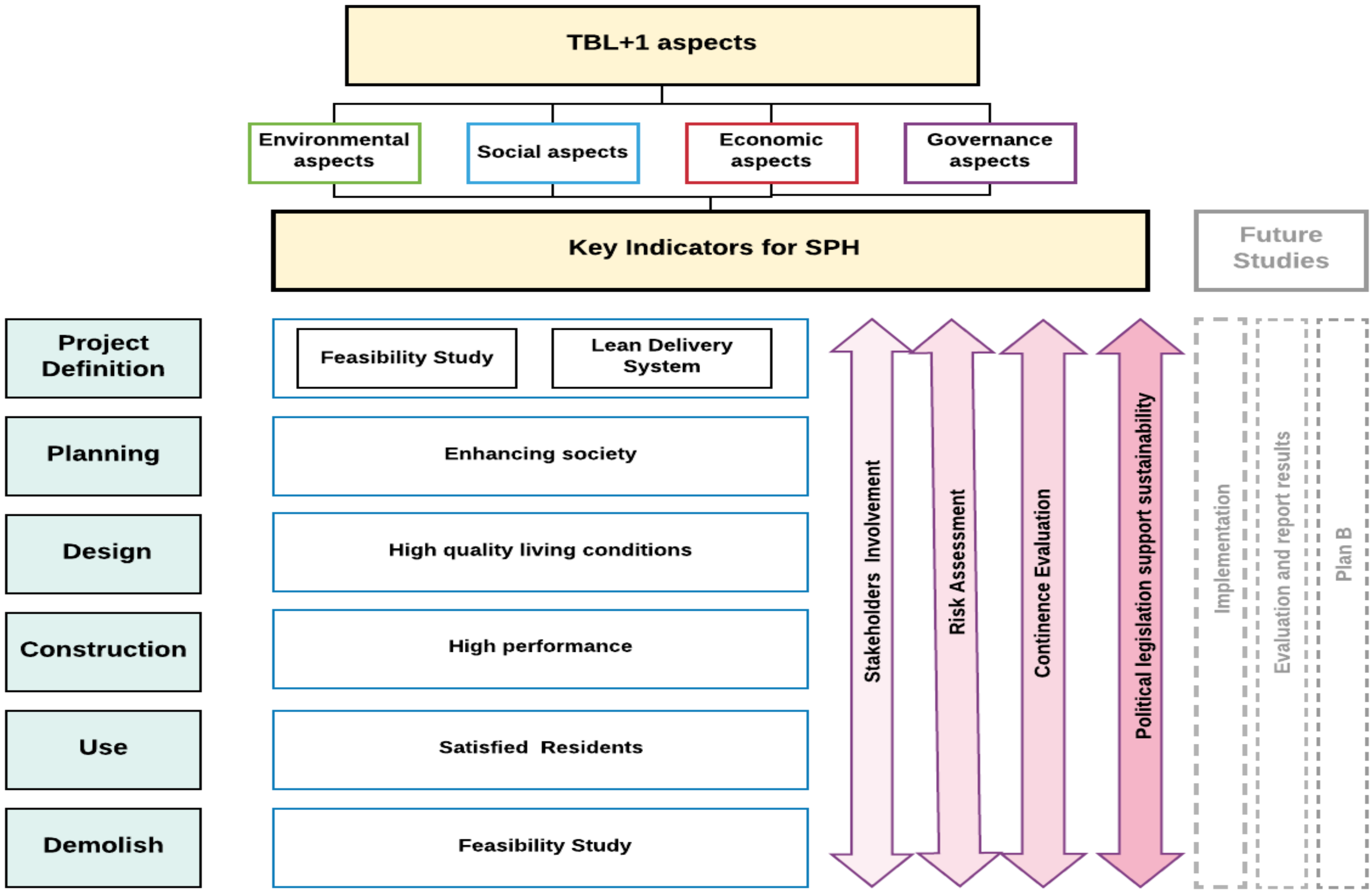

Figure 12: Research flow diagram for manuscript #4

1.10 Future Research

Implementation of the proposed sustainability checklist performance into SPH practices with the evaluation of the application results of the application will be part of future studies. The adoption of an integrated conceptual framework to apply for developing an integrated management plan with consideration of the specific regional requirements is another field for future study that can investigate.

Conducting a combination of architectural and engineering perspectives studies regarding the SPH is an excellent practice to achieve sustainability and provide a satisfactory built environment. Conducting research relevant to restoring the vernacular architecture to optimize the interactions between people and their place throughout the (planning concepts, design strategies, construction techniques, and the use of local materials) is another field of study that highly recommend. In addition, the study does not include high-rise buildings, which we aim to study in the future, perceptions of stakeholders other than residents of SPH, or a detailed management risk plan and a detailed feasibility study for specific SPH, which will be part of anticipated future studies.

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2. Chapter 2: Toward Sustainable Public Housing: Lessons Learned from Public Housing Programs in the US and Libya

2.1 Introduction

Housing is the center of socioeconomic activities for the resident family. It reflects the personality traits of this family and symbolizes its character. According to the Maslow Motivation Theory, the house is the most important element in satisfying people's needs because it provides secure shelter in which to carry out their basic life activities, such as eating, sleeping, working and social interaction (Zavei and Jusan 2012). A compatible house that satisfies its users' needs can lead to fulfillment at the higher level and help people to achieve self-actualization (Zavei and Jusan 2012). The world's urban population is growing, and only 13% of the world cities have affordable housing (UN HABITAT, 2016). The shortage of affordable housing is increasing; the global gap in 2018 was 330 million urban household and estimated to be 440 million household or 1.6 billion people by 2025 (King et al. 2017). The shortage of affordable housing in less developed countries is higher by 28% than it in more developed countries (Kallergis, et al 2018). For instance, in the US, the shortage is more than 7.2 million rental homes (NLIHC 2019), and in UK, according to the Nation Housing Federation report about 8.4 million people are living in unaffordable housing and 14.3 % of the nation population are affected by housing shortage (NHF 2019). In less developed countries, such as Africa over 50% of the populace are living in low living condition, and in India and China about a quarter of inhabitants are living in informal settlements (Florida, 2017). Thus, public housing (PH) programs have become a key component of a country's economy and a principal approach to enhance the quality of life (Gan et al. 2017). Providing a large portion of the community with a decent home at an affordable price is anticipated to promote the social, environmental and economic well-being of the society (DCLG 2007).

Many studies consider sustainable development to be a key that can solve the dilemmas faced by many communities with respect to affordable housing (in particular PH) and sustainable neighborhoods (Choguill 1993, 2008; Chiu 2003; Arman 2009b, Wheeler 2013; Sinha et al. 2017). Many scholars have discussed this topic from different perspectives and at different levels, such as planning urban areas, developing neighborhoods or smart cities, impacts and challenges of sustainable practices, and evaluation of built environment performance. Sustainable Public Housing (SPH), then, is a result of the bringing together of intertwined aspects among multiple disciplines related to sustainability and affordability, such as environmental sensitivity, social acceptability, economic feasibility, and supportive policies to enhance housing sustainability.

This study adopts the Triple Bottom Line + 1(TBL+1) concept (described in more detail in Section 1.2) to assess sustainability of PH programs in the US and Libya. It assumes the four elements of TBL+1 (environmental, economic, and social sustainability and governance) are repeated in each program and provide distinct identification of the failure and success in each program.

PH in Libya is considered an unsuccessful program, suffering from many problems and facing many challenges. The author is from Libya and is interested in studying, analyzing, and evaluating the PH program in Libya and comparing it to those in the USA. The two countries have different political systems, economic development level, social structure, level of environmental sustainable approach; for instance, the USA has been a democratic republic since 1854, while Libya is just entering this political system after royal rule and the Republican State where different perspectives for approaching PH were applied. Nevertheless, the comparison will provide a rich insights on general PH program patterns, a better understanding the complexity of the problems facing PH programs, some specific mechanisms of residential satisfaction across various groups, deliver of more realistic outcomes, and finally will reveal important lessons learned from the PH experience in the USA that should be applicable in Libya.

The objectives of this study are (1) to compare, analyze, and extract the lessons learned from PH experiments in both the United States and Libya that pertain to environmental, social, economic, and governance aspects, and (2) to provide potential leading indicators in order to achieve SPH; in addition to provide some specific recommendations to design and construct suitable SPH in these countries.

2.1.1 Sustainable Housing and Sustainable Communities: Some Definitions

The World Commission on Environment and Development defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). This definition has been applied in sustainable housing, where such housing must be "economically viable, socially acceptable, technically feasible and environmentally compatible" (Choguill 2007) while taking into consideration the housing policies that support those aspects (Choguill 2007; Arman et al.2009a).

Affordable or low-income PH globally is defined by household income, though the precise income defined as "low" or "middle" varies with actual location. It refers to owner- or renter-occupied housing for a large population that are considered as low, moderate and middle-income earners whose income is not sufficient to provide appropriate housing in the market (Milligan et al. 2007; Daud et al. 2017; Winston and Eastaway 2008). Choguill (2007) considers the major cause of housing shortage to be low-income households and claims that sustainability of housing could be reached by identifying the factors that cause low income and determining a new set of sustainability criteria that meet the definition of sustainable development put forth in WCED (1987).

Many studies have considered sustainable affordable housing as key to sustainable communities (DEHLG 2007; Maliene et al. 2008; Ewing and Knapp 2009; Maliene and Malys 2009). The Office of the Deputy Prime Minister and the First Secretary of State, United Kingdom (ODPM and FSS 2005a) defined sustainable communities as “the places where people want to live and work, now and in the future”. The ODPM Autumn Performance Report (2005) state that such a community is well-planned and designed with attention to economic, social and environmental aspects (ODPM and FSS 2005b; Maliene et al. 2008). It should provide the opportunity for everyone to have a sustainable and affordable house in an attractive and secure living environment. Such sustainable communities reach a high standard of economic and social welfare and provide a high-quality of life to current and future residents (Maliene and Ruzinskaite 2006; Maliene and Malys 2009).

2.1.2 Sustainability Assessment Framework TB+1

Blair et al. (2004) introduced indicator measurement systems as flexible tools that provide integrative strategies to assess sustainability performance. Indicators represent imperative concerns and clearly reflect the interests and views of stakeholders. Diverse frameworks have been introduced to define the critical indicators to provide affordable sustainable housing (Table 3). In some instance, economic, social, and environmental indicators sets are most useful (Blair et al. 2004) (Figure 13).

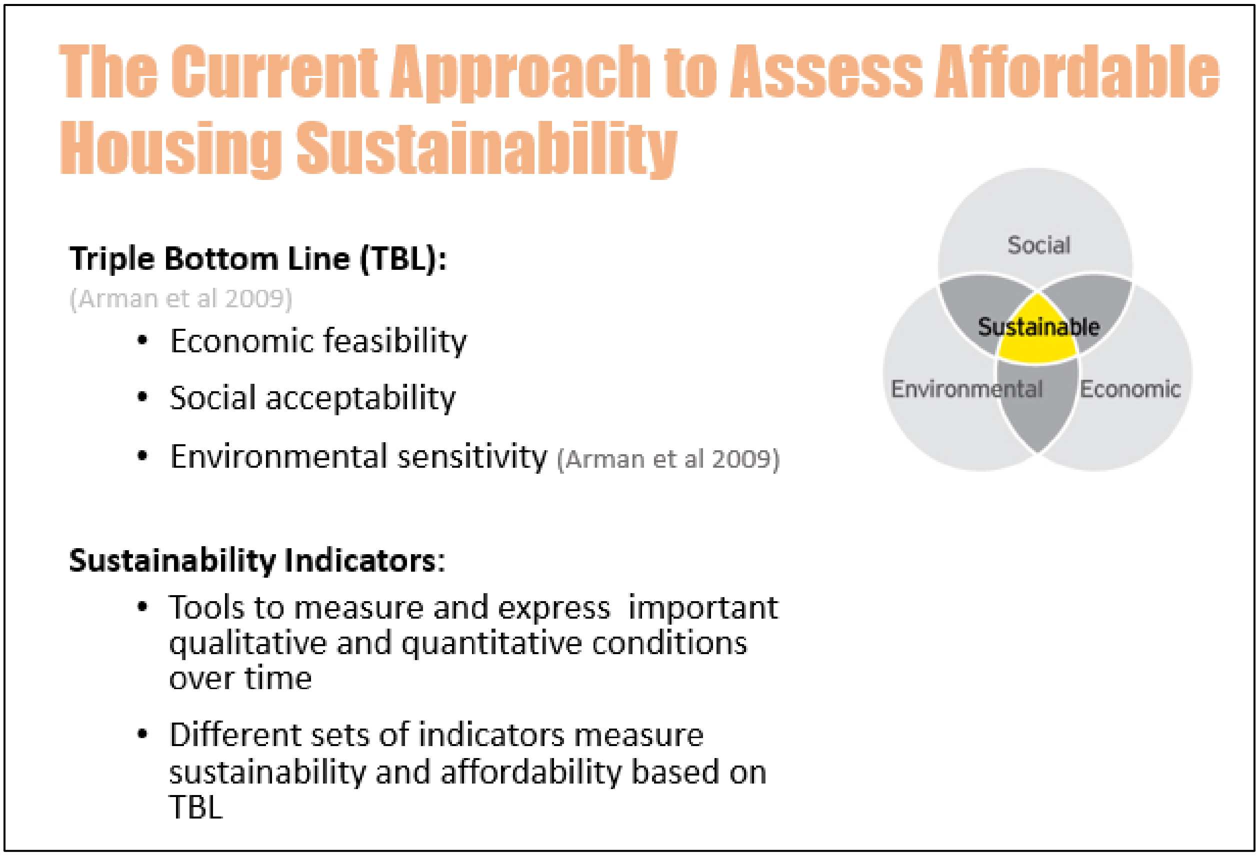

Figure 13: Triple Bottom Line and Sustainability Indicators

Yip et al. (2017) developed a conceptual framework for sustainable housings development that includes physical, social, environmental, and economic dimensions. Ibem and Azuh (2011) have created a framework to evaluate the sustainability of PH that includes four dimensions environmental and technological, economic, social and cultural. Zhang (2016) adopted the accepted four pillars of sustainable development framework by UNESCO, 2006 that include cultural, economic, social inclusion, and environmental, in addition to governance as a central connection. Burford et al. (2013) explore the theoretical and practical frameworks to assess sustainability to define the missing pillar. They examine missing pillars that include cultural – aesthetic, political- institutional, and religious-spiritual, and they conclude that institution as the fourth pillar for sustainability assessment is strongly recommended. In this paper, the framework to evaluate PH was expansion by using a governance as (+1) factor rather than cultural (Figure 14).

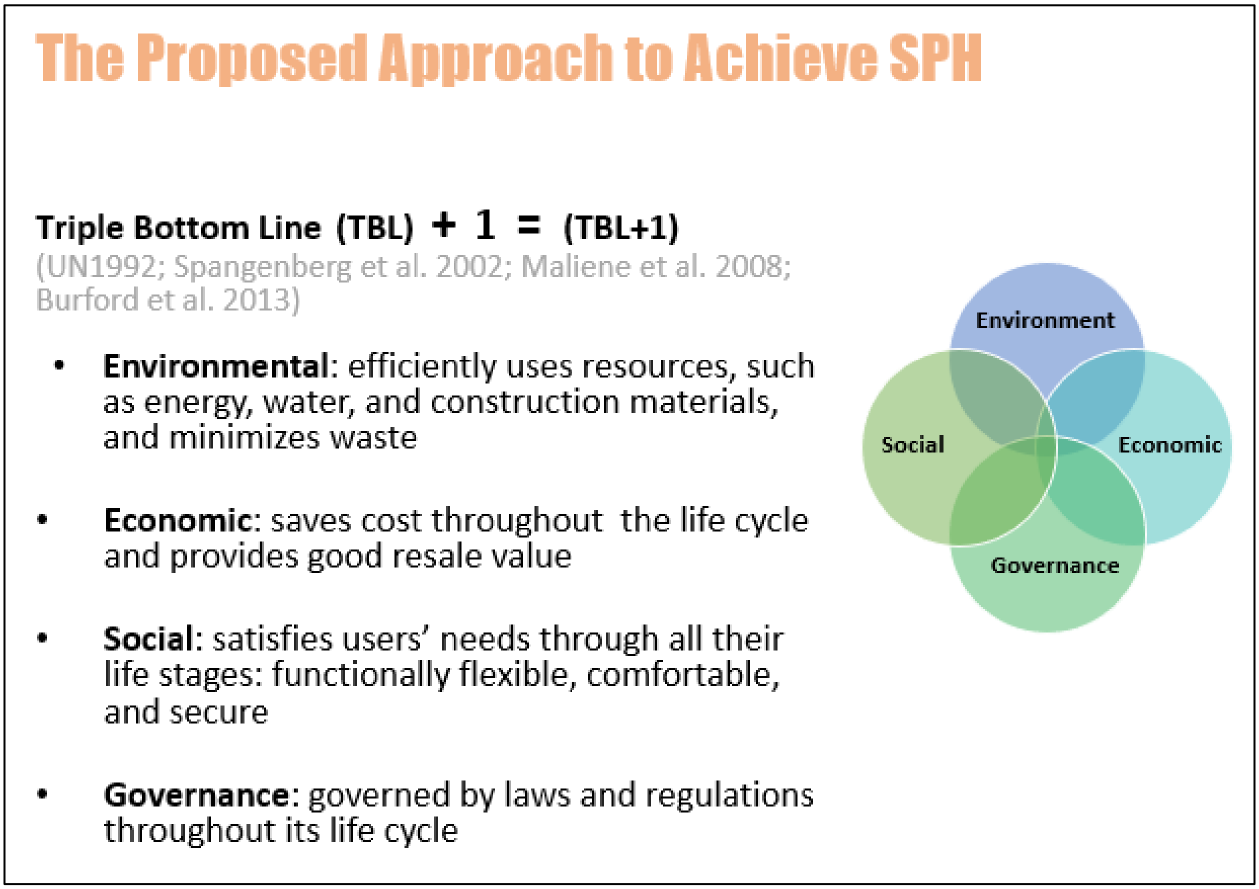

Figure 14: The TBL+1 the proposed approach to achieve SPH

Why governance is used here rather than cultural, first of all, the reviewing of previous frameworks revealed that the cultural diminution included factors such as consideration of the residents' cultural values, natural way of life, and historical architectural in designing of PH (Ibem and Azuh 2011; Ibem et al. 2015; Zhang 2016). These factors have considered part of the social aspect of PH; Vanclay (2012) considered the cultural heritage of the community part of social impact principles, and Li et al. (2014) also consider the cultural aspect as a part of the social impact for their methodology for the ex-post assessment of the social impacts of affordable housing. In this study, the identified factors relevant to cultural aspects in PH found in the literature have an overlap intervention with social, economic, and environmental aspects; thus, governance chooses as the fourth diminution of the framework. Providing a legislative framework that supports social, economic, and environmental aspects that implying cultural aspect will enhance achieving SPH. Olanrewaju et al. (2016) developed a framework to govern the affordable housing. They highlight that the government has a critical role in developing adequate housing and reduce housing deficits. Second, since the government in all the countries is the guarantor to provide the PH units; thus, it is essential to have effective policies to ensure its sustainability at the nation's plan. (Chi-man, 2004.; Huang and Zheng 2015) Considering sustainability legislation at the national level will enhance the PH sector, because all the parties and the funding agencies involved in providing PH will be required to apply a sustainability approach to achieve SPH. Mehmood and Parra (2013) highlighted that developing a sustainable governance approach and enhancing a socio-political capability is critical for housing sustainability. They address that polities support sustainability will enhance partnership among the stakeholders by creating a ‘multi-level governance arrangement,’ and reduce the overall cost of PH construction by eliminating some fees. According to Steinberg (2014), the discussion of connecting economic and social aspects to empower providing affordable housing can reduce the cost, increase the affordable housing number, and empower society. Many studies concluded that having effective policies is the way to fulfill the need for successful sustainable, affordable housing (Adabre and Chan 2019; Hoyt 2020).

The United Nations (UN) has added in 1992, in the Agenda 21 (UN 1992) a fourth dimension to sustainability which is institution or governance, to the three identified sustainability dimensions in 1983 which are: environmental, economic and social (UN 1983). The fourth diminution was added because decision makers and implementation of policy have huge effects on promoting sustainability and the culture, rules, and values of the society (Spangenberg et al. 2002; Maliene et al. 2008). Agenda 21 called on governmental organizations (GOs) and non-governmental sustainability and the culture, rules, and values of the society (Spangenberg et al. 2002; Maliene et al. 2008). Agenda 21 called on governmental organizations (GOs) and non-governmental organizations (NGOs) to develop their own indicators (UN 2007).

In 1996 the United Nations Commission on Sustainable Development (CSD) developed a set of 134 indicators that have been finalized and tested based on the four sustainability dimensions (UN 1996). In 2001, the first revision of Sustainable Development Indicators (SDIs) was published (UN 2001). The indicators were further revised and published in 2007; the final core set includes 50 approved indicators (UN 2007). These and other indicators have been used to assess sustainability at different levels: housing, neighborhood, community, and global.

Table 3: Frameworks to Assess Housing Sustainability

Framework	Reference	Sustainability dimensions	Goal
Four sustainability dimensions	UN 1992	Social, environmental, and economic, institutional	Evaluate the sustainability of built environment
Affordability and sustainability	Rahman et al. 2005	Social, environmental, and economic, government	Housing sustainability and affordability
Triple Bottom Line (TBL)	QDPW 2008	Social, environmental, and economic	Define sustainable housing
Framework to assess sustainability	Ibem and Azuh 2011	Environmental, technological, economic, and social and cultural	Fill the gap between theory and application
Reviewing the existing frameworks	Burford et al. 2013	Social, environmental, and economic, political-institutional	Defining the missing pillar for sustainability
Evaluate the sustainability of the traditional courtyard housing	Zhang 2016	Social, environmental, and economic, political-institutional	Fill the gap among the theory, practice and product
A framework to govern affordable housing in Nigerian market	Olanrewaju et al. 2016	Social, environmental, governance, economic	Highlight the role of policy to improve affordable housing
Conceptual framework for sustainable housing	Yip et al. 2017	physical, social, environmental, and economic	Develop a conceptual framework for sustainable housing

The Triple Bottom Line (TBL) model is one of the models that have been introduced to provide some integration of requirements at the conceptual level between affordability and sustainability (Pullen et al. 2010b). In 1994, Elkington originated the term “Triple Bottom Line” (TBL) to apply to business situations (Elkington 2013), but the term has been adopted in other contexts such as smart and sustainable homes (QG 2008) and environmental development (Blair et al. 2004; Blair et al. 2003; Pullen et al. 2010b). In terms of housing, “Triple Bottom Line” refers to housing that is environmentally, socially, and economically sustainable as defined by the Queensland Department of Public Works (QDPW) (QG 2008; QG 2016; QG 2017). The environmentally sustainable house uses resources efficiently and minimizes waste. The features of socially sustainable housing are concentrated on housing design that is functionally flexible, comfortable, and secure, and that meets inhabitants' needs through all their life stages. Economically sustainable housing saves costs in construction, in operating and living costs, and in long-term maintenance, as well as in future modifications. It provides good resale value and cost efficiency to the community. Rahman et al. (2005) also applied the TBL in housing and he expanded the term to "TBL + 1), by adding a fourth dimension, "governance", which points to laws and regulations that govern such housing throughout its life cycle.

The "four pillars of sustainability" included in TBL+1 have been used to provide a balanced approach to assess sustainability (Valentin and Spangenberg 2000; Sharifi and Murayama 2013; Moscardo and Benckendorff 2015; Komeily and Srinivasan 2015). A sustainable housing policy is key to generating adequate housing (Choguill 2007; Ibem and Azuh 2011), especially for PH where the low-income families have no other choice than to negatively impact the environemtn (Tolba 1987). Policy makers should have more effective roles in solving housing problems (Ibem and Aduwo 2015).

Many objectives to create applicable practical actions have been developed. For instance, Choguill (2007) introduces three objectives that should be considered in designing housing policies that support sustainability (1) provide the basis for household improvement, (2) empower poor people, and (3) give this lower segment of the urban society a feeling of self-worth. Such policies should include involvement of communities, provide good construction materials at affordable cost, and consider local or central government standards, housing finances, and the fundamental problem of land. Adding governance to the TBL is related not only to involvement of other stakeholders in making the decisions, but also to include a set of norms, laws, and regulations that govern this interaction among those stakeholders (Sharifi and Murayama 2013; Sharifi and Murayam 2014; Mulliner et al. 2016).

TBL+1 is a tool that provides an integration assessment level to evaluate affordability and sustainability. The authors adopted the TBL+1 formula to analyze and compare the PH program in the United States and Libya from the perspective of sustainability. To understand such PH experiments, it is important to discuss in detail those aspects affecting the PH movement and its effects on the surrounding areas in both countries. Applying the TBL+1 approach can provide better housing and built quality with respect to environmental, economic, and social aspects and with support from government policy. This approach is used to assess PH programs in both countries and extract the lessons that could be learned to improve PH.

2.2 Methodology

The study systematically reviews the literature in order to explore, critically evaluate, and compare the PH programs in the USA and Libya and extract and identify the lessons learned from PH experiments in both the United States and Libya that pertain to environmental, social, economic, and governance aspects. The study aim was to identify potential leading indicators to achieve SPH by exploring and evaluating the PH programs in the two countries based on the TBL+1 pillar and provide a framework to achieve SPH. The research methodology adopts the three-stage research design used by Tranfield et al. (2003), Burgess et al (2006), Bask and Rajahonka (2017) and Yigitcanlar et al. (2018) that comprises (1) planning, (2) conducting the review and evaluating, and (3) reporting and dissemination.

Stage one, involved defining study objectives, specifying the keyword search, and forming the sets of inclusion and exclusion criteria. The literature review involves the exploration of an extensive selection of material, including journal articles, governmental and non-governmental reports, books, conference proceedings, dissertations, and theses, and policy documents. The objective of our search strategy was to identify the relevant studies of public housing history, strategies, and movements in both countries. Our framework based on the sustainability assessment tool TBL+1. Out search keywords were based on the articles' keywords, title, and abstract, and relevant terms from articles references list. The designated research keyword is presented in Table 4.

Table 4: 1dentified keyword

No	Keyword
1	Affordability assessment
2	Affordable housing
3	History of public housing Libya
4	History of public housing USA
5	Public housing in Libya
6	Public housing in the USA
7	Sustainability assessment
8	Sustainability framework
9	Sustainability
10	Sustainable affordable housing
11	Sustainable community
12	Sustainable housing framework
13	Sustainable housing
14	Sustainable public housing framework
15	Triple Bottom Line (TBL)
16	Triple Bottom Line +1, (TBL+1)
17	Traditional architecture
18	Vernacular architecture

Because hundreds of sources seemed relevant, in order to narrow the scope, we developed research inclusion criteria. The inclusion criteria were academic resource books, dissertations, theses, journal articles, government resource reports and policy documents, and conference proceeding that are available online in full-text and published in English or Arabic. The exclusion criteria include other publications that than those mentioned in the inclusion criteria. The search was conducted in the following databases: ScienceDirect, Web of Science, Directory of Open Access Journals, Wiley Online Library, Google Scholar, and governmental websites.

Stage two, conducting the review involved evaluating the resources selected based on the keywords research. The research returned in 340 governmental and nongovernmental reports and other multidisciplinary scholarly resources related to sustainability, affordability, sustainable community, sustainability assessment, and sustainable housing framework. The abstracts, the executive summaries and the conclusion of the selected resources were evaluated by ‘eye-balling’ for consistency and accuracy of the keyword search (Yin, 1994). Duplicates resources were removed, and abstracts were evaluated against the study objectives. The full texts of resources of related abstracts were read and included in the review pool. After the evaluation, the review pool comprised 140 resources. These resources were screened and then read against the study aim. The final selection of 56 resources then were re-read, reviewed, categorized and analyzed. This literature selection procedure is illustrated in Figure 15.

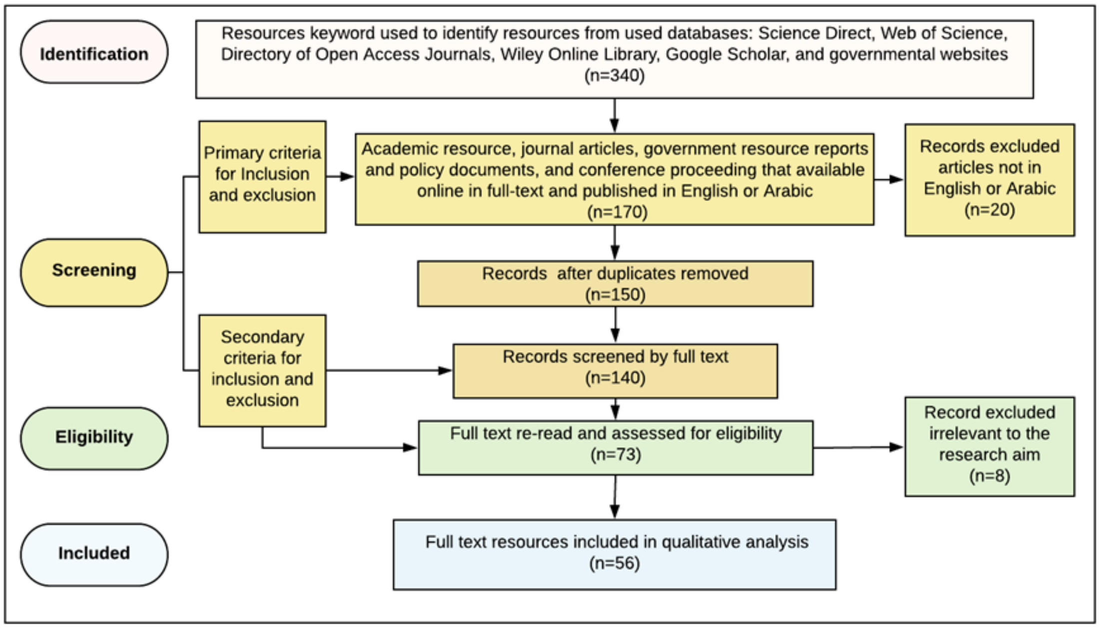

Figure 15: Flowchart for the literature selection procedure after [Yigitcanlar (2018)].

This is a descriptive study, where the qualitative techniques of pattern matching, and explanation building used to categorize the selected resources (Yin, 2015). In this context, a scanning for similarities and differences of TBL+1 aspects of PH programs in the two countries by an eye-balling technique is used to categorize and draw a conclusion of the phenomena (Yin, 1994; Groat & Wang 2013). The selection criteria of the formulated categories are parented in Table. 5. Initially, the key challenges that emerged from the literature resources indicated the major critiques are facing the PH programs in the two countries. Secondly, the significant themes of determined categories based on study objectives were highlighted. Then, in order to verify considered common themes; these themes were cross checked with the sustainability assessment research cross the global (Pullen, et al 2010a, b; Item 2011, Blair 2004; Arman 2009a,b; Choguill 2007; Daud 2017). Finally, the categories were revised and finalized in four themes based on TBL+1: social, economic, environment and governance. Some of the papers fell into more than one category but were assigned to the most relevant.

Table 5: Selection criteria for the identified categories

No	Selection criteria
1	Determine the key critiques and challenges in PH programs in the two countries
2	Formulate the key component of each aspects of TBL+1 related to each program
3	Identify and compare the weaknesses and strength key of each program based on the TBL+1
4	Group the identified key issues related to TBL+1 in order to achieve SPH
5	Shortlist the categories and crosscheck their reliability with other sustainable public housing frameworks at international level
6	Reconsider the shortlisted categories by reviewing the selected literature one more time
7	Confirm the formulated categories
8	Place the reviewed literature pieces under the determined categories—in the case of overlaps, decide the most relevant fit

In Stage 3, the work focused on presenting our findings in a literature review paper. Additional publications were incorporated at this stage as supporting evidence in order to better analyze the topic and elaborate the overall findings. With the inclusion of additional literature, the total number of reviewed, cited and quoted references was increased to 138.

2.3 Review of Related Theories

SPH is a complex topic that necessitates an interdisciplinary approach covering sustainability, social, environment, economics, policies and management, planning, architecture, sociology, psychology, health, history, and other academic and professional disciplines. It is essential to utilize different theories to understand the complexity PH programs development. The relevant theories to SPH programs used in this study include Maslow motivation theory, theory of family housing adjustment, investment theory, justice as fairness theory, and the regime theory.

The Maslow motivation theory considers housing as a basic and first level in satisfying people's needs that followed by security and positive development as a second level of needs and he provides other needs that leads to self-actualization which is a higher stage (Martin & Joomis 2007). Zavei & Jusan (2012) address that "Maslow's Hierarchy of Need" is essential to reaching a sustainable housing. Baqutayan et al (2015) connect housing criteria with the different levels of need illustrated Maslow hierarchy. The relationship between the affordability, livability, and sustainability of the house and Maslow's motivation theory are represented in Figure 16. According to Baqutayan et al (2015) framework affordability is at the first level and corresponding to physical need of the hierarchy, livability is at the second level and equivalent to safety and security, sustainability in the neighborhood is at third level and corresponding to love and belonging.

The theory of family housing adjustment developed by Morris and Winter (1975), illustrated that unsatisfactory housing is deficit house that lead the residents to adapt or make adjustments to correct deficit in their housing. They mention that the residents' adjustment actions are guide by their cultural and needs; residents' adaptation can be by mobility or conducting a modification.

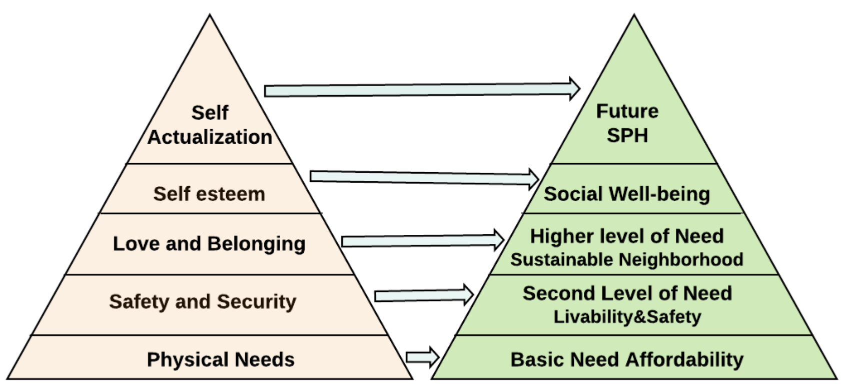

Figure 16: Maslow's Theory of Need after Baqutayan et al (2015)

Meyrick (2013) discuss the housing sustainability and affordability based on the Justice as Fairness theory of (Rawls 1972, 2001). He expands the housing policy to include economic, social and environmental aspects, and develops a framework for housing policy that includes sustainability, affordability, and housing based on justice. In his framework he emphasis that the housing policies rule is to support affordability and sustainability of current generation without compromising the needs of future generations.

Hall and Berry (2002) discuss the efficient housing assistance options in light of the investment theory. They emphasize that application of the investment theory in affordable housing could lower risk and increase the efficiency of housing policy. They highlight that improving housing efficiency is critical to boost long-term return and reduce financial risk associated with PH project Koschinsky & Swanstrom (2001) discuss the interaction of public, private, and nonprofit sectors in the USA regarding the low-income funding and policies based on the regime theory. They high light the important of review, develop, and expand the policies relevant to the nonprofit organization involvement in the low-income housing at the local and state level.

2.4 TBL+1 Aspects of Public Housing Programs in the United States and Libya

The philosophy that the living environment influences people's lives and that eliminating slums and improving living conditions for poor families would remedy urban social problems formed the basis for movement toward PH programs in both the U.S. and Libya (Hoffman 1996; Kadora 1997). Having safe and healthy housing for its inhabitants and eliminating the shortage in housing were the main reasons to start PH programs in both of those countries. However, the two governments have made different decisions pertinent to their PH based on their circumstances.

2.4.1 Overview of Public Housing Programs in the United States

Public housing in the US started in 1937 as a federal rental housing program, as a result of many planners, architects and social workers insisting that decent, affordable housing should be available for all residents, and that it is the state's responsibility to guarantee that such housing is available to all (Stoloff 2004). At first PH programs subsidized construction of housing for low income people; later they covered ongoing operation and maintenance. More recently, the role of the federal government has moved from providing construction-based subsidies to providing rental subsidies. The program is currently administered at the federal level by the Department of Housing and Urban Development (HUD) and owned and managed through local Public Housing Authorities (PHAs) (McCarty 2014). Private developers and property owners are now more important in the programs, and the federal funding is more likely to be channeled through states and localities.

Criticism of PH in the US has continued for several reasons. Housing shortages are still common and the number of families needing affordable housing is increasing, even though, many strategies have been applied to meet the housing demand. In addition, most of PH projects in the US have been severely distressed, especially the high-rise projects, and the number of PH units demolished with HUD approval is always increasing. According to Chicago Housing Authority (CHA), HUD demolition decisions are made based on "algorithmic measures of the size of facilities and levels of decay that were outside of the residents' control" (2000), which increases the housing crisis because of displacements of the project residents (Goetz 2013; Austen 2018).

Moreover, the shift in government role in funding PH and expansion in the role of private finance has raised the concern that PH in the US will lose its affordability, especially with the rise of privatization (McCarty 2014). Others consider that PH programs damage the cities; for instance, Husock (2003) claims that PH has increased social problems both within and around PH, harmed local businesses, and reduced neighborhood property values.

2.4.2 Overview of Public Housing Programs in Libya

The PH concept was introduced in the beginning of the 1960s to solve the shortage of housing that resulted from the discovery of oil. The government's strategic goal was to provide decent healthy houses for the Libyan people. The government was the only responsible party to provide housing for poor families. The beneficiary families either owned their housing because they received it as a gift under the royal rule (1951-1969), or they paid very low rent compared to the market rent during the Republican State period (1969-2011). All the families who were given a PH unit owned their housing after they paid a specific amount (usually less than the construction cost) or after the family breadwinner died.

The political decisions during the Republican State to provide PH had to be made very urgently without adequate economic studies regarding PH projects before and after occupation. No regulations pertaining to managing PH projects have spelled out the responsibility of the users and the provider, nor are there laws that prevent the residents from modifying their units. These factors have led to unsuccessful PH projects that have wasted the governmental resources invested in the sector, because the residents' modifications have destroyed the PH projects.

Even though the Republican government made many attempts to cope with the housing shortage, the need for housing continued to increase dramatically because of (1) a shift in the government role to provide PH as a result of economic conditions and (2) other political situations that limited the role of the private sector. The UN-Habitat estimated 35% of the urban population in 2001 in Libya were living in slums (CAHF 2016), and the demand for PH in Libya will continue.

After the Arabic Spring revolution in Libya (2011) the need to construct a large number of PH units has become even more urgent. The estimated number of housing units that should be implemented to meet the cumulative housing need through 2014-2033 is 1,164,134 units (CAHF 2015). In order to overcome this problem, the transition government has adopted similar strategies to those applied during the Republican State period, depending on foreign companies to design, construct and even manage housing and infrastructure programs. Many studies have highlighted that many problems have emerged in planning and designing growth of Arab cities as a result of a shortage of proper knowledge about the culture of the communities (Berger 1975; Kiet 2011). Kiet (2011) added that local engineers and architects have a better understanding of local characteristics of Arabic cities than do foreign experts, however, they do not have adequate training to translate their valuable knowledge into urban design and planning.

Criticism against PH in Libya is continually increasing because of quantity and quality issues (Kadora 1995; Sharafeddin 2004; Sharafeddin 2012b; Shawesh 2016). The housing crisis is the main problem that has faced the different political regimes in Libya for decades, and it has been growing after the revolution. The PH built during the Republican State especially suffered from a shortage of social study and local standards that are compatible with Libyans' needs and a lack of government regulations that harmonized with Libyan culture. This resulted in unsuccessful PH. Such problems continue to exist because the government still follows the same strategies to deliver and provide PH in Libya while neglecting the requirements of the local social structure.

2.4.3 Environmental Aspects of Public Housing Programs in the United State

Decisions about the architectural design, building materials, building standards, and construction practices applied in PH projects influence their environmental performance. PH projects in the US reflect many architectural designs, including high, middle, and low-rise buildings. Units may be built as self-contained projects, on scattered site properties, or even as part of mixed-income housing developments. The early PH projects were promising, having good design features and compatibility with the residents' needs.

In the 1930s, the early PH projects were a superior image of PH projects such as Techwood Home in Atlanta that have good design landscape, parking garages, and modern kitchens. Harlem River houses, and Lakeview Terrace in Cleveland Ohio also other examples of good PH projects. Most of first generation of public housing reflected a mediocre architecture; they appeared austere and just serviceable nonetheless, but they well appreciated by their occupants. A few of projects in this period, such as Parklawn in Milwaukee, LA Salle Place in Louisville and Cheatham place in Nashville resembles traditional domestic architecture consist of one- and two-story row housing with the pitched roofs and doorway and backyard (Hoffman 1996). More recently, the image of PH has become high-rise housing complexes separated from the surrounding streets and neighborhoods (Pommer 1978; Plunz 1990; Hoffman 1996).

This PH differed from the image of single-family housing, where 75% of American families were living at that time and was constructed with no regard to traditional housing in the areas. The superblock format of PH projects in the US has increased the negative effects on living environment and civic life of the society. Recently, the approach of demolishing deteriorated PH projects is continuing; and many high-rise and low-rise projects have been demolished such as

Mill Creek (1956-2002), Schuylkill Falls (1995-1996), Raymond Rosen (1954-1995), and Mantua Hall (1959- 2008).

Improving PH quality and performance is the current aim of most of the concerned GOs and NGOs. The tendency toward SPH in the US has been increasing, and the sustainability approach has been proposed as a solution to the PH dilemma. Many efforts have been applied to improve PH environmentally, such as using renewable energy and green construction practices as part of the performance assessment (HACSL 2017; HUD.GOV 2015a) in addition to using the Physical Needs Assessments (PNA) (HUD.GOV 2015b) that all PHA authorities are required to carry out to enhances PH quality.

Since 2010, HUD has created many strategic sustainability performance plans that aim to enhance PH quality. HUD recognizes the importance of local government in solving problems at the level where those problems are felt first (Ewing and Knapp 2009). Thus, HUD has created a network of regional offices and smaller field offices to achieve its goals and encourage the local governments around the US to develop their own sustainable plans. Its website includes many resources to encourage local governments to improve or start their own sustainable development plan, such as the sustainable planning toolkit. The toolkit incorporates three of the sustainability pillars (social, environmental, and economic) and includes five milestones (Ewing and Knapp 2009). This toolkit considers affordable housing as key to a vital community and includes the units of affordable housing that were built as part of the annual progress report.

The sustainable planning toolkit (Ewing and Knapp 2009; HUD.GOV 2018) adapted the New York City sustainability model plan (PlaNYC). The PlaNYC is considered a successful model that is “a comprehensive long-term sustainable plan,” and has been used by HUD for other local governments (Ewing and Knapp 2009). This plan aims to improve the neighborhood through lowering utility costs, reducing air emission by using renewable energy systems, and preserving affordable housing (NYC 2016).

Private institutions also have highlighted the importance of SPH. They have exemplified the Passive House standards as a solution to SPH. This building standard includes several performance requirements for new building that are concerned with minimizing energy usage and maximizing airtightness of the building. A passive house is designed to be very energy-efficient, healthy, comfortable, affordable, predictable and resilient (NYPH 2018). According to the Passive House Institute US (PHIUS 2017), housing designed and built to the PHIUS+ 2015 Passive Building Standard consumed 86% less energy for heating and 46% less energy for cooling (on average over all climates). In the Environmental and Energy Study Institute briefing "Sustainable Affordable Housing: Saving Energy, Saving Lives" (EESI 2016), Klingenberg (2016) emphasizes how the features of passive housing provide a high quality and durable envelope that enhances a healthy interior environment. Also, in this briefing, Hecht (2016) explains that reducing energy costs is fundamental to a stable economic situation for low-income families. He uses Weinberg Commons in Washington, DC, as an example of a renovation project that transformed the housing from energy non-passive to passive. Hecht states that the retrofit cost of Weinberg Commons to passive energy use was about 8% more than the retrofit cost to be non-passive, which made the project profitable and its approach useful to apply in other PH projects.

2.4.4 Environmental Aspects of Public Housing Program in Libya

Political decisions have been made by several governments in choosing the architectural design of PH programs in Libya, which have affected their performance: the royal regime (1952-1969), the

Republican State after the September 1969 coup, the Arabic Spring revolution in 2011, until now where the country is struggling with its democratic experiments. The PH projects executed in the royal regime were very promising and provided decent housing that its users appreciated. Most of the PH projects in Libya were built during the Republican State. In contrast, those projects suffered from a shortage of local standards and government regulations that harmonized with Libyan culture and climate, and they lacked compatibility with the local environment and users' needs. Models for the Republican State projects followed western standards of middle and high-rise housing complexes or prefabricated projects and were applied to each region of Libya without respect to local macro and microclimate. The architectural design differed from the planning patterns, vernacular architecture, and construction practices of traditional housing and neighborhoods that were compatible with the local climate and users' needs and reflected their values and own self-esteem. According to Shawesh (1996), traditional shelter design in Libya successfully reflects people's interaction with their environment and the socio-cultural values that have influenced people, their way of life, and their dignity.

Many studies have found that application of standards and specifications in planning and design PH that do not meet the users' needs and expectations have been leading to dissatisfied residents and 'sick building syndrome' (Kian et al. 2001; Ibem et al. 2013). Such unsuccessful building performance has been resulting in increased remodeling and modification. Libyan users of PH projects felt alienation with the units' designs and tended to make many modifications that changed the interior and exterior of their units in order to make them more acceptable. For example, they changed the functions of some interior and exterior spaces, closed off the windows and balconies, or built walls to provide some privacy or to protect their houses. All these modifications were unhealthy solutions because they blocked the natural ventilation and daylight from the unit while increasing energy consumption (Sharafeddin 2004; Sharafeddin 2009). Some modifications have been existing in most PH projects, such as Zawite Al-dahmany towers, Omar Al-Mokhtar high and mid-rise, and seedy Al-Massry projects. In addition, modifications of a building can destroy the building construction (Sharafeddin 2004; Ibem et al. 2013). For instance, some residents of Elhadba Elkadra residential project have modified their unit to the point that damaged the stability and durability of the entire building (Sharafeddin & Hammad 2009).

Several studies have highlighted the importance of implementing a sustainable approach in PH by restoring traditional concepts to solve housing sector problems (For instance, Gabril (2014) found that applying the passive heating and cooling techniques used in traditional Tripoli houses to contemporary housing can improve the thermal environment by 100% in winter and 60% in summer. Nevertheless, the Libyan housing authority has not recognized the importance of restoring the vernacular architecture as a solution to PH problems, either through reusing the traditional architectural design and construction practices or by implementing global sustainable building practices.

2.4.5 Economic Aspects of Public Housing Programs in the United State

Economic aspects of PH are related to the economic situations in the country that enable it to afford new PH projects and the operational costs to keep existing PH in good conditions. Four economic crises caused the United States government to shift the emphasis of their large-scale federal housing programs for low-and moderate-income Americans. Ultimately, the economic situation and inability to fund the ongoing operation cost led the federal government to stop funding construction of new PH and to use existing housing stock by encouraging partnership with the private sector. This new trend raised many questions regarding PH and its affordability since the private sector is a partner in providing PH.

The first economic crisis was the Great Depression (1929 – 1942), which caused the government to initiate the PH program in the 1930s to provide clean housing for lower and middle-income families (Hoffman 1996). The second crisis occurred at the end of World War II, when the housing shortage dramatically increased because of the return of millions of soldiers who were looking for homes and jobs. The Lanham Act of 1940 shifted the PH beneficiary families from families "temporarily poor" to war workers (McCarty 2014). Later, economic revitalization and the Housing Act of 1949 diverted the government focus to providing "a decent home and suitable living environment for every American family" (LII 1968). The Urban Renewal program was set up to clear the slums and place the families displaced by Urban Renewal in public housing. The percentage of families that qualified for private or public assistance for PH also increased from 29% in 1952 to 46% in 1962, which led to the third crisis (McCarty 2014).

The third crisis was the "urban crisis" in the late 1960s, where the pressure on the government to accelerate housing programs serving lower income families increased, especially because bad housing conditions had increased social unrest in society (Hoffman 2012). Simultaneously, the economic inflation rate was increasing markedly because of the large government expenses for the Vietnam War and domestic programs. Thus, the policymakers turned to the private sector by enacting subsidies for private housing through such programs as the Section 236 rent supplement program, the Section 221d (3) program, and the Section 23 Leased Housing Program (McCarty 2014). The federal housing assistance added about half a million units at the beginning of the 1970s (Hoffman 2012).

The Great Inflation (1968 to 1983) caused a fourth crisis to PH programs in the 1970s because the program was very expensive, and its improvement was very slow (McCarty 2014). Thus, HUD decided to use existing housing stock in lieu of constructing new housing and to provide an actual allowance instead of subsidized units.

The portion of rent that eligible families have to pay also has been determined based on those four economic crises and related policies. When the PH program launched, the beneficiary families had to have incomes high enough to pay the rents, with the income not exceeding five times the rent, or six times in the case of large families. During the Urban Renewal program, the rent of PH was assigned to be at least 20% below the market rent (McCarty 2014). According to the National Center for Housing Management (NCHM), during the 1960s the percentage of families receiving PH assistance increased by 45% (NCHM 1973).

The Brooke Amendment to the Housing and Urban Development Act of 1969 raised the percentage of the tenant rent contributions to 25% of the family income. This increase was intended to meet the operation costs of public housing and provide the PHAs with enough money to cover efficient maintenance. In contrast, the increase was very high for poor families to afford and too low to cover the PH operation costs which led to the deterioration of some PH projects (McCarty 2014). The Omnibus Budget Reconciliation Act of 1981 codified the family contribution toward rent to be 30% of family income. Currently, PH programs continue to serve some of the poorest families in the country, including the elderly, disabled persons, and families with and without children. Inhabitants of PH generally pay rent equal to 30% of their adjusted gross income; the average rents are less than private market rents (McCarty 2014).

2.4.6 Economic Aspects of Public Housing Programs in Libya

Housing for poor families was received as a gift during the royal regime, which supported for a private sector role in providing housing. During the Republican State, the private sector was absent in providing housing. The government role in providing PH from 1970 to 1984 was as the sole guarantor; many socialist laws were issued to limit the role of the private sector, such as Act No 4 that forbids leasing and prevents the private sector from building houses for profit (Sheibani & Harvard 2006). This law changed the tenants who lived in rental housing to owners of those properties, which has led to administrative instability and caused conflicts at the local level and confusion at the national housing program (CAHF 2018). Currently, this law still burdens property administration at the national level, which causes local and foreign investors to be afraid of entering the housing program in Libya because of conflicts related to property ownership (CAHF 2018). Thus, establishing investment policies that encourage the private sector and allow foreign companies to enter the Libyan economy and Libya to enter the international economy is hard, but it is an urgent need.

Changes in the economic situation based on the oil prices have changed the governmental expenditures in the PH sector and shifted its involvement. For instance, spending on the housing sector declined from 17% of the total budget of the country in the early 1970s to 9% in the early 1980s, and many governmental institutions responsible for providing PH were abolished or frozen (Sharafeddin 2004). In response to the, economic situation in the country, the government played different roles in providing PH. From 1985 to 2004, the government role changed to just supporting PH programs, but there were no changes pertinent to private sector involvement in providing PH programs (Shawesh 2016). The government has supported the PH programs through introducing investment real estate and saving at public banks as a way to give loans that allowed low-income families to own the land for constructing their housing (Shawesh 2016) or providing them with a mortgage lender through the state banks to build their housing.

In 2008, as a result of the housing shortage, the Housing and Infrastructure Board (HIB) started a large PH program to tackle the PH crisis (Shawesh 2016). Before the Arabic spring revolution in Libya (2011), about $11 billion worth of PH projects were under construction to solve the PH problem. All those contracts were with foreign investors and companies. During the revolution, all housing programs were put on hold, and the housing shortage increased because of the destruction of housing during the revolution and the inability of international companies to work in Libya. After the revolution, the urgent need to construct a large number of PH units led the Housing and Infrastructure Board (HIB) to adopt PH styles similar to those constructed during the Republican State period. The country had no formal state, and instability and unrest following the revolution spread chaos over all sectors, particularly housing and planning. The insecure situation in the country continues to threaten the safety of investments.

2.4.7 Social Aspects of Public Housing Programs in the United State

Uncomfortable living conditions in PH projects, especially high-rise building, globally have negative social consequences for its residents. These are reflected in symptoms such as feeling overcrowded, conflicts of lifestyle, loss of identity, fear of crime, and reduction in privacy (Franck and Mostoller 1995; Williams at al. 2000; Zhu and Chiu 2011). Uncomfortable living conditions in PH projects, especially high-rise building, globally have negative social consequences for its residents. These are reflected in symptoms such as feeling overcrowded, conflicts of lifestyle, loss of identity, fear of crime, and reduction in privacy (Franck and Mostoller 1995; Williams at al.

2000; Zhu and Chiu 2011). Studies have highlighted the negative consequence of high-rise for low-income families globally. For instance, Mitchell (1971) discovered consequences on the socioemotional health of residents at Hong Kong high-rise. The study found that overcrowding and small-size units in multifamily housing have negatively affected the social interaction among the family members and their neighborhood. Problems such as stress, strain, emotional illnesses, and hostility appeared in this built environment. Children that live in crowded conditions spend less time with their parents at home, which leaves them exposed to peer pressure.

Evans and others (2013) summarized 18 studies from Canada, China, Germany, England, and the USA. Nearly all these studies indicated an association between multi-dwelling housing, especially high-rises, and mental health problems. The mental and socioemotional problems include psychological disorder, alienation, neuroticism, negative social interaction, complexity of social contact with neighbors, and depression. Evans and others (2013) summarized 18 studies from Canada, China, Germany, England, and the USA. Nearly all these studies indicated an association between multi-dwelling housing, especially high-rises, and mental health problems. The mental and socioemotional problems include psychological disorder, alienation, neuroticism, negative social interaction, complexity of social contact with neighbors, and depression. Many other studies have found a strong relationship between bad housing conditions and instability and parental stress, resulting in symptoms such as anxiety and depression (Coley et al. 2013; Vandivere (2006); Gifford and Lacombe 2006). Gifford (2007) mentions that problems such the suicide, crime, and fear of crime, and bad behavior are highly experiencing among low-income housing, especially high-rise buildings. Dubrow and Garbarino (1989) interview mothers in PH in Chicago, and they found a severe level of crime and fear of crime among the mothers, and they mention that shooting, gangs, robbery, and violence were part of everyday life. Additional stress arises from financial instability. These stresses can affect the children's school performance (Coley et al. 2013; Jonsson 2013). Levenstein (2009) asserts that the PHA Housing Authority study found that the children arrested within PH are more than from the surrounding neighborhood.

Discrimination and segregation are the main social problems related to PH in the USA. In addition, insecure living conditions, inadequate housing and neighborhood quality have led to behavioral and socioemotional problems, isolation, mobility, and instability. Many of the nation's leaders felt that the urban crisis in the U.S. was a symptom of the racial inequality problem, and they considered bad housing conditions as a major reason of social unrest and discord in the nation (Hoffman 2012).

The Civil Rights Act of 1968, which stopped the discriminatory actions that prohibited PH assistance to families based on their race, was an important positive change in social aspects related to public housing. Also, mixed-income developments were introduced in urban areas to integrate and enhance the built environment by combining different classes and ethnic groups.

HUD sees housing as a way for enhancing quality of life; it works to meet the need for quality affordable rental homes and to create sustainable communities that are free from discrimination and crimes (Weisman 2016). HUD has issued many federal regulations pertaining to fair housing, such as implementation of the Fair Housing Act's Discriminatory Effects Standard and Affirmatively Furthering Fair Housing. Discriminatory housing policies have failed, increasing segregation and isolation while perpetuating stereotypes and racial mistrust within the communities (Jonsson 2013; Hanlon 2014). Hoffman (1996) argued that the rules and regulations pertaining to fair housing should deeply focus on the mechanism of desegregation and address the significance of environment by defining social behavior.

As problems with the physical soundness of PH and the social health of its communities increased, Congress established the National Commission on Severely Distressed Public Housing (NCSDPH) in 1989 to assess the PH situation. The Commission report concluded that the residents lived in fear, with high unemployment and disincentives to self-sufficiency (McCarty, 2014). The commission suggested many recommendations to improve the housing situation, such as increased social services for inhabitants and funding for housing (McCarty, 2014).

2.4.8 Social Aspects of Public Housing Programs in Libya

PH in Libya considered unsuccessful because it was designed and constructed without the benefit of any social study and with no specific standards compatible with Libyan culture (Sharafeddin 2004). Social studies help architects and planners understand the users' needs. In contrast, Libyan PH designs have been done in European offices and the units represent European architectural design and standards (Kadora, 1995). European designs did not match the Libyan culture and assumed that all users have the same family size and needs, which were directly extracted from those of European families (Belgasem 1992; Belgasem 2007). The failure of the Libyan government to have standards extracted from the traditional architectural design has increased the problems in PH (Belgasem 1992; Azlitni 2009; sharafeddin 2012b).

Users were forced to adapt emotionally to these new architectural design, which led, not only to the unit modifications discussed earlier (sharafeddin 2004; sharafeddin 2009), but also to changes in personal behavior, which caused many psychological illnesses (Hammad 2006; Al-Samsam (2002). Residents feel their visual and acoustic privacy is infringed on in these circumstances. In order to have some privacy from outside, residents have destroyed the visual features of the buildings, stamping PH with an unfavorable stigma of poverty (Belgasem 1992). Lack of privacy and inability of families to have their own houses were some of the reasons that led PH residents to have fewer children.

Unsuitable spaces in Libyan PH negatively affect the socioemotional health of all the family members, increasing their daily stress and leading to mental disorder and psychological disease (Hammed 2006). Fatahy (1982) mentions that putting many families in the same building in this type of PH project is very dangerous. He explains that people become frustrated and their imaginations die slowly when they live in this type of houses. High-rise projects (six to eight levels) are considered to be a hotbed of crime (Hammed 2006, Sharafeddin 2009; Sharafeddin & Arocho 2017).

In Libya, as in many other Arabic countries, studies show that the PH occupants are stigmatized by a reputation for poverty, unemployment, drugs, and gangs' activities (Belgasem 1992; Al-Kettani 2004; Hammad 2006; Sharafeddin & Arocho (2017). For instance, Al-Kettani (2004) studies low-income housing in Egypt, and she found that poverty and poor living conditions affected family interaction and caused children and teenagers to have bad companions, join gangs' activities, and follow bad pattern of behavior. Hammed (2006) studies the social performance of the two of Libyan PH projects that include Omar Elmkhtae residential tower and Al-Fornage low rise project, and she used five levels of Likert scale to get the residents' responses regarding the unemployment and gangs among formed among the residents of the explored project. Hammad (2006) found that the responses of the residents of Omar Elmkhtae and Al-Fornage regarding the unemployment level were at a very high level by 41.2% and 46.7, respectively, while no responses recorded at a very- low level at the two projects. Hammad (2006) also found that the responses of the residents of Omar Elmkhtae and Al-Fornage regarding the gangs formed in the project from the residents were at a very high level by 50% and 42.5% respectively, while no responses recorded at a very- low level at the two projects. Furthermore, Hammad (2006) study revealed that Omar Elmkhtae project has high level of thievery according to the residents' responses; the thievery level in the project were at a very high level by 44.1% while no response recorded at a very low-level of thievery. Furthermore, Sharafeddin & Arocho (2017) evaluate the appropriateness of playing areas in the Dar Elmazda Libyan PH project, and they found increasing in the aggressive behavior among the children in PH. They mention that children in PH projects tend to drop off school to provide their own money or join gangs.

2.4.9 Governance Aspects of Public Housing Programs in the United State

PH programs in the USA have been driven by both GOs, which include federal, state, and city, or county government, and NGOs, which include advocates from religious and nonprofit affordable housing groups. PH number and styles are influenced by laws and regulations, political decisions, and NGOs. For instance, government and developers supported the high-rise vision for PH, even though the cost per unite is more expensive than that for other types of units, because they used land efficiently in cities, where land is extremely expensive. In contrast, the government has faced the consequences of severely distressed PH projects such as Pruitt Igoe, (Stoloff 2004), and Raymond Rosen Housing and demolished them. Howden-Chapman and Chapman (2012) highlight the important to create policy that empower provision of high-quality housing. HUD established the HOPE VI which is a plan to provide grants to revitalize worst PH project into mixed income (Williams 2003).

Both public and private institutions have made many attempts to improve PH quality in the US. Examples include Traditional Neighborhood Design (TND), New Urbanism (NU), reviewing the conventional zoning, The form-based code (FBC) and Self-Sufficiency (SS). TND applies the planning principles used in traditional small towns and city neighborhoods to promote a new city-built environment. The TND approach was applied by HUD (1996) to remedy the social disorder had resulted from poor PH to revitalize the community. Both the NU and SS approaches were the basic principles for Inner City Neighborhood Designing (ICND) developed by HUD and the Congress for New Urbanism (CNU).

The NU approach combines the features of the traditional society with current daily lifestyles, and the SS approach aims to enhance the housing quality and produce vital and vibrant neighborhoods (Cuomo and Davis 2000). The CNU and HUD formed the criteria for such projects in order to boost the pride of communities where PH is well designed, and the neighborhood meets its residents' expectations and is integrated with the broader community. Those principles aim to integrate mixed incomes, ages and abilities, enhance educational opportunities, and develop the economic future of the surrounding community. The NGOs also have introduced many ideas to transform or restore the stressed neighborhood and enhance the quality of life and health conditions of its residents, such as the Prevention Institute (PI) that transformed eleven neighborhoods to improve their built environment and boost their residents' health conditions (Aboelata et al. 2004). Studies have highlighted the importance of considering and incorporating the social and environmental aspects of regulations related to PH location. Reviewing the existing regulation and standards that govern residential areas in terms of its sustainability is an important step to achieve SPH. For instance, there have been attempts to change the conventional zoning code to reduce low-density and increase the number of different housing types for SPH developments to promote walkability and to enhance the living environment of residential areas. Additionally, there is increased attention to social and environmental aspects that influence PH performance during decision-making that governs the location of PH development. Tillyer et al. (2018) highlight the impacts of the neighborhood conditions and some non-residential activities in the surrounding of low-income development in increasing the violence level and crime rate in the projects and the community.

Studies highlighted the importance of enhancing the flexibility of laws and regulation to incorporate code standards by reforming the conventional zoning to meet the NU and sustainability approach requirements (Parolek et al. 2008; CMAP 2013). This could be accomplished by enhancing mix of land use, providing different types of housing and building in the neighborhoods, and reducing travel time and improving walkability by creating a streetscape design and building characters that define the SPH projects and enhance the sense of place (CMAP 2013).

The FBC is an urban design code that was introduced as a "method of regulating development to achieve a specific urban form" (Parolek et al. 2008), and define street and public spaces to build compact, walkable, and mixed-use neighborhoods. FBC adopted into the laws to control the physical form to create a satisfactory built environment (CMAP 2013). The FBC improved the understanding of the site needs and applied standards of physical characteristics that are advance the community than the ones in conventional zoning. According to the Chicago Metropolitan Agency for Planning (Ill), conventional zoning applies a "one-size-fits-all" standard throughout the entire community (CMAP 2013). The FBC has a supplement form standard as a specific standard for each site to regulate the types of forms and buildings. Application of FBC includes scoping, assessing existing conditions, and visioning and creating regulations. The final specific FBC supplemental form standards for a specific location and community are created at the last stage to regulate the site design and building types based on the community's defined needs and requirements (CMAP 2013). A Tassafaronga Village in Oakland, CA, is an affordable housing project that applied FBC and is considered an example of a successful project.

2.4.10 Governance Aspects of Public Housing Programs in Libya

Elmknasa (1985) says that the laws and building regulations in Arabic countries do not reflect the Arabic culture because most of them are legacies from the colonial period or have been transferred from the west after autonomy. Incompatibility of laws and regulations that have been applied in housing sectors has been recognized and there have been many attempts to establish new regulations by the Urban Planning Department since 1993. Nevertheless, there are no specific standards to ensure adequate PH programs, or any laws, regulations, or even standards pertinent to any sustainable building approach. Hakemy (2002) mentions that, in order to have high quality urban planning and designs, it is important to improve the planning and building regulations to be suitable with the Arabic culture and environment without European effects. Instead, the Libyan government has depended on foreign consulting companies to provide the solution for local problems throughout all three political periods and even after the revolution.

PH programs in Libya were driven by urgent political decisions; there has been no clear stable strategic plan related to GOs throughout the all different political periods. There was no plan to expand other parties' involvement in PH programs in Libya. The NGOs were not involved in the PH sector, and the researcher's efforts to provide solutions were not applied; thus, it has been hard to change the one-sided point of view that controls the decision-making in the country. Designing a housing policy that the sustainability approach especially for PH. Enacting policies to expand other parties' involvement in PH program in Libya in order to promote its qualities. Such policies aim to promote resident engagement and NGOs involvement. In addition, enacting investment policies that governance private sector and foreign companies' involvement in PH to open such project for coemption national which will produce a better-quality PH.

2.5 Example of PH projects in the United State and Libya

This section will provide some examples of PH projects in the two countries includes both high-rise and low-rise projects from each country. The high-rise projects are Pruitt Igoe, ST Louis, USA and Zawite Al-Dhmany, Tripoli, Libya, and the low-rise projects are the Lindonfield, Philadelphia, USA and Al-fornage, Tripoli, Libya

2.5.1 Pruitt Igoe, ST Louis, The USA

Pruitt Igoe, in St Louis, was an extreme example of failed of public housing projects; the project was a middle-class complex consists of 33 11-story towers on the Northside of St Louis constructed between 1954 and 1956. The project designer is Minoru Yamasaki, who introduced the new design standards for residential housing. (Figure 17, page 104) shows the project after completion. The project was an example of the new PH image, the design concepts focus on having the space that satisfied the design requirement, such as the proportion, forms, and spaces, and it ignored the social, pollical structure of sociality since the design idea was to introduce the new design standard in housing design. The residents liked the apartments when they first came to the project; they liked not only the plumbing, heating, and electricity, but also the views and the social interaction in the project (Montgomery1985). Nevertheless, the entire project demolished at the end of 1976 (Figure 18) because of its inefficient performance environmentally, economically, and socially. The project suffered from many interior and exterior problems; the interior problems include poor planning, and physical design features and construction such as inefficient material choices, in addition to the funding issues that impacts the final design and eliminate amenities. The eliminated amenities include children's play areas, landscaping, and ground-floor bathrooms (Faisst 2017). The exterior problems are related to the policies and regulations that increased the degradation in the society between black and white (Montgomery1985), and the influence of the 'man in the house rules' that divided the families. Faisst (2017) state that "buildings turned into prisons devoid of human caring—featuring drugs, prostitution." Leavitt (1993) mentions that public housing is inhabited primarily by women of color, who struggle with the public housing landscape and design component which increases the time those women spend doing their daily activities and makes their lives harder. He also describes how those women fight for better life in public housing environment where there are not secure and clean places to raise their children, and he adds that they also fight the stereotypes of people who live in public housing. poor maintenance and reducing the social interaction have led to increase the violent crime and vandalism (Faisst 2017).

Figure 17: Pruitt Igoe, in St Louis 1976. Photograph: Bettmann/Corbis. Resource: The guardian. < https://www.theguardian.com/ cities/2015/apr/22/pruitt-igoe-high-rise-urban-america-history-cities>.

Figure 18: demolition of the Pruitt Igoe, in St Louis. Photograph: Lee Balterman/Time & Life Pictures/Getty Images. Recourse: The guardian. < https://www.theguardian.com/cities/2015/apr/22/pruitt-igoe-high-rise-urban-america-history-cities>.

2.5.2 Liddonfield, Philadelphia, the USA

Linddonfield is a low-rise project that constructed in 1953 on the 32-acre; it consists of 412 units and occupied in 1955. Linddonfield built for the military veterans and their families and later converted to a PH. Most of the residents were white and the percentage of black was 1.9 in 1956 and reduced to 1.0 in 1964 (Levenstein 2009). The project demolished in 2011, based on the decision made by the Philadelphia Housing Authority, because the project was unfunctional and the costly. Figure 19 shows the living conditions in the project. According to Philadelphia Neighborhoods (PHN) the project suffered from many serious problems, such as social and safety issues include fighting and drug dealing, in addition to deterioration that affected its performance; it had outdated plumbing heating and electrical system (2010).

Figure 19: Living conditions of Linddonfield units, source: https ://www.flickr.com/photos/503 16351@N08/5198 025301

2.5.3 Zawite Al-Dhmany PH Towers, Tripoli, Libya

The project consists of 11, eight-story towers; each floor includes three units. The project is located in the city center and connected directly with two multi-lane arterial thoroughfares named Al-

Gomhoria Street and Saadoun Al-Suwahili Street. Those streets provide a high level of accessibility to transportation, facilities, and services such as education and health facilities, mosques, and markets (Sharafeddin 2010). Nevertheless, the project has critical planning, design, and construction problems, unclear periodic maintenance programs, and lack of amenities (Sharafeddin 2010). Absent amenities in the project include children's play areas, landscaping, and community center to support social interaction (Sharafeddin 2010). The project suffered from many social and safety problems such as drugs, thievery, and high traffic accidents (Sharafeddin 2010). Figure 20 (A, B, &C) shows project conditions. Figure 20 (A) shows the basement of one of the towers in the project that indicates unhealthy and dangerous living conditions results from leaking water and sewage because of outdated plumbing. The maintenance program for the project by the government usually includes some of the towers that overlooked Al-Gomhoria Street and Saadoun Al-Suwahili Street while other towers discarded. Figure 20 (B) shows one of the balconies was eliminated from the deterioration in the maintained towers. Figure 20 (C) shows one of the neglected towers from the maintenance program.

Figure 20: Zwite Al-Dhmany PH Towers, Tripoli, Libya

2.5.4 Al-fornage PH projects Tripoli, Libya

The project consists of 344, one-floor units, two, and three bedrooms. The project located out of the administrative boundaries of Tripoli city at the time it constructed. The project location is near the highway, industrial areas, and rubbish dumps, which increase the air and acoustic pollutions that negatively affect the environment, safety, and residents' health. The project lacked to have any green areas or trees as a buffer around the project to reduce pollution (Sharafeddin 2004).

The project lacked to have landscaping, play areas, and community center that enhance social cohesion, support walkability, and provide healthy interaction among residents. Figure 21 (A) shows the open areas in the project that indicates the absence of any and street furniture and landscaping to provide shade.

Incompatibility of the planning concepts used in the project with the climate affected the project performance (Sharafeddin 2004). For instance, the adoption of wide streets and openness to the outside than insider as in traditional architecture has led to the exposure of residential units to dust storms and external dazzles and increased surfaces exposed to solar radiation, which increase discomfort and energy consumption Figure 21 (B).

The residents of the project have suffered from many social and safety problems. The residents mention that the projects suffered from problems, such as drug dealers and high thievery, and formed gangs among the project adolescence, in addition to high traffic accidents (Sharafeddin 2004).

Each unit has a front yard, back yard, and garage area (Figure 21 C); however, one-floor units have transformed into two or three units by their residents. The PH rules and regulations allow the residents to own their units. Owing the PH units have encouraged the residents to remodel their units and expand them to accommodate the family growth and extend or sell them to have some money. Recently, the project has transformed from a one-floor project to two or three-floor projects and from only low-income families to mixed communities (Figure 21 D) (Sharafeddin 2004).

Figure 21: Al-fornage PH projects in Tripoli, Libya

2.6 Comparison of the PH Programs in the United States and Libya

In both countries, the political and economic situations have influenced the PH movements as shows in Table 6. In the US, there have been clear aims, and both governmental and nongovernmental organizations have worked together to solve emerging problems. Historical movements were driven by scholarly research and other studies to evaluate problems and suggest solutions. Discussions of acceptable solutions that will enhance the living environment are ongoing. For instance, several high-rise projects were demolished to solve the problems apparent in those projects. Applying a sustainable approach to promote a healthy PH living environment has also gained prominence.

In Libya, on the other hand, all the decisions have been urgent and lacked guidance from detailed studies. There has been a desire to solve PH problems, such as in the US, but the housing authority aims to cope with the shortage of housing without attention to its quality and consequences in society. For example, the residents of high-rise buildings in Libya suffered from situations similar to those in the US, where the projects became insecure places to live. In Libya, however, there was no decision to demolish those buildings. The Libyan housing authority has repeated the same mistakes without learning from programs or solutions applied by other countries, because there is no recognition of the social or environmental and economic consequences of unsuitable PH.

The US society is diverse with many races and cultures; however, mixed-income communities have been developed to integrate the communities without economic distinction (Chaskin et al. 2013). Partnerships between the private sector and government agencies have attempted to repair existing neighborhoods and increase diversity. Nevertheless, a stigma remains for low-income occupants (Chaskin et al. 2013). Libyan society is homogeneous; there is no diversity of races. Conversely, the residents of PH have their own stigma of underclass that affects their aspirations and isolates them from society (Hammad 2006). There are no attempts to disperse poverty or integrate communities to support self-esteem and community pride. Private partnerships in Libya have faced many obstacles that limit their opportunities to integrate communities as they have in the US.

Table 6: Comparison between PH Programs in the USA and Libya with respect to TBL+1 concept

Concept	United States	Libya
Public Housing Program	**Similarities**	
	Providing PH for low-income families is the government's responsibility. PH programs are criticized because of housing shortages and distressed existing projects.	
	Differences	
	The federal rental housing is owned and managed by local PHAs. Demolition of distressed PH has wasted government resources.	Eligible families are intended to own their housing eventually/ Unauthorized user modifications of PH have wasted government resources.
Environmental Aspects	**Similarities**	
	Early PH projects were more promising than later projects. Architectural design and planning patterns of PH projects that differ from traditional housing styles have led to distressed PH projects.	
	Differences	
	The superblock format of PH projects suffered from many problems. Stressed projects were demolished or restored to a traditional design. A sustainability approach was adopted to solve problems in PH.	Western architecture design of PH led to defective PH projects. A sustainability approach to solve problems was not applied.
Economic Aspects	**Similarities**	
	Economic conditions have shaped the government movement in providing PH and reduced its involvement in providing PH projects.	
	Differences	
	Partnership with the private sector in encouraged. The portion of rent that beneficiary families pay has been increasing.	The private sector is absent in providing PH. Lack of financial study related to options tile PH residents own their unit
Social Aspects	**Similarities**	
	PH occupants are stigmatized by a reputation for poverty, unemployment, drugs and gangs, that negatively affects the residents and surrounding society.	
	Differences	
	Discrimination and segregation are the main social problems.	Forced adaptations to defective housing is a part of social problems.
Governance Aspects	**Similarities**	
	Political decisions have led to initiating PH programs to cope with the shortage of housing and provide better living conditions.	
	Differences	
	Both GOs and NGOs have driven the PH program. GOs and NGOs define emerging problems and provide solutions. Laws and regulations have been enacted to support a sustainability approach.	There is no clear form of GOs that provide a stable strategic plan for PH. There is no NGO involvement in the PH program. There are no attempts to solve emerging problems in PH projects. Laws and regulations that support a sustainability approach are lacking.

2.7 Lessons Learned

This section includes the lessons learned from two PH programs in the USA and Libya. It is divided based on the TBL+1 Pillars used in the analysis of both programs.

2.7.1 Environmental Aspects

1. Certain strategies that have been used in the US may be useful in introducing a sustainable approach. For example, retrofitting PH projects using passive house concepts, adopting green building practices, or demolishing low-efficiency and stressed high-rise PH projects and replacing them with low-rise projects.
2. Studying and redeveloping vernacular architecture concepts in the region to satisfy contemporary needs will provide a fruitful solution for SPH. Traditional housing is a historical example of housing that is compatible with the climate and provides an efficient constructability level by using sustainable local materials.

2.7.2 Economic aspects

1. Enhancing the government role in providing SPH for low-income families is fundamental to ensuring that PH is affordable.
2. The PH should not be completely free, however, and not eventually owned by the residents. In Libya, when PH has been owned by residents who had not paid enough of its cost, they have not taken care of it because they assumed that the government would allow them to have other housing if they destroyed their current residence (Kadora, 1995).
3. The portion of rent that eligible families pay should be carefully studied. The rent should support a regular maintenance plan to keep PH in good condition and that plan should be critically assessed and carried out as a part of governmental responsibility.

4. A shortage of strategic maintenance plans for PH projects has been noticed in both the US and Libyan programs. For instance, in the US the cost of maintenance sufficient to keep the buildings in good condition is higher than the rent allowed by law and regulations. That makes it hard for government to provide enough funds to construct new projects while keeping existing PH in good condition. This situation has led to introducing the private sector as a partner in providing PH, which raises concerns about its affordability. In Libya, having a clear maintenance plan that all residents can easily understand is the best way to ensure that the residents take care of PH projects; such a program should include a requirement that families who damage their units must fix them.

2.7.3 Social Aspects

1. Assessing social effects of PH projects on society is critical to allow healthy social interactions. Thus, conducting evaluation studies is the most important approach to find the main causes and propose the most appropriate solutions for PH social problems. One example of a solution is the 14 principles for ICND that apply in the US; these provide good reference points to guide new PH projects and evaluation tools to measure their success and failure.
2. Conducting a broad social study would lead to providing PH compatible with users' needs and the local culture (traditional design). Libyan PH exemplifies unsuccessful PH projects that have been built according to foreign (western) standards without social studies or standards compatible with local culture. Although residents have tried hard to adapt to the PH, their efforts often have increased mental and psychological disease among residents and destroyed the housing features and performance. Superblock and high-rise buildings do not work for PH.

3. Mitigating socio-emotional risk associated with PH is critical for its residents' health. In general, PH is related to a stigma of poverty and the residents of PH feel isolated because society does not accept them. Because the population is homogenous in Libya, but heterogeneous in the US, some strategies used in the US may not be applicable in Libya. Nevertheless, the development of mixed communities could be a way to reduce the poverty stigmatizing of the PH projects.

2.7.4 Governance Aspects

- Reviewing the PH programs in the two countries indicate that political decisions usually have a significant influence on PH development, and the centralized governmental PH programs are politically challenging to track and manage. Locally based PH programs increase the ability to create appropriate plans for each region and quickly solve apparent PH problems as they happen.
- Creating an integrated strategic management plan for SPH projects that includes a specific framework and codes compatible with the sustainable development and local community needs and values based on the TBL+1 aspect is critical to attaining a successful PH project.
- Developing an integrated framework for SPH is a step toward involving all the stakeholders (decision-makers, investors, developers, architects, planners, project managers, residents, and community) in the PH production and achieve satisfactory PH and sustainable built environment at the local level.
- Applying an integrated framework that provides criteria that work as a simple code for SPH development that covers the project lifecycle from the scoping to the demolishing. This code includes a detailed supplemental standard for each stage of the projects that will be created based on the specific calibration of the specific location and community.

- Creating the integrated framework criteria to plan SPH in the light of the FBC standards, NU, and TND and supported by local laws and regulations to ensure the SPH planning criteria meet the requirements of sustainable neighborhoods based on the social, economic, and environmental needs for a specific community. The specific criteria will work as a manageable code that highlights the community's specific needs throughout the site design and building form; it does not have to be very deep or have enormous breadth. Specific detailed supplemental standards are intended to be part of the code and interpreted in-depth.
- Creating specific codes to design the SPH based on the sustainability criteria, building codes, and use-based codes. The design code should have supplemental design standards to generate an advanced sustainable design. The supplement design standards are developed based on the community and residents' perspectives of needs and values that differ from place to place.
- Discussing during the development stage of the project the incorporation of the supplemental standards through the planning and design stages of the SPH projects.
- Providing a long-term funding mechanism for PH projects instead of an annual plan (McCarty 2014) is fundamental to mitigate the risk associated with PH funds and future economic crises.
- The government should prioritize sustainability in PH sectors throughout, setting laws and regulations that support SPH and creating an applicable plan. Such laws, regulations, and plans have been used in the US but not in Libya. Libyan PH has suffered from excessive central authority and a reluctance to manage and solve its problems. This has led to superficial attempts to develop laws, regulations, or local standards that reflect the cultural needs of Libyans or even support

sustainability. Because the law reflects the social development in each country, Libya, as well as other Arabic countries, needs to set its own laws, extracted from their cultures and societies (Elmknasa 1985; Hakemy 2002).

- Involvement of all stakeholders of PH projects in decision making is important to incorporate different points of view and determine residents' and societal expectations. Government should open PH project developments to public and community discussion to get their feedback regarding the PH problem. In the US, the NGOs have a great influence in PH movements; however, in Libya there are no NGOs, which has increased PH problems because the housing was constructed without realizing the residents' needs or discussing its negative consequences on society.
- Involvement of the private sector in PH should be studied. Private partnership has been introduced in the US as a solution to providing PH. However, partnership with the private sector can have both positive results and negative consequences---positive results such as increasing the number of housing units, and negative consequences, in that landlords' screening of prospective tenants and refusal to take vouchers may keep the poorest families from occupying the units (McCarty 2014). On the other hand, in Libya, the laws have eliminated the role of the private sector in providing PH in Libya; there still are no new laws that support such partnerships.
- Continual improvement through evaluation is critically significant. An assessment performance plan to manage SPH is the successful way to enhance those projects. Thus, improving existing assessment plans is important and creating such plans can promote PH performance. In addition, in Libya, the government should set laws and regulations to prevent modification by the occupants.

2.8 Potential Leading Indicators

This section highlights the potential leading indicators that are related to the TBL+1 aspect and the lessons learned from two PH programs in the USA and Libya.

2.8.1 Environmentally Sustainable Potential Leading Indicators

1. Incorporation of the sustainability environmental aspects consideration into planning, designing, and construction criteria.

2. Application of practices such as green building standards, passive housing concepts, and restoring traditional housing criteria will create a high-quality SPH. Applying energy-efficient design principles to reduce the negative impacts on the environment, preserve its resources, and decrease energy consumption. In some cases, more than one construction method or practices could provide more sustainable solution and reduce waste (Ganiyu et al. 2015).

3. Choosing the construction and finishing materials that are preserved the resources reduce the environmental impact and saves energy.

2.8.2 Economic Sustainable Potential Leading Indicators

1. Affordability of PH for people in need is critical, and it should be determent based on broad economic social studies. Accurate housing costs (renters and owners) as % of average household income plays a vital role in providing PH.

2. Reconsideration of the profitability and social responsibility in providing PH for both the government and private sector is required to achieve SPH. Indeed, the government is responsible for providing people with needs with PH to promote the quality of life in the society which implies its responsibility to ensure adequate funding for PH. The private sector is looking for PH as an investment, which is associated with financial risk and the fear of community rejection (Susilawati

2009). Orihuela et al. (2011) highlighted that besides the profit, there are other needs and desires for the non-government organization that should consider such as position, social responsibility, and reputation.

3. Multi approach methods based on the Long-term benefits for the development of existing PH projects or constructing the new PH is the way to achieve SPH. Additionally, proper planning for the PH project anticipated to benefit its surrounding and infrastructure services, such as roads, water, storm water, rail services.

4. Design for realistic needs with consideration of providing varieties of different housing styles and size in the same project to satisfy different residents' needs.

5. Ensuring adequate funding that ensures sufficient periodic maintenance for PH is fundamental to achieve SPH.

2.8.3 Social Sustainable Potential Leading Indicators

1. Enhancing social cohesion and healthy interaction among the residents and their neighborhood are anticipated to have long-term social benefits for the residents and their society. The residents will feel belonging and will being which enhance their sense of cultural identity. Such integrated communities will create equal opportunities for all in society (Cooper and Jones, 2008).

2. Promoting accessibility to services such as public transportation, education, health is anticipated to enhancing the quality of life of the PH residents.

3. Connecting to job opportunities is considered a way to minims poverty and engages the community (Oyebanji et al. 2017). Local programs to educating residents and provide them with skills acquisition aim to support equity and eliminate discrimination in the community (Power 2004). Such programs can lead to eliminating poverty stigma facing the residents of PH.

4. Ensuring adequate secure and safe living conditions at the units, within the project, and throughout the neighborhood. Safety concerns of lives and properties have been considering as one of the important reasons to demolish PH projects in the USA. Additionally, providing a safe living environment in the PH anticipated to enhance the sense of place and quality of life (UN 2002).

5. Involving the community in the decision-making process regarding PH and increasing residents' awareness are the basis for successful SPH projects. The residents of Diggs Fork Town have valuable input to redevelop the project. The resident indicated the main problems and highlighted their needs and expectations (Bothwell et al. 1998). Early anticipated residents' involvement in the new project is considered a key for successful PH programs. Enhancing residents' awareness and ability to adapt to a sustainable lifestyle in their practical life is critical for achieving satisfactory PH (Oyebanji et al 2017). The force adaptations in Libyan PH have led to many adverse consequences.

2.8.4 Governance Sustainable Potential Leading Indicators

1. Supporting sustainability approach from the government which allows for the provision of adequate SPH for people in need.
2. Designing for realistic decision making process regarding SPH because limited fund beside other factors have led to unsuccessful PH. Thus, consideration of government responsibility in providing PH is expanded to revitalize the neighborhoods and the entire cities as the sustainability development highlighted (Choguill 1993, Worika 2002; Chiu 2003; DCLG 2007; Gan et al 2017).

3. Effective policy and legal frameworks for encouraging: (1) the private sector involvement in provision of SPH, (2) residents' feedback, and (3) anticipated residents to fulfillment their expectations.
4. Enhancing efficient implementation and control for sustainability approach for existing and future PH.
5. Incorporation of the social and environmental aspects in developing regulations and standards related to SPH to ensure provision of satisfactory SPH in sustainable community.

2.9 Conclusions and Recommendations

A great deal could be learned from these two PH programs to improve PH programs in general. SPH is economically, environmentally, and socially acceptable and governed by laws and regulations that support sustainability. SPH provides PH that saves energy and reduces waste, respects the environment, and ensures the right of the new generation to a good quality of life. A SPH approach could be created or improved in any country at any time based on the four sustainability pillars and adoption of other countries' sustainability models, such as those that have been used in the US. SPH could be approached by using green building standards, passive housing or vernacular architectural practices. Those strategies can be applied to existing and new PH projects.

2.9.1 Environmental aspects

SPH could be environmentally responsible by following these steps.

- Setting a target to improve SPH programs by incorporating new sustainability strategies to existing and new PH programs.

- Applying practices that enhance environmental aspects of SPH, such as green building standards, passive housing concepts, and studying traditional housing in the specific area to determine the characteristics needed. For instance, a traditional approach will provide a vital neighborhood and encourage sustainable communities. In the US, the traditional approach has been used to restore stressed PH neighborhoods such as Diggs Town in Norfolk, VA (Bothwell et al. 1998). In Libya, the vernacular architecture provides a successful example of housing that is compatible with the regional climate and traditional lifestyle and social activities. The Tripoli House exemplifies the vernacular architecture of housing in the coast regions in Libya, and it can be easily adapted to PH project design and planning criteria, especially since the Libyan people are familiar with it.
- Implementing a sustainability plan to enhance the strengths and eliminate the weaknesses of SPH.
- Conducting periodic assessments to measure and monitor housing performance and report the results.
- Enhancing research regarding SPH.

2.9.2 Economic aspects

- SPH should not be free. The practice in Libya of allowing the residents to own their unit eventually has not been successful in improving the life quality for low-income families, which supports the practice of rental-only access to PH in the US.
- The portion of rent that low-income families should pay to improve the living conditions needs to be reexamined.

- Feasibility studies that support life cycle operation costs of SPH projects are a successful way to reduce waste and save government and residents' money. Well-designed SPH functions well for its users and is compatible with its surroundings, which prevents deleterious modifications that cost the residents and wastes the government money. The money saved by the government can be used to enhance and increase PH units. The money saved by the families can be used to enhance health, standards of living and children's education.

2.9.3 Social aspects

- Design of PH projects should respect the human scale. High-rise PH projects should be avoided because of their negative consequences in many countries. In Libya, as in the US, high-rise PH projects are considered hot spots of crime. In the US, high-rise PH projects have been demolished and replaced by low-rise projects.
- A clear periodic maintenance program to ensure the projects are in safe condition is critical because poor maintenance affects the performance of the housing.
- Improving social services for PH residents will eliminate some of their social problems as suggested by NCSDPH in the US.
- Enhancing research related to socioemotional health of inhabits of PH projects would provide background for decision makers to use in promoting the PH sector.
- Conducting assessments, such as Post Occupancy Evaluation, to evaluate PH stock and track PH project performance will increase the users' satisfaction level and promote new PH projects.

2.9.4 Governance aspects

The government should promote its role to enhance SPH through the following:

- The government role in providing SPH should be increased. It is the responsibility of government to provide SPH in both countries. PH should be owned by the government. May be better to be in economic only.
- Decentralizing PH programs to serve regional needs and enhancing the local management level trend is important, because the size of both countries make such programs politically very hard to manage. In the United States, local regions have been encouraged to solve their architectural and societal problems as they first occur. In Libya, this approach has not been adopted, but it could benefit from similar local modifications appropriate to regional climate and societal situations.
- The role of partners in providing affordable housing requires serious discussion. The role of private partnerships needs more study in both countries in order to eliminate negative consequences and enhance positive results. In the USA, involvement with the private sector increases uncertainty that PH programs will be affordable. In Libya, improving the laws related to the private sector is urgently needed and requires a lot of work before public-private partnerships can be formed.
- The role of NGOs in providing PH should be increased, especially in Libya. Input from NGOs and PH advocates in the US have improved living environments in PH there.
- The community must be engaged and involved in bringing up PH problems and discussing solutions. In addition, getting feedback from communities for planning and design phases will ensure that the PH constructed fulfills the community's needs.
- Laws and regulations that support sustainability must be enacted, and the housing standards, laws and regulations that govern SPH should be improved

- Enhancing research related to policy application and periodically updating these regulations to include new improvements related to SPH are crucial.

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3. Chapter 3: Toward Sustainable Public Housing: A Comparison of Social Aspects in Public Housing in the United State and Libya

3.1 Introduction

A house is an important part of family life; it is more than its materials and the spaces of its physical structure. It reflects the meaningful aspects of users' lives, their ideas, their social behavior, and other special socio-cultural aspects. Sustainable housing and sustainable community have received significant attention globally. They are considered key to providing a high-quality built environment. Public housing (PH) programs provide a substantial portion of housing in both developed and less developed countries--for example, approximately 1.3 million units in the USA (McCarty 2014), while 62% of total housing in Libya are PH units (Sharafeddin 2004). Therefore, it is imperative to have sustainable public housing (SPH) in order to enhance the quality of the built environment.

Sustainable housing has been defined by the Queensland Department of Public Works (QDPW 2008) with the term "Triple Bottom Line" (TBL), which means housing that is environmentally, socially, and economically sustainable. Rahman et al. (2005) added a fourth dimension called 'governance,' defining such housing as 'TBL+1', which points to laws and regulations that govern such housing throughout its life cycle. The TBL+1 concept will be used in this paper to define sustainable housing.

The Office of the Deputy Prime Minister, London (ODPM 2005) defined sustainable communities as "the places where people want to live and work, now and in the future" and indicated that a decent and affordable home for all is essential for a sustainable community. Many scholars have also mentioned the relationship between sustainable affordable housing and sustainable communities, and they explain the imperative to simultaneously tackle PH sustainability issues and sustainable community to enhance society. (e.g., (IDEHLG) 2007; Mulliner et al 2013).

Studies show increased attention toward discovering the relationship between housing and neighborhood qualities and its effects on residents' well-being (Hanlon 2010; Coley et al 2013; Ellen & Glied 2015). Poor housing quality and distressed neighborhoods negatively affect both individual and civic life. Social and economic aspects of the living environment are linked to general health and socio-emotional conditions of the residents (Evans et al 2003; Coley et al 2013; Ellen & Glied 2015). Poor housing conditions include poor quality construction, roof leaks, broken windows, and breakdowns in plumbing. These conditions can result from inadequate design and construction, lack of maintenance, and the economic situation of the family and its poverty level. Poverty leads to crowding in residential buildings, which can cause psychological distress among the family members and in their interactions with community (Hanlon 2010). In addition, it can discourage the residents and lead to poor eating habits, smoking, excessive drinking, and neglect of their health (Cubbin et al 2008).

The objective of this paper is to identify social criteria that could be applied by housing ministries and policymakers in order to integrate sustainable PH in a sustainable community. The conditions of PH programs in the USA and Libya will be compared and analyzed with particular emphasis on the social factors affecting the residents, the houses, and the community in order to provide potential solutions to social problems. The information used for this study was collected from literature and previous work on the topic

The study presented here thoroughly reviews the literature to identify social criteria that could be consider by housing ministries and policymakers in order to integrate SPH in a sustainable community. The conditions of PH programs in the USA and Libya will be compared and analyzed with particular emphasis on the social factors affecting the residents, the houses, and the community in order to provide potential solutions to social problems. Even though the two countries have different political system, social structure, and economic status, the PH programs in the USA and Libya were chosen, to provide more comprehensive understanding of the complexity of social aspect facing such programs in different societies which intended to provide realistic solutions.

3.2 Methodology

The systematically review of the literature based on three stages as research design were adopted from Tranfield et al. (2003) and Yigitcanlar et al. (2018). These three stages included: planning, conducting the review and evaluating, and reporting and dissemination to explore and identify social problems facing PH in both countries and provide potential solutions. First, at planning stage, study objectives were stated, and relevant studies selected based on the specified research keywords. The designated research keywords include social sustainable housing, public housing in the United States, public housing in Libya, housing and mental health, social sustainability assessment frameworks, sustainable social factors, social success housing, sustainable affordable housing, Triple Bottom Line, sustainable built environment and health, social sustainable community. The search was conducted in the following databases: ScienceDirect, Web of Science, Directory of Open Access Journals, Wiley Online Library, Google Scholar, and governmental websites. The literature review search encompasses an extensive selection of journal articles, governmental and non-governmental reports, books, conference proceedings, dissertations, and theses. The inclusion criteria for preceding literature review search that are available online in full-text and published in English or Arabic.

The second step is reviewing and evaluating of 105 selected resources based on the research key words and includes: removing the duplicated resources, incomplete resources, eyeballing the abstracts, the executive summaries, and the conclusions for accuracy, and re-evaluating the abstract against the study objectives. A total of 70 resources were fully read, evaluated, and included in the review pool. The final screen involved re-read, reviewed, categorized and analyzed of 42 selection resources. Figure 22 shows the selection criteria of the resources.

Finally, in Stage 3, presenting the research findings in a literature review paper that include other incorporated publication to provide better analysis. The total number of cited references was increased to 63.

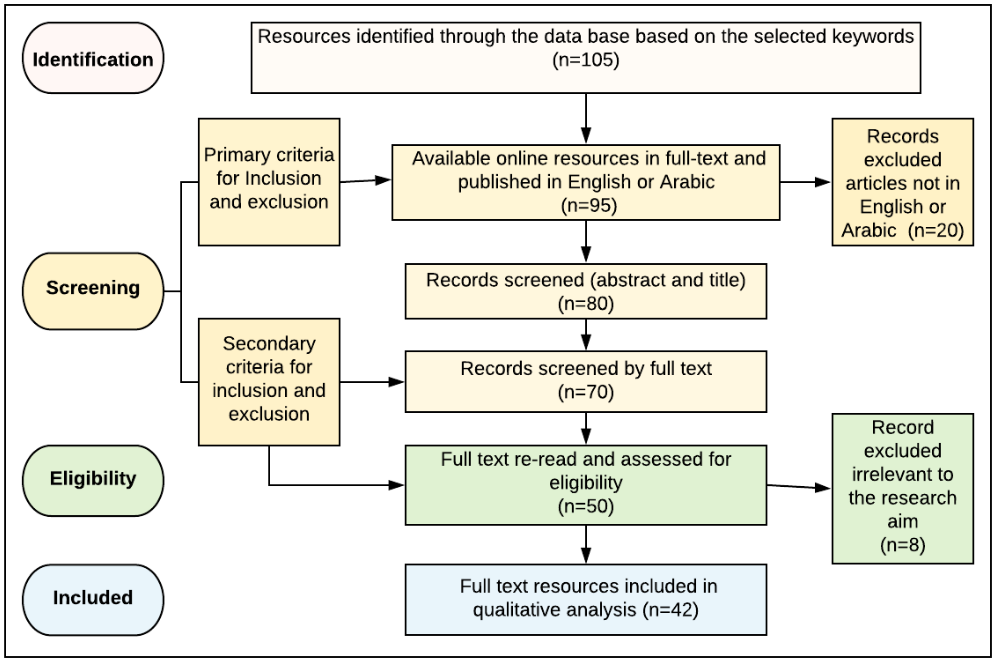


Figure 22: Flowchart for Selection of Review Articles Format from Yigitcanlar et al. (2018) After Semrau et al. (2016).

3.3 Social Aspect of Public Housing

Many studies have identified different significant social criteria for sustainable housing that affect residents' satisfaction and influence society. Absence of such factors led to dissatisfied residents and unsuccessful PH projects. Discrimination and segregation, stigma of poverty, isolation and less social cohesion, and low quality of housing and dissatisfaction conditions of living environment are the majority if social problems that are facing PH in the world. Weisman (2016) stated that Department of Housing and Urban Development (HUD) perceives of the quality of life enhancement through promoting affordable housing quality and creating a sustainable community that promotes desegregation, provides equal opportunities, secure, safe, and free of crimes living environment.

To understand such social problems faced by PH programs, it is important to review the social criteria to have successful housing. Oyebanji (2014) highlighted that social sustainability of housing is about satisfied different residents' cultural background and lifestyle. Pattinaja and Putuhena (2010), expanded social sustainability of housing to include social cohesion, security level, accessibility and suitability to surrounding services. Dixon and Woodcraft (2016) added other factors such as residents' participation and community involvement.

Oyebanji et al (2017) identify nine social successful factors including: ensuring security of lives and properties, enhancing community development and social services, empowering social cohesion, ensuring welfare and quality life, sponsoring skills acquisition and job opportunities, promoting equity, boosting quality housing provision, raising public awareness, and stakeholders' participation. Atanda (2019) provide a set of social sustainability criteria that includes: social equity, environmental education, participation and control, social cohesion, health and safety, accessibility and satisfaction, cultural value, and physical resilience.

In the same context, many studies have highlighted the importance of residents' perceptions to identify critical social successful factors for sustainable hosing (Ibem et al. 2015, Tapsuwan et al. 2018, Sharafeddin et al 2019). Sharafeddin et al (2019) defined a set of social indicators for SPH that affect resident satisfaction including: security and safety level, accessibility to recitation services and social cohesion. They found that lack of security reduces residents' satisfaction. Such indictor has a negative influence on resident satisfaction and surrounding neighborhood. The following Table 7 illustrates the significate social problems that have been facing sustainability of PH in literature and its influence on residents.

Table 7 social problems facing sustainability of public housing projects in previous studies

No	Social problem	References	Themes of health consequences on residents
1	Discrimination and segregation	Weisman 2016; Hoffman 1996; Jonsson 2013; Hanlon 2014; Jensen 2009; Leavitt 1993; Dreler and Atlas 1994	Fear, insecure, poor psychological health, depression, negative social interaction
2	Crime level and insecure living conditions	Pattinaja & Putuhena 2010; Jensen 2009; Leavitt 1993; Dreler and Atlas 1994; Gifford 2007; Belgasem 2007	High violence behavior, fear, poor psychological and physical health
3	Incompatible PH format (High-rise) and bad neighborhood conditions	Bothwell, et al. 1998; Gifford 2007; Sweatt et al 2002; Evans et al. (2003); Ellen & Glied 2015	Alienation, neuroticism, negative social interaction, mental and socioemotional problems for children and adults; injuries and homicide
4	Isolations and disrupts social cohesion	Harraka, 2002; Bohl 2000; Passell 2013; Bothwell 1998; Manal et al. 2004; Evans et al. 2003	Alienation, children's emotional development problems, complexity of social contact with neighbors, and depression
5	Mobility and instability	Coley et al 2013; Jensen 2009; Marcal & Fowler 2015	Negative socioemotional performance within parents and children, less academic performance for children, negative social interaction, and depression
6	Force adaptation	Marcal & Fowler 2015; Hammad 2006; Gabril 2014	Socioemotional problems among family members, behavior changes, mental disorder and psychological disease
7	Lack of visual and acoustic privacy level	Memarian & Ranjbar-Kermani 2011; Hammad 2006	Negatively emotional behaviors, negative social interaction, complexity of social contact with neighbors.
8	Low quality and discomfort living conditions	Hanlon 2010; Cubbin et al 2008; Hecht 2016; Coley et al 2013; Jensen 2009	Behavioral problems and less cognitive function; inadequate health care; teen motherhood, injuries and homicide especially among children
9	Modifications	Hammad 2006; Kim& Kim 2010	physical and emotional health problems, performance difficulties and depression, complexity of social contact with neighbors
10	Poverty stigma	Coley et al 2013; Jensen 2009; Hammad 2006	Anxiety and depression, parents' stress, interrupts the child learning, low self confidence among family members
11	Detached to the place and disability of self-display	Belgasem 1992; Shawesh 1996; Azlitni 2009.	Stress, children low academic performance which negatively affects their emotional behaviors., and social interaction
12	Low residents' participations and involvement	(Bothwell 1998).	Alienation, negative social interaction, complexity of social contact with neighbors

3.4 Overview of Public Housing in the USA and Libya

PH programs in the United States and Libya, as in other countries, are formed by the economic and social situations and by changes in related policies. The philosophy that the living environment influences people's lives and the idea that "eliminating slums would cure the urban social problems" were the basis for establishing PH in both the USA and Libya (Von Hoffman 1996; Kadora 1995). Providing safe, healthy, and affordable housing and eliminating housing shortages were the main goal for PH programs in both countries.

In spite of their common aims, the PH programs in the USA and Libya differ significantly in certain aspects. The PH programs in the USA refer to a unique federal-local relationship where "the properties are owned and managed at the local level by quasi-governmental public housing authorities (PHAs) under contract with the federal government" (McCarty 2014). USA PH programs started in 1937 as subsidized construction of housing for eligible families; later they included operation and maintenance costs; recently, the federal government role has decreased to affordable rental subsidies and the private sector has played a more important role in providing PH (McCarty 2014).

PH programs in the USA have been facing many problems especially the superblock format of PH that burdened the living environment, which have led to demolished most of them. Such new architectural format was different from the single-family housing where 75% of American families were living at the time the projects were designed (Plunz 1990; Pommer 1978; Hoffman 1996). High-rise projects were suffering from many social, environmental and economic problems and considered inefficient projects.

In Libya, the PH concept was introduced in the beginning of the 1960s to eliminate the shortage of housing in big cities such as Tripoli and Banghazi as a result of oil discovery (Hammad 2006). Two main features of overcrowding appeared in the Libyan big cities. First, marginal congested housing in the inner Old Cities and other existing housing, and second, construction of new slums and squatter camps (Sharafeddin 2004). The housing situation prompted the government to establish a PH program. Providing poor families with decent healthy houses was the government responsibility. Those families owned their modern housing during different political regimen; under the royal rule, they were received as a gift, and during the republican state period, they had to pay very low amount of money as rent (Sharafeddin 2004; Shawesh 2016).

This strategy envisioned to provide a successful PH projects; however, numerous problems have been faced by PH programs in Libya. Residents were not able to adapt rapidly to the new architectural housing styles that are different from traditional housing style that are compatible with users' needs and regional climate. Criticism of PH increased, and people tended to leave it or to change the housing to make it more acceptable and satisfactory for their needs (Belgasem 1992; Kadora 1995; Sharafeddin 2004).

3.5 Features of Public Housing and Neighborhoods in the USA

The megadevelopment in the cities and the superblock format of PH projects have increased alienation and reduced social interaction in the communities, which negatively affects civic life (Bothwell, et al. 1998). According to Harraka, (2002) social capital is no longer a valued commodity in the USA. Social capital includes the "connections among individual social networks and the norms of reciprocity and trustworthiness that arise from them" (Putnam 2001).

3.5.1 Attempts to enhance sustainability of public housing and neighborhood in the USA

Many governmental, private, and nonprofit institutions have attempted to improve the housing quality in the USA (Hanlon 2010). Often two or more entities realize the connection between the built environment and human health and cooperate to enhance PH quality in the USA. Those entities, both public and private, recognize the importance of improving physical conditions of the built environment in order to have well-designed and healthy neighborhoods that enhance civic life (Cubbin et al 2008). Many attempts have been carried on by those entities to enhance PH living conditions.

3.5.1.1 Governmental attempts

The USA governmental entities have been applying different strategies to enhance PH performance including utilizing the Traditional Neighborhood Design (TND) and the New Urbanism approaches; taking actions to reinforce, restore, remodeled or demolished stressed projects; and launching numerous legislations

First, application of The TND and The New Urbanism approach. The TND was introduced as a solution to remedy social disorder that faces PH as a result of poor housing design and to revitalize the community. Residents of PH often lose their ability to interact socially through the physical network. TND provides primary physical elements in both housing and its surroundings that socially enhance the community (Bohl 2000). For example, elements such as front porches, windows, and door size and position increase the safety of outdoor spaces because they allow residents to monitor the street. In addition, well-designed streets, wide sidewalks, playgrounds, comfortable street furniture, and applying human scale promote social interaction among neighbors and increase residents' affiliation with their housing and society.

The New Urbanism approach developed by HUD combines the traditional societal features with the new daily lifestyle and the path of self- sufficiency to enhance housing quality and encourage vibrant neighborhoods. The idea is to have good design for PH and neighborhoods that meet the residents' hopes and aspirations and are integrated with the wide-ranging community. Those principles are targeted to integrate mixed incomes, enhance educational and employment opportunities, and revitalize the economy in the community. Planners and architects have engaged a new vision by considering interdisciplinary aspects that address environmental and social conditions that enhance community (Passell 2013). Such aspects might include walkability, where the street is designed for pedestrian use; a variety of housing; mixed use; services in the neighborhood; and provision of amenities such as a community center, exercise facilities, and daycare center.

Second, actions have been made to reinforce the PH and provide modern amenities such as demolished some physically and socially distressed and constructing new PH in its place; other PH project has been remodeled and retrofitted. The following are some examples of those attempts to promote distressed PH to improve housing quality and revitalize the community.

Some of demolished distressed PH include Pruitt-Igoe, in St Louis, Cabrini-Green in Chicago and Layfayette Courts in Baltimore, MD (Hoffman 1996; Bohl 2000). These PH projects were high-rise buildings in superblocks that had been constructed with no regard to traditional housing in the areas. Lafayette Courts was replaced by Pleasant View Gardens, which applied a traditional neighborhood design approach with low-rise townhouses with front and back yards and individual addresses. New through streets connect the project with the surrounding neighborhoods. The high-rise apartments in the Lexington Terrace project in Chicago, was also replaced with mixed-income ground units. The Columbia Villa project, a barracks-style PH in Portland, OR, was reconstructed, turning an aging PH site into a new, mixed-income community.

Diggs Town in Norfolk, VA was example of restoring PH projects-based on TND to create a dynamic and productive reciprocal relationship between the built environment and social life (Bothwell 1998). The plan was to get the residents' feedback regarding existing problems in the project and to engage them in solution development (Bothwell 1998). This project suffered from serious social problems, such as crime, drugs, and decay, and the residents had lost the ability to define their territory and control their community. (Figure 23, page148) shows the Diggs Town in Norfolk before the development. (Figure 24, page 148) shows the Diggs town plan view before and after the revitalizing. Incorporation of TND features and elements, such as porches, fences, patios, and storage sheds were introduced in development plan. Adding the new front porches was the most important change; it redefined public and private areas, linked the residents to their space and increased the social cohesion among residents (Figure 25, page 149). It also allowed the residents to express themselves as individuals and connected them within the community (Bothwell 1998). Adding front and back fences for each unit to define the outdoor spaces and providing new elements such as backyard patios and storage sheds made it easier for residents to control their outdoor spaces and increased the safety and protection levels in the project (Figure 25, page149).

The project streets and open areas were also redesigned to improve civic life in this community. The redesign intended to provide accessibility to the projects' courts and parking in front of most units by replacing the pathways with streets, adding parking islands and small-scale streets. The Digges Town redevelopment program is contradictory with the defensible space theoretical framework (Newman 1995; 1996). Newman's defensible theory points out that crime can be prevented by increasing the residents' ability to control spaces. Newman's framework was applied in the Five Oaks Community in Dayton, Ohio. The redesign of the street at the Five Oaks Community has entirely changed the long street character with directional avenues laden with traffic to provide short and controllable streets with fewer cars and limited entry to residential areas, which reduced the crime rates by 50% (Newman 1995).

Reynald & Elffers (2009) discuss the future of Newman's defensible space theory; they examine the relationship between Newman's defensible theoretical framework and the effects of different types of activities carried out in the place. Reynald & Elffers (2009) state the Newman's defensible theory remains obscure in some respects related to the territorial definition of individual premises such as the semi-public and public spaces in a residential area. Reynald & Elffers (2009) reviewing of Newman's defensible theory can explain how the redesign of the residential street in Diggs Town was applied to produce a more satisfactory living environment in the project. The revitalization plan also included walking paths created to be eight-foot-wide brick or concrete paths with shade trees along the walks and front yards (Figure 25, page 149).

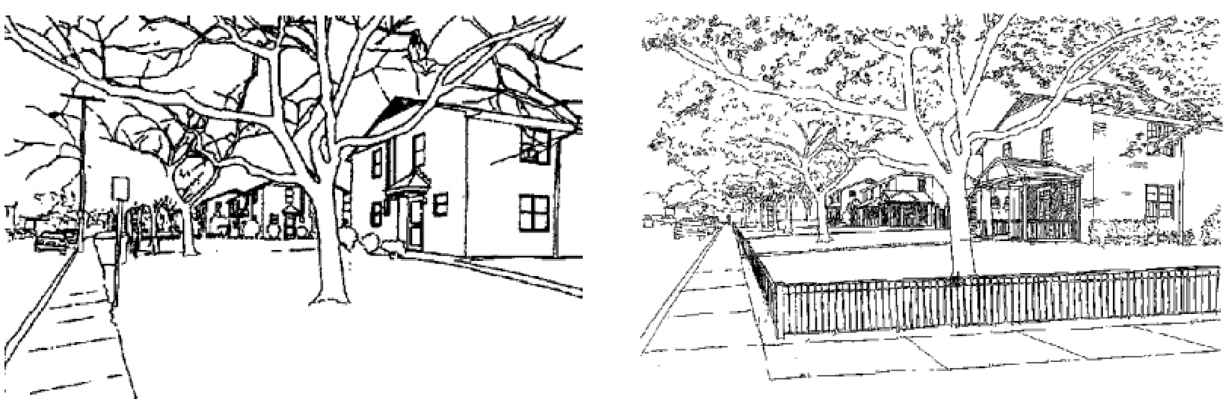
Figure 23: Diggs Twon Plan View. Sources: courtesy of Urban Design: https://www.preventioninstitute.org/location/diggs-town-public-housing-redevelopment-project-norfolk-virginia

Plan view for Diggs Town; Left: before; Right: After

Figure 24: Diggs Town Plan View. Sources: courtesy of Urban Design: https://www.preventioninstitute.org/location/diggs-town-public-housing-redevelopment-project-norfolk-virginia

Street replace pathways; Left: before; Right:

Porches for Living; Left: before; Right: After



Adding a metal fences; Left: before; Right:

Figure 25: Revitalization features in Diggs Norfolk.
https://www.innovations.harvard.edu/sites/default/files/hpd_0901_bothwell.pdf

Third, launching several legislations to promote PH also have been applied to promote PH performance. For instance, the Housing and Urban Development Acts of 1968 banned new high-rise PH projects for families (McCarty 2014). Newman (1995) distinguish the difference between high-income families and low-income families live in a high-rise. He indicates that the interior public areas, such as the corridors, stairs, and elevators, are controlled by management staff such as doormen and porters. On the contrary, Newman (1995) described the interior public areas in Pruitt-Igoe as a “dangerous places to walk through that is covered in graffiti and littered with garbage and human waste.”

In order to improve the PH quality, the U. S. Department of Housing and Urban Development, Office of Public and Indian Housing has issued many notices regarding PH performance and quality. Most of these notices expired one year after the issued date, which indicates how fast is the movement to improve housing quality. The notice PIH-2009- 43 (HA) aimed to enhance the PH quality by defining green building principles that can be applied in PH, such as using “renewable energy and green construction practices and encouraging the office of Public and Indian Housing (PIH) to apply green construction techniques for construction, maintenance, or modernization of PH projects” (HUD 2009). Coincident with applying green building concepts in PH are the efforts to improve PH quality by devolving a standard format for Physical Needs Assessments (PNA) that is required to be used by all PHA authorities (PHAs). According to notice PIH 2010- 46 (HA), the new PNA form “will integrate utility management and capital planning, provide PHAs a project-based capital planning tool, and permit HUD to aggregate PNA data to derive a national needs number” (HUD 2010).

Deferent laws and regulations have been initiated to ensure fairness and equity in the PH living environment. Jonsson (2013), and Hanlon (2014) pointed that the fair housing law and regulation that aim to eliminate segregation and isolation have failed. In contrary, Hoffman (1996) indicted that rules and regulations pertaining to fair housing have continued stereotypes and racial mistrust in the society. He suggested advancing desegregation applications of housing rules and regulations with particular emphasis of social behavior studies of PH residents.

Non-governmental institution attempts Private institutions also have aimed to improve the quality of PH. For example, the Environmental and Energy Study Institute (EESI) held a briefing in 2016 titled "Sustainable Affordable Housing: Saving Energy, Saving Lives" (EESI 2016). Klingenberg (2016), the executive director of Passive House Institute US (PHIUS), illustrated how applying passive building heating energy principles can reduce the energy cost by ~80-90%. She described the features of passive housing, such as high quality and durable building envelope and a healthy inside environment. Klingenberg (2016) mentions that the comfortable and healthy living spaces pay back the cost of construction and describes some examples of new and retrofit affordable housing projects that have been completed or are under construction that have incorporated applied passive housing concepts. Her examples include Uptown Lofts–Affordable Development in Pittsburgh, PA; the Affordable Retrofit Project in Washington, DC; and the development with 57 units, The Orchards affordable multi-family Passive House at Orenco, Hillsoro, OR.

Pointing out that reducing energy costs is fundamental to providing a stable economic situation for low-income families, Hecht (2016) describes a renovation project that transformed the Weinberg Commons, Washington, DC, project for low-income and formerly homeless families from non-passive to passive. Hecht (2016) stated that the construction cost of Weinberg Commons is about 8% more than the cost of using traditional construction techniques and materials, but the project is profitable and worth continuing thanks to tax credits, a capital grant, and project-based rental vouchers.

Some projects have been conducted by public and private partnerships to enhance their communities. For instance, the Evergreen Jogging Path Coalition (EJPC) in Boyle Heights, Los Angeles, California is a 1.5-mile walking/jogging path that provides an open space where people can walk, run, engage and communicate (Manal et al. 2004). This project enhanced socializing and communicating among the residents and increased their affiliations to the place, which dramatically reduced the crime rate. Another project was the Gardens for Growing Healthy Communities in Denver, Colorado. This garden represents a partnership between Denver-based community organizations, the University of Colorado and community residents. It has greatly contributed to promoting social interactions in the communities (Manal et al. 2004).

3.5.2 Social Aspects of Public Housing in the USA

Some important social problems in the USA related to PH include discrimination and segregation, insecure living conditions, behavioral and socioemotional problems, isolation, and mobility and instability. The National Commission on Severely Distressed Public Housing report states that PH projects had deteriorated to the point where they were physically dangerous to live in, and 6% of those housing projects were severely distressed (McCarty 2014). Their report concluded that the residents in PH lived in fear, with high unemployment and disincentives to self-sufficiency. The commission provided several recommendations to promote PH conditions, such as increased social services for inhabitants and funding for housing (McCarty 2014).

Many of the nation’s leaders felt that the urban crisis in the U.S. was a symptom of the racial inequality problem. The Civil Rights Act 1968 was an important positive change in social aspects related to public housing, stopping the discriminatory actions that prohibited PH assistance to families based on their race. The law stated the moral and legal authority, but the application mechanism was still weak. Therefore, discrimination has increased the social problems that burden the PH program.

In general, PH in the USA is linked to failure and misery. One study found that stressed mothers in a poverty situation tend to increase use of physical punishment, which negatively affects the children's emotional development (Jensen 2009). Substandard housing can bring on depression, among other stresses, in adults (Coley et al 2013), which in turn can negatively affect the behavior achievement of their children in early school years (Claessens et al 2015). Leavitt (1993) mentions that PH is inhabited primarily by single women of color, who struggle with the PH landscape and design components, which increases the time those women spend doing their daily activities and makes their lives harder. Leavitt (1993) also describes how those women fight for a better life in a PH environment where there are no secure and clean places to raise their children, while fighting the stereotypes of people who live in PH (Leavitt 1993).

Insecure living conditions also have increased the social problems in PH. Such conditions are related to the form of the building and its design; for instance, living in high-rise PH buildings has many bad consequences for residents, including "daily fear of death from drugs, drug wars, or random shots" (Dreler and Atlas 1994). Children who live in high rises have on average more behavior problems, crime and fear of crime than those who live in low-rise buildings (Gifford 2007). These adolescents are also exposed to higher violence and less safe personal conditions (Sweatt et al 2002). In summarizing 18 studies from Canada, China, Germany, England, and the USA, Evans et al. (2003) found that nearly all those studies indicate an association between multi-dwelling housing, especially high-rises, and poor psychological health. The outcome of mental and socioemotional problems includes psychological disorder, alienation, neuroticism, negative social interaction, complexity of social contact with neighbors, and depression.

In the USA, injuries and homicide among young children are associated with home and neighborhood features (Ellen & Glied 2015). Furthermore, children who live in poor-quality housing tend to have more socioemotional and behavioral problems and less cognitive function than those who live in good quality housing (Coley et al 2013). Low-income housing challenges parents to provide a good environment that leads children to have academic and social success (Jensen 2009). Socioemotional problems faced by children can result in inadequate health care, depression, and teen motherhood (Jensen 2009).

Mobility and instability have huge impacts on the residents and their children. A study conducted in substandard housing in Boston, Chicago, and San Antonio found that the children who live in low-income housing develop many emotional and behavioral problems, such as anxiety, depression, lying, and aggressive behavior (Coley et al 2013). Parents usually confronted stress, depression, and a disrupted social network, which reduce their ability to satisfy their children’s needs (Coley et al 2013). The study found a strong relationship between bad housing conditions and instability and the level of parental stress, which results in symptoms such as anxiety and depression. Low income and financial instability add to the parents’ stress and can be transferred to the children (Jensen 2009). Multiple moves from one house to another create an unstable situation that can affect the socioemotional performance of parents and children (Marcal & Fowler 2015). For instance, changing schools interrupts the child learning and forces adaptation to a different learning environment.

In advanced step toward improve housing quality and reduce its consequences on mental health of its residents. Evans et al (2003), develop a theoretical framework for future studies on the influence of low-income housing quality on psychological and mental health of its residents. They suggested reconsideration of economic political decisions high and multiple family housing projects regard its mental health effects on resident especially mothers and children. They advised applying more restricted evaluation process regarding housing quality to discover and measure hidden psychological consequence that affect low-income families' members.

3.6 Features of Public Housing and its Neighborhoods in Libya

About 70% of existing PH units in Libya were constructed between 1970 and 1980 to serve low-income families. The planning criteria of the PH neighborhoods followed Western modern planning, such as wide streets that serve cars and an absence of human scale. In addition, those projects have suffered from lack of pedestrian paths, safe sidewalks and street furniture, well-designed shaded open areas, parking spaces, and green and vegetated areas (Sharafeddin & Belgasem 2009). Pedestrians find walking on the PH streets to be boring, they feel those wide long streets will not end and they are not compatible with the local climate. Besides that, there are no landscape treatments such as fountains, trees, shrubs, bush, or grassy green open spaces to help to moderate local climate conditions (Sharafeddin 2004). People usually avoid using those open areas; eventually they are abandoned by residents because they are considered unsafe and insecure and as places for drug dealers (Belgasem 2007). Children usually do not have a protected place to play, and families do not have proper places to interact (Sharafeddin & Arocho 2017).

3.6.1 Attempts to enhance sustainability of public housing and neighborhood in Libya

The traditional housing and neighborhood features in Libyan cities respect social structure of the society, provide adequate defense requirements, adapt with the climate and fulfill the economic necessity (Saleh 2002). Studies have highlighted the importance of restoring traditional features in contemporary ways to enhance housing and neighborhood and improve live quality in the society (Shawesh 1969; Hammad 2006; Saleh 202; Sharif et al 2010; Gabril 2014).

3.6.1.1 The traditional neighborhood features

The traditional neighborhood provides its users with a human street scale that is compatible with the local climate and provides enough shade in summer and reduces the wind speed in winter. Walking through these streets is therefore provide walkable neighborhood that include shades and street furniture, in addition to enhance the social interaction at the required level of privacy. The residential street in traditional neighborhoods include all the services that residents need. People feel comfortable with their traditional neighborhoods; they know each other, walk together, and exchange conversations. These streets provide safe places where the children can play under supervision of their parents, neighbor, or other people (Hammad 2006). Older residents usually have places along the street to gather; and they can also monitor the neighborhood. Figure 26 compares between the traditional residential street in the Tripoli Old City and residential street in the PH project; Left shows the residential street in Tripoli Old City, while the Right shows the residential building and streets in PH projects.

Courtyard housing, known as Al-Haush, is a type of vernacular settlement that reflects the tradition, heritage and history of Tripoli and other coastal cities in Libya. Al-Haush design and development response to users' need. For instance, the socio-cultural factors formed the Tripoli house Al-Haush were extracted from the Islamic religion. The planning and design of Al-Haush developed also to compatible with the population distribution in the cities. For example, two story courtyard housing located in high density areas, while the one-story courtyard houses in less denseareas (shawesh 1996).

Figure 26: Residential Street; left Tripoli Old City; Right: PH Projects Tripoli

In traditional housing, the residents move from the public space street to open private space in the center of their house where they feel well connected with greenery, sky, and a sense of home. The courtyard is the heart of the traditional house; it is a living area and the place of social activities for all family members (Sharif et al 2010). It also provides a natural environment because it is open to the sky, which connects people to the seasons and awakens their sense of the succession between night and daylight. It is an interior landscape for plants and trees and frequently includes a water element; it is a safe place to enjoy nature without going outside the house or hearing any noise.

3.6.1.2 The traditional housing features

The courtyard also can become a private paradise for the residents. The courtyard provides a comfortable environment for social functions and enhances the relationship between all family members (Hammad 2006). In this place, all the family gather for different social activities such as praying, eating breakfast during Ramadan, preparing food for special occasions, playing and exercises. It also provides space for teaching social values and customs to the new generation of the extended family. Furthermore, the courtyard is a place where family members of all ages can have dialogues about culture and religious teachings, share their experience, and discuss different ideas. The younger generations learn from their parents, grandparents, and other older cousins about their place in the larger society in a lovely and safe environment. The courtyard is considered the first place where the small children can extract core principles from their families and become attuned to their roles within their community in the future (Hammad 2006). Other traditional housing features respect privacy, provide a vibrant environment inside the house and provide spaces where family members of different generations can meet, pass their core concepts and reserve their values (Elbendak 2008).

The design of Al-Haush also respects privacy among family members and guests; one of the house components is the Al-Marpoaa, a specific room customized for the male guest. Al-Marpoaa is not connected to the courtyard and has an entrance near the main entrance of the house. For female guests, there is a room known as Dar Elkapoo that opens to the courtyard. Modesty in life and suitability of multi-use of spaces inherited in Al-Haush components and lifestyle, and the rooms are furnishing with traditional furniture that supports different use of the area; for instance, Al-

Marpoaa is sleeping space for family boys.

The vernacular architecture in Libyan cities has been disappearing because of the political and economic circumstances that history faced the Libyans including the Italian occupation in the early 20th century and the discovery of oil after 1950. The Italian period ignored traditional architectural practices and resulted in a new city pattern, housing design, and neighborhood features. The new planning and architecture design by Italian planners and architects were only applied outside of the Old City of Tripoli. The new housing does not include a courtyard and has windows that open directly to the street. The street network was planned to be wider to accommodate the needs of automobile use. These modern housing consists of multifamily building where the first floor is used for commercial purposes. Non-Libyan residents occupied this modern housing when it was first constructed. Private housing continued to build based on the Old City of Tripoli's traditional housing criteria. The new streets pattern has grown in Tripoli city.

After the independence of Libya and the discovery of oil in the middle 1950s, there was a considerable need for housing to meet the needs of people moving toward cities, especially Tripoli. Changes in the housing features occurred, especially with the introduction of PH based on Western standards provided by the government to meet the urgent need for housing. Private housing design also experienced a transition phase starting in the 1950s from the traditional courtyard house to two types of housing: Haush and Villa (Tošković 2006). The Haush is a popular housing type of the 1950s and 1960s. Windows and doors are open directly into the street, and loses the advantages of the courtyard, because it serves only the kitchen and the bathrooms (Tošković 2006). The Villa is a modern type of housing in Tripoli that reflects the European type housing, in which there is no central courtyard (Tošković 2006). It is a detached house surrounded by gardens, and all the openings overlook the garden. There are high fences to ensure privacy, and the Villa is surrounded by the garden (Tošković 2006).

Gabril (2014) mentions that the architecture features in Libya reflect a larger discrepancy than in any other Arab state. She adds that “Libya has a long way to go to gain an architectural identity, as do all other Arab states.” Kiet (2011) mentions that almost all Arabic countries suffered when they applied Western planning and designing concepts in their cities. He describes how the shortage of proper knowledge regarding socio-cultural aspects of those societies has caused many problems in planning and designing new neighborhoods. Kiet (2011) adds that local engineers and architects have better understanding of local characteristics of Arabic cities than foreign experts do, but local engineers and architects do not have adequate training to translate their valuable knowledge into urban design and planning.

Libyan architects are aiming to develop satisfactory housing based of Al-Haush that compatible with the local climate, and to provide an acceptable spatial solution for the requirements of traditional custom and culture. Figure 27 shows some of the contemporary visions of developing Al-hash design concepts.

Figure 27: The Contemporary vision of Al-hash.
Sources: ttp://mirathlibya.blogspot.com/2010/04/blog-post.html

3.6.2 Social Aspects of Public Housing in Libya

Traditional neighborhood planning and shelter design in Libya successfully reflect humans' interaction with the environment and the socio-cultural values that have influenced people, their way of life, and their dignity. It reflects their values and self-esteem (Shawesh 1996). For example, concepts such as privacy in Libyan housing are inherent in Islamic culture and embedded in the built heritage of society (Altomonte et al 2015). If the privacy in Muslim housing is violated, the house no longer serves as a home (Memarian & Ranjbar-Kermani 2011). In contrast, traditional design was ignored in the development of PH in Libya in favor of new building forms and housing designs. As a result, many problems appeared in the PH program in Libya related to new neighborhood planning, building forms, and housing designs.

The housing projects executed in Libya show diverse architectural design such as townhomes, low rise, and high-rise. Those models have been repeated in almost all Libyan cities. Additionally, no specific design is compatible with the specific site, and people do not have any attachment to their residence (Belgasem 1992; Shawesh 1996). Residents felt alienation from their units, and they were not able to display themselves (Belgasem 1992). In all the design models for multifamily housing, the apartment is very small, which increases the residents' struggles in the tight living conditions. Residents feel their visual and acoustic privacy is infringed on under these circumstances (Hammad 2006).

In addition to design problems, nontraditional modern construction methods and materials have been used, such as prefabricated elements and precast concrete frames. Elwefati (2007) mentions that "modern" construction materials lacked compatibility with the environment in Libya. These new materials led to uncomfortable thermal levels and extra energy consumption compared to vernacular buildings. Traditional housing that applies traditional design concepts and uses local materials is compatible with the Libyan climate and provides users with a proper thermal comfort level. Gabril (2014) compared the thermal comfort level in traditional and contemporary architecture design in Libya; she mentions that people adapt their behavior and expectations with respect to thermal comfort. Gabril (2014) adds that people tend to change their behavior in order to feel comfortable. Her study suggested revitalizing the use of local traditional construction techniques and materials to reach the thermal comfort level that is congruent with the sociocultural needs of Libyan users and reduces consumption cost (Gabril 2014). Sharafeddin (2004) illustrates that PH in Libya had no social study and depended on western standards that are incongruent with Libyan culture or local climate, which had led to unsuccessful PH projects. For instance, the privacy concept had disappeared in the Libyan PH program, and people tended to make many changes to their housing in order to satisfy their needs and provide some privacy (Shawesh 1996). Belgasem (1992) mentions that the design of the PH projects in Libya theoretically consider all the users have the same characteristics, size, and needs, which were directly related to the European families and their needs and did not compatible with the Libyan family structure.

Two main categories can summarize the reaction of the users of PH in Libya: (1) changes made by the users that affect the interior and exterior environment of the housing, and (2) changes in users' behavior because the housing does not satisfy their needs. In order to make their units more acceptable and add some privacy, the Libyan residents tend to redesign and reconstruct the interior and exterior of their housing. They close off the windows and balconies or build walls to provide some privacy or to protect their houses. Those changes affect the users' physical and emotional health. For example, when they close off the windows, they reduce ventilation and prevent daylight from entering their apartment, which increases depression and strain and reduces interaction with their surroundings. As medical researchers have proven, lack of sunlight in particular has many bad consequences on physical and mental health and leads to socioemotional problems, such as performance difficulties and depression (Kim& Kim 2010).

In addition, residents have made many modifications themselves, changing the functions of some interior and exterior spaces of the building. They destroyed the visual features of the buildings by using different colors and different building materials. All these changes made to satisfy personal beliefs and needs added to the formation of a new architectural character that did not match the original building's features and created a random composition and appearance (Azlitni 2009).

Figure 28: The modifications done by users in PH in Libya

Figure 28 shows some of the changes that the users made to their units. Such changes depended on the unit position; for instance, occupants who lived in the upper stories took out some walls in their units to extend the kitchen area, or they blocked the balconies to extend the room area to satisfy their daily life needs. Occupants who lived in the ground floor went further and expanded interior spaces to add the sidewalk and the public areas attached to their unit; some of them have constructed a new unit for their son and his new family to live in. One of the most important social problems in existing PH is the lack of laws and regulations that rules and manage PH and lack of enforcement of those regulations that do exist. People do what they want without caring about laws and regulation and without any sort of legal consequence, such as having to return units to their original condition.

People are forced to adapt emotionally to those housing units, which negatively affects their lives; the repeated daily stress has led to mental disorder and psychological disease (Hammad 2006). In addition, because of the limitations of the housing areas in multifamily houses and their inability to have their own houses, the families in Libya tend to reduce the number of children (Hammad 2006). Many social problems are caused by unsuitable spaces in PH projects in Libya, such as stress and depression that affect all the family members, especially children (Hammad 2006).

PH in Libya has thus acquired a bad reputation, and the criticisms of it have been increasing. Most children in those projects tend to drop out of school to provide their own money or join gangs. PH also has increased isolation among the residents and their neighbors, especially in multi-family and high-rise housing, which disrupts social cohesion (Hammad 2006). Problems such as cleaning shared areas in the building, noise, and aggressive behaviors such as breaking windows and hitting among the children in the project's open areas lead to conflict among the residents. In Libya, there is no segregation by color as there has been in the USA, but, as in the USA, people who live in PH projects have their own stigma, which is usually of poverty, unemployment, drugs and gangs. Insecure living conditions, isolation and mental and psychological illnesses are common. Problems related to high-rise building, overcrowding and low-quality housing conditions are similar to those at PH in the USA.

The shortage of adequate housing was increased by the Revolution of 2011, which destroyed much of the existing housing in the country. Instability resulting from the Revolution and the overall poor condition of the country, including shortage of cash, burden the parents and increase the poverty level among the residents of PH. This condition can affect the performance of the children in school, which negatively affects their emotional behaviors.

3.7 Comparison between the Social Problems in the USA and Libya

In addition to social problems that burden PH projects in both the USA and Libya, there are many similarities related to architecture design and neighborhood planning. For instance, PH projects in both countries have mixed styles that may include low-rise, mid-rise, and high-rise housing. In the USA, however, the megadevelopment and the superblocks formats were applied to PH projects and some PH buildings are 20 stories high. On the other hand, PH in Libya is arranged in small blocks based on a Western-style street grid, and the highest high-rises are 9 to 11 stories height. Social problems have appeared in PH in both countries because the design of the PH does not satisfy residents' personal and social needs, and neighborhoods planning negatively affects social interaction. Social problems such as unsecure living conditions, poor psychological health, poverty stigma and high unemployment levels among the residents, isolation and alienation and absence of a sense of community are similar in both countries. In contrast, the ownership conditions affect the influence of other social problems such as mobility and instability. In Libya, the residents eventually can own their units; conversely, in the USA residents rent their units; they do not own them.

There are important differences in the steps that have been taken to solve PH problems in the two countries. In the USA, governmental, private, and other nonprofit agencies have provided the solutions. Many attempts to improve PH and its surroundings, enhance civic life, and to revitalize the community have been applied, for example, TND, the New Urbanism approach, applying green building features and passive housing concepts in PH, and receiving residents' feedback about their needs and current PH conditions. These steps have been followed up by related decisions to demolish or renovate the PH in the USA and set up criteria for new PH. The results have enhanced the built environment and social interaction among residents.

In Libya, on the other hand, building changes are done by residents to satisfy their needs. Those modifications are from the residents' own perspective, which negatively affects the safety level and aesthetic appearance. There is no engineering evaluation of the durability and safety of the new modifications, which may destroy parts of the adjacent apartments. All these modifications are against the housing and urban planning law and regulations, but no one enforces those laws and regulations.

Small improvements to the built environment would significantly improve the quality of life for PH residents in Libya. For example, safe and comfortable open areas in Libyan PH, such as the ones often available in PH in the USA, would greatly increase the quality of life and sense of community among the residents and their children and need not be too expensive or difficult to do. The investment in time and money to eliminate unsafe and unsecure conditions in open areas would result in better social interaction and reduce the social problems that burden these projects. Keeping the current situation could result in social and physical problems that will be costly for the children in the projects, their parents, the community, and the government.

3.8 Conclusion

PH projects in both countries have similar social problems that are related to architectural design and neighborhood planning, such as unsafe living conditions, poor psychological health, poverty and unemployment, alienation and an absence of community sense. In the USA, solutions for socially distressed neighborhoods are provided by both governmental and private institutions. There are many successful examples of applying different approaches to revitalize the society and enhance civic life in PH, such as TND, the New Urbanism, green building features and passive housing concepts. Continuing to get residents' feedback and engage them in the design process will improve the outcome.

In Libya, attempts to improve PH have to begin with and come from government. The housing ministry in Libya should start an assessment plan to evaluate existing PH, as has been done in the USA. A strong clear decision to demolish current PH having many social problems and to renovate projects with fewer physical and social problems would improve the existing situation of PH in Libya. Returning to regional and local traditional patterns, incorporating traditional designs such as the Tripoli courtyard house, and planning to design new PH that is more suitable for its users is called for. It will be necessary to develop standards compatible with vernacular architecture and New Urbanism concepts and set up a plan to manage and evaluate this type of PH projects. In developing the PH designs, it will be particularly important to get feedback from current and perspective residents about their needs and preferences.

3.9 References

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4. Chapter 4: Toward Indicators for Sustainable Public Housing, Case Studies for Three Public Housing projects in the USA and Libya

4.1 INTRODUCTION

Public housing (PH) is considered a key component of a county's economy and a principal approach to enhancing the quality of life. Providing a large part of the community with a decent home at an affordable price aims to promote the social, environmental and economic well-being of the society (DCLG 2007). Sustainable public housing (SPH) has multiple dimensions, such as housing quality, performance, livability, and accessibility. Indicators have been used as tools to measure significant qualitative and quantitative conditions over time (Sinha et al., 2017). Several studies have emphasized the importance of using sets of indicators to evaluate the sustainability needs to be defined of affordable housing in order to improve housing quality and enhance the quality of life (Sinha and Mandal 2017; Gan et al., 2017). Defining key indicators contributing to measuring sustainable affordable housing have received significant attention (Emsley et al., 2008; Ibem and Azuh 2011; Mulliner and Maliene 2015; Gan et al., 2017; Sinha and Mandal 2017). Significant indicators have been defined by experts, policy makers, governmental organization (GOs), non-governmental organizations (NGOs), and housing developers (Mulliner and Maliene 2015; Oyebanji et al., 2017; Gan et al., 2017). Some studies have focused on socio-cultural and traditional, financial, environmental, or ecological aspects, while others used more holistic approaches. In addition, many sets of indicators of residents' satisfaction based on residents' perspective have been identified in preceding studies (Meir et al., 2009; Tapsuwan et al., 2018), however, statistical relationships and the magnitude of their effects have not been provided.

The Queensland Department of Public Works (QDPW) created the term "Triple Bottom Line" (TBL), to define sustainable housing that is environmentally, socially, and economically sustainable. Numerous sets of indicators to evaluate affordability and sustainability affordable housing have been created based on the TBL concept (Pullen et al., 2010a; Blair et al., 2003, 2004; Ibem and Azuh 2011; Oyebanji et al., 2017). For instance, indicators related to social sustainability include social cohesion, community involvement and participation, suitability, safety and security level, walkability and accessibility to neighborhood services (Sharafeddin et al., 2019). Indicators related to environmental sustainability include housing performance, design flexibility, indoor air quality, adaptability of construction and finishing materials, livability and comfort level, and aesthetic appearance (Sharafeddin et al., 2019). Economic sustainability indicators include affordability, life cycle cost, opportunities of employment, revenue and resale (Sharafeddin et al., 2019).

This study adapted the Triple Bottom Line Plus One (TBL+1) approach to identify the critical indicators for sustainable affordable housing based on the satisfaction level, of the current occupants of PH projects, based on post-occupancy evaluation (POE). The (+1) part of the TBL+1 approach indicates the laws and regulations governing SPH and will be discussed through the recommendations.

In this study, the terms PH and affordable housing indicate low-cost housing for low-income families. PH projects are usually developed by government agencies; they are affordable to residents because of rent subsidies or other government regulations. For instance, in Libya, the government is the only agency responsible for providing PH for low-income families, and the families can buy their units. In the USA, affordable housing is rental housing provided by private developers for low-income residents based on incentives that are provided by the government. In general, PH and affordable housing terms indicate low-cost housing provided to low-income residents where the rent does not exceed 30 % of their income.

Three PH projects were assessed: two in Corvallis, Oregon, USA (Camas Commons and Family Housing at Oregon State University (OSU)) and one in Tripoli, Libya, (Hay Al-Andalus). The first author has chosen these projects because she is from Libya and she is interested in studying and evaluating PH in Libya and comparing it with projects in the USA. Being an international student in the USA has encouraged her to expand her knowledge regarding PH; thus, she studies low-income housing in Corvallis in Camas Common project and to have more international preceptive she chose the Family Housing at OSU, which houses many international students.

The objectives of this study are (1) to identify statistically significant indicators of residents' satisfaction, (2) to compare the significant indicators of residents' satisfaction between three PH projects, and (3) to provide recommendations pertinent to a set of indicators from the residents' perspective in order to achieve SPH.

The multimethod approach utilized both qualitative and quantitative data analysis to provide a stronger conclusion. The study includes a POE as the quantitative data analysis approach, utilizing an ordered probit model to determine statistical significance of the indicators and their effects on the reported level of satisfaction. Both observation of physical traces and interviews were utilized as a qualitative data analysis.

4.2 LITERATURE REVIEW

This section provides a theoretical review of literature dealing with four main topics: (1) sustainability of PH, (2) post-occupancy evaluation and occupants' satisfaction levels, (3) SPH indicators and (4) the TBL indicators that influence in occupants' satisfaction levels.

4.2.1 The Relation between Affordability and Sustainability of Sustainable Public Housing

Studies have emphasized that affordability is not merely providing low-cost housing but also considering satisfaction of basic human needs with socially acceptable standards (Stone 1993; Chaplin et al., 1994; Karuppannan & Sivam 2010; Choguill 2007; Mulliner and Maliene, 2015). Several studies demonstrated the importance of sustainable affordable housing in attaining a sustainable community and improving quality of life of current and future residents (Maliene and Ruzinskaite 2006; DEHLG 2007; Maliene et al., 2008; Ewing and Knapp 2009; Maliene and Malys 2009).

Various definitions have been used to identify sustainable housing. Principle 15 of the United Nation Conference on Humane Environment (Bakar et al., 2009), for example, states that "Planning must be applied to human settlements and urbanization with a view to avoiding adverse effects on the environment and obtaining maximum social, economic and environmental benefits for all" (UN 1972). The sustainable house concept is not new; the State Advances Act 1916 (Queensland Workers' Dwellings) a clearly outlines the use of passive design principles that are congruent with the Queensland climate in erecting suitable and sustainable housing for low-income families (Cumming 1925). The act includes elements such as orientation of housing spaces, natural ventilation, shading and use of local building materials to provide a natural indoor environment that is cool in summer and warm in winter. Recently, the Department of Housing and

Public Works defined sustainable housing based on the term “Triple Bottom Line” (TBL) as housing that is socially sustainable (e.g., safety and security), environmentally sustainable (e.g., water and energy efficiency), and economically sustainable (e.g., cost-efficiency and higher resale value) (QG 2018).

In planning to make affordable housing available to those who need it, attempts to integrate sustainability and affordability concerns have been increasing. According to Mulliner and Maliene (2015), the sustainable affordable housing concept combines economic factors (e.g., household income), social factors (e.g., quality of life), and environmental factors (e.g., housing performance and efficient use of energy) that focus on a household’s situation pertaining to monetary and non-monetary criteria. Many studies have discussed the challenges and opportunities in this integration (Emsley et al., 2008; Gan et al., 2017; Ibem and Azuh 2011). Some studies consider sustainability as a basis of affordability, because it saves money spent in other aspects such as health care, energy consumption or transportation (MacKillop 2013; Gan et al., 2017). Gurran (2002) explains the key themes of sustainability that integrate “a variety of social, cultural, economic, and environmental considerations, across sectoral and administrative boundaries, as well as space and time.” Arman (2009a) described sustainable affordable housing as “... housing that meets the needs and demands of the present generation without compromising the ability of future generations to meet their housing needs and demands. Housing sustainability is reflected in economic feasibility, social acceptability, and environmental sensitivity.” Others (e.g., Lin et al., (2015), and Li et al., (2016) as cited by Gan et al., (2017) have echoed this concept.

In this paper, SPH is defined based on the term TBL +1 (+ 1 refers to ‘governance’). SPH is housing that is socially, economically and environmentally sustainable with an embodied framework of policies that support its affordability and sustainability. The socially sustainable affordable house satisfies its users' needs through all their life stages; it is functionally flexible, comfortable, secure, livable, and accessible. The environmentally sustainable house saves money; efficiently uses resources such as energy and water; and minimizes waste. Economically sustainable housing saves costs at the construction stage, in running and living costs, and in long-term maintenance, as well as in future modifications, and provides good resale value and cost efficiency to the community. Finally, governance covers the laws and regulations that govern such housing throughout its life cycle. Governance will be included in the recommendations part because this paper examines and analyzes the residents' satisfaction based on a POE survey.

4.2.2 Post Occupancy Evaluation (POE) and Occupants' Satisfaction Levels

POE is a systematic process to assess the performance of a building and the effectiveness of the housing environment by determining the satisfaction level of the occupants after they have adjusted to the building (Watson 2003, Preiser et al., 2015, Sanni-Anibire et al., 2016).

POE provides a practical way to reach a sustainable outcome; its scope includes building performance as it pertains to its functional, environmental, economic and social aspects (Sharafeddin et al., 2019). It provides information about what needs to be redone and what needs to be avoided (Watson 2003). Many studies have highlighted the importance of housing satisfaction to attain sustainability of the built environment and define satisfactory housing elements (Zimmerman and Martin 2001; Teck-Hong 2012; Sanni-Anibire et al., 2016; Forte and Russo 2017). Satisfactory housing meets its residents' needs and aspirations. Unsatisfactory housing indicates a 'housing deficit', which pressures its residents to correct the deficit (Morris and Winter 1975). Residents tend to adjust to their living conditions with adaptations such as remodeling the residence or to move to another unit (Gibson 2007; Mohit et al., 2010).

The term ‘user satisfaction’ is applied in the housing industry to measure differences between users’ desires/ expectations and actual housing conditions (Forte and Russo 2017). It refers to “the degree of contentment experienced by a household with reference to current housing situation” (Teck-Hong 2012) and neighborhood conditions (Galster 1987). Users’ satisfaction has been incorporated in POE since the 1970s to assess affordable housing performance (Forte and Russo 2017).

Satisfaction surveys to evaluate affordable housing through the POE approach are broadly used to evaluate and anticipate residents’ perceptions of their residence and their perception of quality of life (Mohit et al., 2010). Many frameworks to evaluate building performance have been developed based on POEs and the impact factors of residential satisfaction in various countries (Galster, 1987; Ibem & Aduwo, 2013; Mohit, Ibrahim, & Rashid, 2010).

A POE satisfaction survey con provide immediate problem solving in current building situations or apply to the next building cycle. Ultimately, it provides feed forward for improving the design criteria (Lin 1999). POE provides an important indicator that can be used by planners, architects, developers, managers and policy makers to improve the quality of life of housing residents (Sanni-Anibire et al., 2016). In addition, POE studies provide a conceptual framework for how housing characteristics, neighborhood environment, social environment and housing allocation scheme and policy influence residential satisfaction (Mohit & Nazyddah, 2011).

4.3 Indicators for Sustainable Public Housing

Heink and Kowarik (2010) define an indicator as “a measure from which conclusions on the phenomenon of interest can be inferred.” Several studies have emphasized the importance of using sets of indicators to assess the sustainability level of affordable housing and to identify ways of promoting quality of life for its residents and for new housing development (Wongbumru and Dewancker 2016; Sinha at al. 2017; Gan et al., 2017). Vast sets of indicators that include different variables or criteria to assess sustainability of affordable housing are available (Wallbaum et al., 2012). In contrast, the challenge is to develop and select the specific set of indicators and link them to the objective of sustainability assessment.

Salleh (2010) used four indicators, namely socio-economic, building features, building quality, and neighborhood aspects. Wongbumru and Dewancker (2016) considered the following indicators: household characteristics, dwelling and physical conditions, and environments. Tapsuwan et al., (2018) developed a custom set of indicators that include housing quality, performance, livability, and accessibility. Mulliner and Maliene (2015) provide a comprehensive set of 20 criteria contributing to sustainable housing affordability, including 20 criteria such as safety (crime), access to employment, quality of housing, energy efficiency, and deprivation in the area.

Others have used sets of indicators based on TBL (Blair et al., 2003; Blair et al., 2004; Pullen 2010a; Pullen 2010b; Mulliner and Maliene 2012; Oyebanji et al., 2017). Different selections of criteria based on the objectives of the study have been included under each pillar of TBL. For instance, Blair et al., (2004) found 37 indicators, which included almost 100 sub measures indicators that represent the three pillars of TBL. Oyebanji et al., (2017) provided a set of success factors that are critically important to sustainable social housing, including nine social, four environmental, and six economic indicators. Gan et al., (2017) identified 14 social, 15 environmental, and 13 economic indicators for achieving sustainable affordable housing.

Social sustainable factors identified by Gan et al., (2017) included accessibility, sense of community, social acceptability, harmonious social relationships and stability. Oyebanji et al., (2017) found indicators such as security of lives and properties, community development and social services, social cohesion, and public awareness and stakeholders' participation to be important.

Wongbumru and Dewancker (2016) considered quality of indoor air and ventilation, natural lighting, and noisy surroundings as important environmental criteria. Gan et al., (2017) named environmental indicators such as land-use efficiency, energy and water efficiency, effective waste management, and a comfortable and healthy indoor environment. Oyebanji et al., (2017) found environmental protection, use of an appropriate material, and appropriate land use and development plan as part of the important environmental indicators for sustainable social housing.

With respect to economic indicators, Oyebanji et al., (2017) found adequate funding and provision of affordability, appropriate construction technology, and good governance and political for affordability significant indicators for achieving social housing. Gan et al., (2017) mentioned indicators such as providing human resources for economic development, generating job opportunities, reducing energy bills, and integrating related industries.

2.4 TBL Indicators Related to Occupants' Satisfaction Levels

The following section includes an extensive review of literature relevant to the relationship between some TBL indicators and residents' satisfaction level. It focuses on indicators related to residents' characteristics, and the social, environmental, and economic aspects of their built environment.

4.3.1 Residents characteristics indicators

Establishing PH based on a broad social study of the resident characteristics is a critical factor in achieving a satisfactory project. Several studies have found that increased household size reduces satisfaction level (Mohit et al., 2010; Ibem et al., 2013; Huang and Du 2015). Although Mohit and Azim (2012) found that residents conveyed high satisfaction regarding the household number living in the units, the average family size in their project was less than the national average. According to Ibem et al., (2013), policymakers should consider providing larger PH units to accommodate large families more comfortably.

4.3.2 **Social Characteristic Indicators**

Social aspects of sustainable housing significantly influence resident satisfaction: social problems such as high crime and unemployment rates, social inequity and residential segregation, and low quality of lives lower residents' satisfaction level. Atanda (2019) developed a framework of social criteria to assess built environment sustainability. This framework includes indicators such as social equity, safety and security level, accessibility and satisfaction, and social cohesion. Congruent with those indicators, many studies have highlighted the importance of providing safe and secure living conditions for PH residents; they conclude that insecure living conditions lower residents' satisfaction (Leigh Rosenberg 2008; Mohit and Azim 2012; Dickson-Gome et al., 2016; Riazi and Emami 2018; Ziama and Li 2018).

Maximizing accessibility to a healthy environment and basic support services are key for sustainable housing and residents' satisfaction (Emsley et al., 2008; Turcotte and Geiser 2010;

Ibem 2013). In addition, provision of services in the project or surrounding neighborhood, such as recreational, educational, and health care facilities, transportation and other basic urban infrastructure increases residents' satisfaction (Ibem et al., 2015). Locating PH at a walkable distance from a recreational area increases residents' satisfaction (Liu 1999; Leaman et al., 2010; Item and Amoles 2013; Ibem et al., 2015, Mohit and Azim 2018).

Achieving social cohesion among the residents and with their living/built environment is key for attaining satisfactory SPH projects. A wide range of literature discusses social cohesion benefits and ways to enhance it. Oyebanji et al., (2017) mention that social cohesion and a sense of community have short- and long-term benefits in achieving a sustainable society. Increasing safety and security and enhancing health through reducing of stress among residents are short-term benefits that crystallize in long-term benefits of achieving social integration, enhancing productivity, and lowering health costs. According to Oyebanji et al., (2017) and Atanda (2019), social cohesion could be achieved by enhancing residents' participation in and contribution to decision-making and through promoting environmental education, such as providing seminars and conferences that empower residents to make sustainable decisions. Strong interaction among the residents and a sense of community increase residents' satisfaction (Emsley et al., 2008; Mohit and Azim 2012; Ibem and Amole 2013; Riazi and Emami 2018). Access to employment opportunities is another factor in a sustainable mixed community approach that provides income to enhance residents' quality of life (DCLG 2007; Chan & Lee 2008) and increases their satisfaction level (Awotona 1991; Mohit & Azim 2012).

4.3.3 Environmental Characteristic Indicators

Natural light is a key component of quality of indoor living conditions that affects housing performance and the residents' satisfaction in PH (Wang and Li 2006). Studies have connected natural lighting level in the residence with housing sustainability performance (Mousavi et al., 2013; Mulliner and Algrnas 2018), psychological health (Brown and Jacobs 2011; Xue et al., 2014) and productivity (Leaman et al., 2010; Item et al., 2013b). Adequate natural light entering the unit increases residents' satisfaction level (Wiesel et al., 2012; Ibem et al., 2015; Ziama and Li 2018; Ibem et al., 2013; Leaman et al., 2010; Xue et al., 2014). In the same context, Mulliner and Algrnas (2018) found that residents gave a higher priority to sunlight penetration in the units than did professional property developers.

Many researchers have highlighted parking space size, location, types, and availability as a primary factor that influence the satisfaction level of PH residents. Unsatisfactory parking conditions in residential projects reduce resident's satisfaction (Kowaltowski et al., 2006; Leigh Rosenberg 2008; Leaman et al., 2010; Wiesel et al., 2012; Ibem 2013; Azemati et al., 2017; Ziama and Li 2018). Other studies have also found that good parking conditions that satisfy residents' needs increase their satisfaction levels (Blair et al., 2004; Mohit and Azim 2012; Tilsbi et al., 2017; Reid 2018).

The design and planning of project units are central in affecting residents' comfort. For instance, elements such as privacy inside and outside the unit are essential. In general, Ibem and Aduwo (2015) defined privacy as a psychological need that is necessary for healthy PH projects. Ibem et al., (2015) found that residents are satisfied with the architectural forms that provide satisfactory privacy from neighbors and, they consider such indicators to be critical for sustainability of PH projects.

Djebarni and Al-Abed (2000) considered residents' perception of privacy and their satisfaction to be based on their cultural context. Shuey et al., (2016) emphasized that residents' race and ethnicity influence their preferences regarding living conditions and housing and neighborhood choice. Mulliner and Algrnas (2018) also mention that privacy has different requirements in different cultures. For instance, in Japan, privacy is about "home-center living and personal space" (Opoku and Abdul-Muhmin 2010), and in Middle Eastern Islamic countries, it is about separation of Muslim female household members from non-family males (Berween, 2002) and separation between guest and family spaces (Al-Kurdi, 2002). Studies have found that a high level of privacy inside the unit increases residents' satisfaction (Liu 1999; Djebarni and Al-Abed 2000; Jiboye 2009; Leaman et al., 2010; Ibem et al., 2013; Ibem et al., 2015; Ziama and Li 2018), whereas, insufficient privacy negatively affects it (Ukoha and Beamish 1996; Moolla et al., 2011).

Liu (1999) is also found a positive correlation between residents' satisfaction and privacy. Kahraman (2016) considers the type of housing to be related to satisfaction level based on the level of privacy provided to its residents. Riazi & Emami (2018) found that interaction among neighbors in low-income units was a strong indicator of resident satisfaction; however, they suggested applying design strategies to reduce annoyance in the neighborhood.

Housing quality affects residents' satisfaction based on their perception of the living conditions. Quality of construction materials is considered a key component of housing quality. Hashim et al., (2012) considered quality of construction materials and maintenance practices to be key for achieving SPH. Construction materials are related to such aspects as health, safety and livability, and aesthetics. According to Mustapha et al., (1995), it is important to choose construction and finishing materials that provide a healthier condition, ease sanitation and cleaning, and enhance functionality. Satsangi and Kearns (1992) and Al-Momani (2003) assert that construction and finishing materials influence residents' satisfaction, and they recommended using local materials that provide high durability, serviceability, and aesthetic appearance and low economic cost. In addition, such choice of materials could lower maintenance costs (Satsangi & Kearns 1992; Al-Momani 2003).

Ibem et al., (2013) have highlighted the effect of aesthetic appearance of construction and finishing materials on residents' satisfaction level. Supporting that, Kahraman (2016) found some interior features of the unit, such as durable construction material and finishing materials for the walls, roof and floor affect residents' satisfaction. Kahraman (2016) also highlighted the importance of providing a functional design for housing. In contrast, Ibem et al., (2015) have pointed out the health and environmental consequences of using specific unsustainable predominant materials such as asbestos-based materials even if they are available, durable, and satisfy the residents.

Satisfactory indoor environmental quality maintains a comfortable, healthy, and productive environment, which is fundamental for residents' satisfaction. Thermal condition is one of the factors cited by ASHRAE as affecting indoor environment, in combination with air quality, lighting, and noise (Emmerich et al, 2011; 2017). People are uncomfortable when their thermal sensations exceed a certain range of conditions, and they tend to take action to adapt to their living conditions (ASHRAE 2010). Lan at el (2011) found that feeling too warm or too cold reduces individuals' performance.

The World Health Organization (WHO) considers thermal comfort to be related to health protection, and there is increasing attention to applying strategies to avoid and reduce health consequences of energy inefficiency and fuel poverty (WHO 2007).

Thermal comfort is affected by other factors beyond the body's internal heat balance, such as climate, economic, and social situations (Brager & De Dear 1998). Subjective discomfort usually leads to thermal adaptation, where the occupants take charge to achieve their thermal comfort. The adaptive approach has various aspects that could involve behavioral, physiological or psychological adjustment (Brager & De Dear 1998). According to Brager & De Dear (1998), physiological acclimatization to heat regimes takes one to four days to develop fully; longer periods are needed for cold acclimatization (Bruce 1960).

Ormandy & Ezratty (2012) consider estimating the residents' thermal satisfaction an important approach to achieve satisfactory housing. Ibem et al., (2013) highlighted that thermal and visual comfort have significant influence in residents' satisfaction; they found residents were satisfied with thermal comfort level in their units. Soebarto & Bennetts (2014) also found that residents were satisfied with their comfort level in their units, sometimes taking some action such as opening doors or windows or using fans.

4.3.4 Economic Characteristic Indicators

As discussed earlier, thermal comfort greatly affects in residents' satisfaction (Ibem et al., 2015). Many factors lead residents to be dissatisfied with their thermal condition, such as low energy efficiency, high-energy costs, low household income (Papada and Kaliampakos 2016) or physiological and psychological traits of the residents. Hwang et al., (2009) mention that residents' adaptive behavior is impacted by convenience, usage of space, and energy cost. In order to have more satisfactory living conditions, people tend to use technological adjustments to achieve their desired thermal comfort level, such as using air conditioners in summer and electric heaters in winter. The average hours of using heaters or air conditioners reflects residents' level of discomfort. Using technological adjustments always affects energy consumption. Residents spend much of their income on energy consumption, which increases their expenses and lowers their economic stability and status. Hwang et al., (2009) found that it is difficult to convince residents to sacrifice their thermal comfort in order to save energy cost. Thus, it is important to provide low-income families with energy efficient housing.

Holmes & Hacker (2007) suggested reducing energy costs by using passive strategies such as operable windows and adjustable shading devices. Other studies mention that energy efficiency for future PH projects can be achieved through applying energy-efficient building codes (Ormandy & Ezratty 2012; Chegut et al., 2016). Different strategies have been introduced to reduce operation cost and enhance thermal comfort in PH projects. For instance, Ismail et al., (2015) advised applying passive housing principles and Ibem et al., (2013) and Synnefa et al., (2017) suggested using alternative renewable energy resources that economically and environmentally benefit residents and society.

Studies have discussed the residential types---apartment, multi-family, single-family house, and single room---and their relationship with sustainability and residents' satisfaction (Talen and Koschinsky 2011; Kahraman 2016). The debate has addressed several economic aspects, including housing type, rent, size, energy consumption, and management and maintenance plan for housing. Kahraman (2016) found that the type of house strongly influences in residents' satisfaction, because of its relation to different factors such as project planning and special arrangements, social interaction, and privacy. Talen and Koschinsky (2011) found that provision of different types of affordable housing is key for sustaining diversity of communities. Beamish (1996) found positive correlations between residents' satisfaction and housing types.

Im et al., (2017) examined energy-saving achievement among different residential types and its impact on rent cost. They found single-family houses required higher incorporation of energy efficient features. They suggested promoting energy efficiency in PH by choosing a type of housing that saves money and conserves the environment (Im et al., 2017). Ibem et al., (2013) found that residents were dissatisfied with their units' size and type, and they brought to light the importance of considering housing type in PH projects. Al-Momani (2003) highlighted the importance of involving the occupants in decisions regarding the type of housing to be constructed. Salama & Alshuwaikhat (2006) note that the guidelines for sustainability always are very general, and users and building types receive less attention; they suggested applying a bottom-up approach that addresses the users and building types to achieve sustainable affordable housing.

Housing modifications indicate poor building performance that could be related to social, environmental, or economic aspects that its users perceive as negatively affecting their living conditions. Zabawa and Krzypkowska (2018) mentioned that spatial design of housing should satisfy its users' physical and psychological needs. Safety, privacy and sense of community are elements that affect the interaction between people and their ambient environment. Unsatisfactory housing results in 'sick building syndrome' that leads its residents to modify and adjust their living conditions to be acceptable (Kian et al., 2001; Ibem et al., 2013). Azlitni (2009) mentioned that increasing modifications reduces the economic value of the building and destroys the intended aesthetic features of the project. Modification also influences the residents' behavior and emotions;

thus, providing PH that fulfills its residents' expectations is critical to providing a healthy built environment (Hammad 2006; Zabawa and Krzypkowska 2018). Modifications also could negatively affect the safety performance of the housing (Sharafeddin 2004; Ibema et. al 2013). In contrast, Shiferaw (1998) indicated that some low-income housing modifications perhaps provide some residents a valuable resource to improve their living conditions. Wilkinson and Kardash (1992) highlighted the importance of using residents' modifications to improve urban areas. In general, studies have suggested promoting government standards and specifications to meet the users' expectations as a key to avoid such modifications and attain more efficient PH projects (Zeiler and Boxem 2008; Meir et al., 2009). According to the Federal Facilities Council Technical Report # 145, (2002), involving the residents' organizations throughout the earlier design phases to suggest needed design changes will prevent future modifications.

4.4 METHODOLOGY

The multimethod approach used for this study included both qualitative and quantitative data analysis. The POE was used as quantitative data analysis approach, and both a semi-structured interviews and observation of physical traces as qualitative data analysis. The case studies used for this study were three PH projects two in the USA and one in Libya: Camas Commons, Corvallis, OR; Oregon State University Family Housing, Corvallis, OR; and Hay Al-Andalus, Tripoli, Libya.

4.4.1 Projects Description

This section includes the description of the three projects with brief analysis of the planning concepts applied on each one**.** All three projects are low-rise housing. Camas Commons project was chosen because its residents reflect the demographics of the low-income families in Corvallis area. The Family Housing reflects international and American students affiliated with OSU, which can provide a broader insight from different ethnicities and backgrounds. The Hay Al-Andalus project in Libya now is located in an affluent area, although when the project was built the area was an undeveloped suburb. Existing project conditions can provide better understanding of residents needs over time since all of the residents own their units.

4.4.1.1 **Camas Commons**

Camas Commons project consists of 56 affordable one to four-bedrooms units, with ADA accessibility features. It is developed and owned by Willamette Neighborhood Housing Services (WNHS) in partnership with Linn-Benton County, and managed by Linn-Benton Housing Authority (LBHA). WNHS is a private, nonprofit community development corporation whose goal to enhance affordable housing quality, promote sense of community among residents and afford them with economic opportunity.

The project, as shown in Figure 29, has two main entrances, and has one main residential street in the shape of a curved that branches out of it another L shape sub residential street residential. The

Figure 29: Camas Commons Project USA, lift: project site plan, right: view of two residences

project site is divided into three main residential areas. Two of them are a strip of duplexes arranged in a row along with the residential streets. The third residential area duplexes around the green, and recreation areas, and the community center. The project includes street parking and driveway parking for some units; there is a limited number of handicap parking spaces. There are many humps in the main residential streets to provide safe crossing for residents, especially at the open and recreational areas.

4.4.1.2 **Family Housing**

Orchard Court, Oregon State University's family housing apartments is affordable housing for students. It consists of 107 apartments with one, two or three bedrooms. The project also includes some services, including an office, a community center, laundry rooms and three outdoor playgrounds. The project is owned by OSU and managed by University Housing and Dining Services (UHDS). The UHDS goal is to provide living and learning environment for OSU students from different backgrounds to support their affiliation with OSU and enhance their success. The project as shown in (Figure 30) has two main entrances; it has one residential street the shape of an L that divides the project into three main residential areas. Two residential areas have a rectangle shape, the third of them is shaped into a square. The residential street includes parking lots where the use of cars stops, and the pedestrian-bicycle pathway start. There are three humps in the main residential street to slow traffic and allow residents to cross safely. All the housing clustered in residential areas is connected to open space that supports walkability and recreation and play throughout the project. The large rectangle includes several housing clusters that provide public spaces and promote social interaction differently, three of them in U shape. The small rectangle includes two U-shaped housing clusters. Three housing clusters form a square around

Figure 30 Family Housing Project at OSU: left, project site plan; right, views of some residences

the open areas that is connected directly to a community center by the pedestrian way. The arrangement of the project facilities along the pedestrian path increases walkability and improves the safety by allowing a high level of supervision.

4.4.1.3 Hay Al-Andalus

Shaabeit Hay Al-Andalus is a PH project in the Hay Al-Andalus neighborhood in Hay Al-Andalus Municipality, in the western part of the center of Tripoli, Libya. It is one of the PH projects managed by the government's General Organization for Housing. The project consists of 144 units, in three different models including three bedrooms, a living area and guests' room (*Al-marpoaa*). The project was constructed during 1964-1967 and distributed to eligible families in 1967. The residents owned their unit after they paid 3,000 Libyan pounds ($ 84.000 USA) in total as advance payment and rent.

The project has 10 entrances (Figure 31). The project is divided into five residential areas with two rows of housing. Each row has 16 units; the project units were intended to be one-floor housing with a front yard and small services court in the back. In contrary, as the Figure 31 shown the units have been modified which change the project image to be multi floor single unit.

Figure 31: Hay Al-Andalus Project, Tripoli, Libya. Left: the project site plan; Right: view of a residential street

4.4.2 Data Collection

Data collection included administering the survey, conducting a semi-structured interview with the residents, and carrying out physical trace observations throughout the project sites and a sample of residences.

4.4.2.1 **Survey**

The POE survey consisted of 11 parts and covered a large spectrum of aspects of PH projects in both countries that are related to residents' satisfaction. The four characteristics used to measure resident's satisfaction level with project performance comprise resident, social, environmental, and economic characteristics. Resident characteristics incorporate variables such as household size, age, and educational level. Social sustainability characteristics include variables such as accessibility, suitability and services in the site, and sense of community. Environmental sustainability characteristics encompass variables such as comfortable and healthy indoor environment, effective maintenance and management of properties, and increased consciousness of environmental protection. Finally, economic sustainability characteristics include variables such as cost effectiveness and reduced costs throughout the life cycle.

The first step in the survey process was to develop the survey instrument. The survey was conducted from January 2018 to September 2018 to reach a population size from which statistical inferences can be made with a high level of confidence. A total of 233 responses were collected: 72 responses from the residents of Camas Commons affordable housing, 72 responses from the residents of Family housing at OSU; and 89 responses from residents of Hay Al-Andalus project. In this study, each of the three-sample size was considerably larger than 68 for a 90% confidence level based on Eq. (1) (Smith 2013; Anderson et al. 2018):

[1] $$N = \frac{(\text{z}-\text{score})^2\ (\sigma)(1-\sigma)}{(\text{Margin of Error})}$$

where N is the sample size needed, the z-score is equal to 1.645 (the value associated with 90% confidence), the confidence interval (or the margin of error that is acceptable) is the difference between 1 and 0.90, and σ is a standard deviation of 0.5 (the most conservative number that is used to ensure the sample size is large enough).

The survey respondents were asked to rank their level on the survey questions based on a 6-point Likert scale (1 = not applicable; 2 = very dissatisfied; 3 = dissatisfied; 4 = fair; 5 = satisfied; 6 = very satisfied). Also, the importance of having specific features was determined by a 6- pint Likert scale (1= not applicable; 2= not at all important; 3 = unimportant; 4 = fair; 5= important; 6= very important). The truth level was determined by using a 5-point Likert scale (1 = completely untrue; 2 = fairly untrue; 3 = nether true nor false; 4 =fairly true; 5= very true). A "non-applicable" option response was removed from the analysis (because there was no responses for this rank).

4.4.2.2 **Interview**

The interviews were semi-structured, with open-ended questions. A semi-structured interview allows interviewer to modify questions in response to significant replies (Bryman, 2008), which identifies the perspective of participants and uncovers rich descriptive data on personal experience. In-person and telephone interviews were carried out, in addition to walk-and-talk interviews while walking through the different areas of the projects. Carrying out the interview while walking provides a rich interpretation of place narratives from residents' perspective (Evans and Jones 2011). Residents' detailed and specified insights deliver a better understanding of their existing situation. The interviews in the USA projects were conducted in person by the first author, while the interviews in the Libyan project were conducted through the telephone and with other first-author architect colleagues in Tripoli, Libya. The 65 interviews comprise 19 in Camas commons, 19 at Family Housing, and 27 at Hay Al-Andalus. Each interview lasted approximately 30-45 min.

4.4.2.3 **Observing Physical Trace**

An observation of physical traces was done throughout the project sites and some residences to gather further indications of use. According to Zeisel (2006), observing physical traces is "systematically looking at physical surroundings to find reflections of previous activities." This observation method does not influence the behavior that caused the traces (Zeisel 2006). In order to make the observation less intrusive the observations of the project's sites were undertaken by residents of the projects who were trained by the first author. A total of 45 observation rounds were carried out during the data collection period June 2018-Oct 2018, 15 for each project, with an average of 2 days between rounds, varying from a 1-day to a 10-day interval. The observation round lasted approximately 30-45 min, depending on the number of traces to detect. Traces were recorded with photographs and text description.

4.5 Data Analysis

This section includes the data analysis applied for the three approaches: the best-fit model analysis, the interview, and the observation of physical traces.

4.5.1 Best-Fit Model

Because the variable was ordered, an ordered econometric modeling framework, the ordered probit model, was used. This study applies the model to identify the significant indicators in terms of probable satisfaction level based on the residents' point of view. The ordered probit model begins by defining an unobservable variable y* as a linear function:

[2] $y^* = \boldsymbol{\beta X} + \varepsilon$

where X is a vector of explanatory variables related to previously discussed characteristics (e.g., resident, social, environmental, and economic), β is a vector of estimable parameters that correspond to X, and ε is an independently randomly distributed disturbance term with a mean of 0 and variance of 1. From Eq. (2), each considered response can now be represented as observable:

$$[3] \quad \begin{array}{l} y = 0 \ \text{ if } \ y^* \leq 0 \\ y = 1 \ \text{ if } \ 0 < y^* \leq \mu_1 \\ y = 2 \ \text{ if } \ \mu_1 < y^* \leq \mu_2 \\ \quad \vdots \\ y = J \ \text{ if } \ \mu_{J-1} \leq y^* \end{array}$$

where μ are the thresholds used to define the ranked responses provided by the surveyed residents. In this analysis, μ is estimated simultaneously with β. By estimating μ simultaneously with β, integer ordering is conducted, in which J is the highest ranking (i.e., very satisfied).

Upon defining the unobservable and observable ordered probit functions, the probabilities of J are estimated. This is accomplished by assuming ε to be normally distributed (i.e., mean of 0 and variance of 1), where the ranked selection probabilities are as follows (Greene 2012; Anderson et al., 2018)

$$[4] \quad \begin{array}{l} \text{Prob}(y = 0 \mid \boldsymbol{X}) = \Phi(-\boldsymbol{\beta X}) \\ \text{Prob}(y = 1 \mid \boldsymbol{X}) = \Phi(\mu_1 - \boldsymbol{\beta X}) - \Phi(-\boldsymbol{\beta X}) \\ \text{Prob}(y = 2 \mid \boldsymbol{X}) = \Phi(\mu_2 - \boldsymbol{\beta X}) - \Phi(\mu_1 - \boldsymbol{\beta X}) \\ \text{Prob}(y = 3 \mid \boldsymbol{X}) = 1 - \Phi(\mu_3 - \boldsymbol{\beta X}) \\ \vdots \end{array}$$

$$\text{Prob}(y = \text{j} \mid \boldsymbol{X}) = 1 - \Phi\left(\mu_{\text{j}} - \boldsymbol{\beta X}\right)$$

with:

$$[5] \quad 0 < \mu_1 < \mu_2 < \mu_3 < \mu_j$$

where $y = j$ is the highest satisfaction level $y = 0$ is the lowest satisfaction level, and Eq. (5) shows the required relationship among rankings to ensure all probabilities are positive.

Finally, to assess the impact of explanatory variable X, marginal effects are computed. For the ordered probit model, there is difficulty in interpreting the interior rankings (i.e., rankings 1 and

2). That is to say, the analyst does not know for certain what magnitude of impact a positive or negative estimate has on the probability of an interior ranking, only that it is positive or negative (Anderson et al.,2018, Washington et al.,2011). In an attempt to account for this, marginal effects are interpreted at the extremes (very satisfied and dissatisfied (Washington et al., 2011). For this work, where all explanatory variables are indicator variables, marginal effects are computed as the difference in probability when an indicator variable changes from zero to one (Anderson et al.,2018, Greene 2012, Washington et al., 2011):

[6] $ME_{X_k} = \Pr[y \mid \ddot{\boldsymbol{X}}_{X_k}, X_k = 1] - \Pr[y \mid \ddot{\boldsymbol{X}}_{X_k}, X_k = 0]$

where $\ddot{\boldsymbol{X}}_{X_k}$ is the mean of all other variables (i.e., variables are held constant) while the indicator variable X_k changes from 0-1.

4.5.2 The Thematic Content Analysis

The thematic content analysis method was used to analyze the semi-structured interview collected data. A detailed systemic recording of the interviewed data was developed into a reasonable exhaustive categorized structure (Burnard1991). Many different stages were applied in the processing of category generation. Two validation methods were used to validate identified categories including asking researcher and retaining to three of the interviewees' residents.

4.5.3 Observing Physical Trace

The information collected to explore how residents intervene with their living conditions to make the setting suitable to their needs and provide the designers with better understanding to design more satisfactory built livening. The physical traces looked for product of use, self-display, and adaptations of use. The information was processed to generate assumptions about the potential causes of the traces. Such assumptions were further explored in focused interviews (Zeisel 2006;

Kvale & Brinkmann 2009). Identified categories was used to support the discussion of best-fit model for each project.

4.6 Models Estimation Results

This section presents the best-fit model specifications and the marginal effects computed result for each project. It Includes the tables that represent the sustainability indictors based on the best-fit modes and their effects on residents' satisfaction. The best-fit model for each project will present separately because each project has its own characteristics. Descriptive statistics of the best fit model indicators for the three projects (Camas Common, Family Housing and Hay Al-Andalus) are shown in Table 8, page 201; 11, page 204, and 14, page 209 respectively. While best fit ordered probit model specifications are shown in Tables 9, page 201, 12, page 204, and 15, page 209. Finally, the marginal effects computed at the means are shown in Tables 10, page 202; 13, page 205 and 16, page 210. The interpreting of the magnitude in probability of actual effect in satisfaction level of sustainability indicators are presented based on the four sustainability characteristics for each project.

4.6.1 Key Finding for Camas Commons Project

For Camas Common project, nine variables were statistically significant and are shown in Table8. The distribution of these nine variables consists of one resident's characteristic indicators, four social sustainability indicators, three environmental sustainability indicators, and one economic sustainability indicator. Specifications for best-fit model are log-likelihood at convergence of -33.30 and a McFadden Pseudo R-Squared of 0.65 Table 9. The marginal effects computed at the means are shown in Table 10. The interpretation of the magnitude in probability of actual effect in satisfaction level of the nine variables presented based on the four sustainability characteristics.

Table 8: Descriptive Statistics of Significant Variables for Camas Common -Corvallis

Variable	Mean	SD
Residents Characteristics		
Number of people living in house	4.97	1.52
Social sustainability indicators		
Adequate measures against crime (1 if Dissatisfied, 0 Otherwise)	0.19	0.39
The project displays moderate level of recurrent thievery (1 if fair, 0 Otherwise)	0.87	0.33
It is important to be within walking distance to ballfield (1 if Important, 0 Otherwise)	0.43	0.49
Community planning as a "we", not a "they", activity (1 if True, 0 Otherwise)	0.40	0.49
Environmental sustainability indicators		
Adequacy of daylight (1 if Satisfied, 0 Otherwise)	0.59	0 .49
Adequate parking at the residence (1 if Dissatisfied, 0 Otherwise)	0.23	0.42
Clear separation between guest areas and family areas (1 if Satisfied, 0 Otherwise)	0.56	0.49
Economic sustainability indicators		
Average use of the electrical heater in winter is 6-12 hours (1 if Yes, Otherwise)	0.06	0.25

Table 9: Best Fit Ordered Probit Model Specifications for camas common -Corvallis

Variable	**Coef.**	**Std. Err.**	**t-stat**
Residents Characteristics			
Number of people living in house	-0.99	0.20	-4.80
Social sustainability indicators			
Adequate measures against crime (1 if Dissatisfied, 0 Otherwise)	-1.24	0.49	-2.49
The project displays fairly level of recurrent thievery (1 if fair, 0 Otherwise)	-1.43	0.64	-2.25
It is important to be within walking distance to ballfield (1 if Important, 0 Otherwise)	2.71	0.59	4.58
Community planning as a "we", not a "they", activity (1 if True, 0 therwise)	2.00	0.56	3.56
Environmental sustainability indicators			
Adequacy of daylight (1 if Satisfied, 0 Otherwise)	2.41	0.56	4.32
Adequate parking at the residence (1 if Dissatisfied, 0 Otherwise)	-2.39	0.65	-3.66
Clear separation between guest areas and family areas (1 if Satisfied, 0 Otherwise)	1.30	0. 50	2.56
Economic sustainability indicators			
Average use of the electrical heater in winter is 6-12 hours (1 if Yes, 0 Otherwise)	-1.55	0.76	-2.03
Threshold 1	2.55	0.47	5.42
Threshold 2	5.94	0.90	6.60
Model Statistics			
Number of Observations	72		
Log-Likelihood at Zero	-95.73		
Log-Likelihood at Convergence	-33.30		
McFadden Pseudo R^2	0.65		

Table 10: Ordered Probit Marginal Effects at Camas Commons

Variable	Marginal Effects at Parameter Means			
	Dissatisfied =0	Fair=1	Satisfied=2	Very Satisfied=3
Residents Characteristics indicator				
Number of people living in house	0.00103	0.26450	-0.24758	-0.01794
Social Sustainability Indicators				
Adequate measures against crime (1 if Dissatisfied, 0 Otherwise)	0.00702	0.40730	-0.40224	-0.01209
The project displays moderate level of recurrent thievery (1 if fair, 0 Otherwise)	0.00053	0.22073	-0.11547	-0.10579
It is important to be within walking distance to ballfield (1 if Important, 0 Otherwise)	-0.01121	-0.58881	0.42717	0.17285
Community planning as a "we", not a "they", activity (1 if True, 0 Otherwise)	-0.00410	-0.44283	0.34878	0.09815
Environmental Sustainability Indicators				
Adequacy of daylight (1 if Satisfied, 0 Otherwise)	-0.02230	-0.65489	0.61232	0.06488
Adequate parking at the residence (1 if Dissatisfied, 0 Otherwise)	0.05242	0.70063	-0.72580	-0.02725
Clear separation between guest areas and family areas (1 if Satisfied, 0 Otherwise)	-0.00334	-0.36323	0.34019	0.02639
Economic Sustainability Indicators				
Average use of the electric heater in winter is 6-12 hours (1 if Yes, 0 Otherwise)	0.02207	0.52790	-0.54137	-0.00859

4.6.1.1 Residents Characteristics Indicators

For the final model, the one resident characteristic found to be statistically significant is the number of people living in the house. Marginal effects show that increasing the number of people living in the household by one-person results in a 0.017 decrease in the probability of reporting being very satisfied with their living conditions.

4.6.1.2 Social Indicators

The four social sustainability indicators found to be significant are (1) adequate measures against crime, (2) project displays moderate high level of recurrent thievery, (3) being within walking distance to a ballfield (e.g., soccer, basketball, volleyball), and (4) thinking of community planning in the neighborhood as a "we", not a "they," activity.

First social sustainability indicator was adequate measures against crime. Marginal effects show that inadequate measures against crime in the neighborhood results in a 0.012 decrease in probability of reporting being very satisfied with living conditions.

Second social sustainability indicator was the level of crimes displayed in the project. Marginal effects show that moderate level of recurrent thievery in the project, results in a 0.1 decrease in probability of reporting being very satisfied with living environment.

The third social sustainability indicator was the importance of being within walking distance to a ballfield. Marginal effects show that accessibility to a ballfield in the neighborhood results in a 0.17 increase in probability of reporting being very satisfied with living conditions.

The fourth social sustainability indicator was thinking of community planning in the neighborhood as a "we", not a "they", activity. Marginal effects show that thinking of community as a "we", results in a 0.09 increase in probability of reporting being very satisfied with project living conditions.

4.6.1.3 **Environmental Sustainability Indicators**

Three environmental indicators were found to be significant: (1) adequacy of daylight, (2) adequate parking at the residence, and (3) clear separation between guest areas and family areas.

First environmental sustainability indicator was adequacy of daylight penetrating the unit. Marginal effects show that adequate daylight inside the unit results in a 0.06 increase in probability of reporting being very satisfied with living condition.

Second environmental sustainability indictor was adequate parking in the project. Marginal effects show that inadequacy of parking at the residence results in a 0.05 increase in the probability of reporting being dissatisfied with living conditions.

Third environmental sustainability indicator was availability of clear separation in the design of residence between guest areas and family areas. Marginal effects show that clear separation in the design of residence between guest areas and family areas results in 0.02 increase in the probability of reporting being very satisfied with living conditions.

4.6.1.4 Economic Sustainability Indicators

Only one economic indicator was significant: the average use of the electrical heater in winter. Marginal effects show that the average use of electrical heater in winter is 6 -12 hours per day, results in a 0.008 decrease in the probability of reporting being very satisfied with living conditions.

4.6.2 Key Finding for Family Housing Project

For Family Housing, ten variables were statistically significant and are presented in Table 11. The distribution of these ten variables consists of one resident's characteristic, four social sustainability indicators, four environmental sustainability indicators, and one economic sustainability indicator. Specifications for best-fit model are a McFadden Pseudo R-Squared of Log likelihood at convergence of -71.07 Pseudo R-Squared of 0.29 Table 12. The marginal effects computed at the means are shown in Table 13. The interpretation of the magnitude in probability of actual effect in satisfaction level of the ten variables presented based on the four sustainability characteristics.

Table 11: Descriptive Statistics of Significant Variables for Family Housing at OSU -Corvallis

Variable	Mean	S D
Residents Characteristics		
Number of children with age from 5-17	1.05	1.22
Social sustainability indicators		
The project displays moderate level of recurrent thievery crimes (1 if moderate, 0 Otherwise)	0.88	0.31
It is important to have a dry cleaner within walking distance (1 if Important, 0 Otherwise)	0.19	0.39
High unemployment among the occupants (1 if True, 0 Otherwise)	0.18	0.38

Unimportant to have cohesion/community (e.g., sense of community among neighbors (1 if Unimportant, 0 Otherwise)	0.01	0.11
Environmental sustainability indicators		
Durability of the construction materials of balconies (1 if Dissatisfied, 0 Otherwise)	0.19	0.39
Durability of finishing materials for kitchen floor (1 if Dissatisfied, 0 Otherwise)	0.51	0.50
Unit design provides high level of privacy from neighbors (1 if Satisfied, 0 Otherwise)	0.25	0.43
Feet cold always (1 if Yes, 0 if No)	0.09	0.29
Economic sustainability indicators		
The importance housing type (e.g., apartment in a tower, town-home, single-family home, etc.) (1 if fair, 0 Otherwise)	0.05	0.23

Table 12: Best-Fit Ordered Probit Model Specifications for Family Housing at OSU - Corvallis

Variable	**Coef.**	**Std. Err.**	**t-test**
Residents Characteristics			
Number of children with age from 5-17	-0.57	0.13	-4.10
Social sustainability indicators			
The project displays moderate level of recurrent thievery crimes (1 if moderate, 0 Otherwise)	-2.15	0.67	-3.19
It is important to have a dry cleaner within walking distance (1 if Important, 0 Otherwise)	-2.50	0.66	-3.74
High unemployment among the occupants (1 if True, 0 Otherwise)	1.74	0.54	3.17
Unimportant to have cohesion/community (e.g., sense of community among neighbors (1 if Unimportant, 0 Otherwise)	-2.23	1.26	-1.76
Environmental sustainability indicators			
Durability of the construction materials of balconies (1 if Dissatisfied, 0 Otherwise)	-0.69	0.36	-1.91
Durability of finishing materials for kitchen floor (1 if Dissatisfied, 0 Otherwise)	0.70	0.35	1.98
Unit design provides high level of privacy from neighbors (1 if Satisfied, 0 Otherwise)	1.63	0.54	3.00
Feet cold always (1 if Yes, 0 if No)	-1.37	0.47	-2.89
Economic sustainability indicators			
The importance housing type (e.g., apartment in a tower, town-home, single-family home, etc.) (1 if fair, 0 Otherwise)	2.73	0.80	3.14
Threshold Parameters			
Threshold 1,	2.10	0.21	9.63
Threshold 2,	3.13	0. 19	16.18
Threshold 3,	4.94	0. 30	16.06
Model Statistics			
Number of Observations	72		
Log-Likelihood at Zero	-100.32		
Log-Likelihood at Convergence	-71.07		
McFadden Pseudo R^2	0.29		

Table 13: Ordered Probit Marginal Effects at Parameter Means for Family Housing Project

Variable	Marginal Effects at Parameter Means				
	Very Dissatisfied = 0	Dissatisfied =1	Fair=2	Satisfied =3	Very Satisfied=4
Residents Characteristics					
Number of children with age from 5-17	0.0007	0.1011	0.1192	-0.1553	-0.0658
Social sustainability indicators					
The project displays moderate level of recurrent thievery crimes (1 if moderate, 0 Otherwise)	0.0008	0.1503	0.3329	0.1142	-0.5983
It is important to have a dry cleaner within walking distance (1 if Important, 0 Otherwise)	0.0873	0.6453	-0.0045	-0.5902	-0.1380
High unemployment among the occupants (1 if True, 0 Otherwise)	0.0007	-0.1655	-0.3151	0.0701	0.4116
Unimportant to have cohesion/community (e.g., sense of community among neighbors (1 if Unimportant, 0 Otherwise)	0.1204	0.6069	-0.1455	-0.5206	-0.0612
Environmental sustainability indicators					
Durability of the construction materials of balconies (1 if Dissatisfied, 0 Otherwise)	0.0022	0.1557	0.1120	0.2116	-0.0583
Durability of finishing materials for kitchen floor (1 if Dissatisfied, 0 Otherwise)	-0.0012	-0.1273	-0.1392	0. 1854	0. 0823
Unit design provides high level of privacy from neighbors (1 if Satisfied, 0 Otherwise)	-0.0015	-0.15971	0.29275	0.1555	0.3402
Feet cold always (1 if Yes, 0 if No)	0.0163	0.3923	0.0785	-0.4148	-0.0723
Economic sustainability indicators					
The importance housing type (e.g., apartment in a tower, town-home, single-family home, etc.) (1 if fair, 0 Otherwise)	-0.0006	-0.1316	-0.3303	-0.3396	0.8022

4.6.2.1 **Residents Characteristics**

For the final model, one resident's characteristic was found to be statistically significant which is the number of children with ages between 5-17. Marginal effects show that increase the number of children at this range of ages living in the household by one result in a 0.06 decrease in probability of reporting being very satisfied with their living conditions.

4.6.2.2 **Social Sustainability Indicators**

The four social sustainability indicators were found to be significant are: (1) The project displays moderate level of recurrent thievery crimes, (2) the importance of being in walking distance to dry cleaner, (3) High unemployment among the occupants, and (4) the importance of having a cohesion community.

The first indicator was that the project displays moderate level of recurrent thievery crimes. Marginal effects show that having moderate level of recurrent thievery crimes at neighborhood results in a 0.59 decrease in probability of reporting being very satisfied with living conditions.

Second social sustainability indicator was the importance of having a dry cleaner at walking distance to the neighborhood. Marginal effects show that an unavailability of a dry cleaner at walking distance results in a 0.13 decrease in probability of reporting being very satisfied with living environment.

Third social sustainability indicator was having a high unemployment among the occupants. Marginal effects show that having a high level of unemployment among the occupant's results in a 0.41 increase in probability of reporting being very satisfied with the living conditions.

Fourth social sustainability indicator was cohesion among community such as a sense of community. Marginal effects show that absence of cohesion among community results in a 0.12 increase in probability of reporting being very dissatisfied with their living environment.

4.6.2.3 Environmental Sustainability Indicators

Four environmental indicators were found to be significant include: (1) Durability of the construction materials of balconies, (2) Durability of finishing materials for kitchen floor, (3) Unit design provides high level of privacy from neighbors, and (4) feel cold always.

First environmental indicator was durability of the construction materials of balconies. Marginal effects show that lack of durability of the construction materials of balconies results in a 0.05 decrease in probability of reporting being very satisfied with living condition.

Second environmental indicator was durability of finishing materials for kitchen floor. Marginal effects show being dissatisfied with the durability of finishing materials of the kitchen floor results in 0.0012 decrease in probability of reporting being very dissatisfied and in a 0.08 increase in probability of reporting being very satisfied with indoor living condition. More explanations of the residents' perceptions are provided in the discussion section.

Third environmental indicator was unit design provides high level of privacy from neighbors. Marginal effects show that having a high level of privacy from neighbors' results in 0.34 increase in probability of reporting being very satisfied with living environment.

Fourth environmental indicator was about feeling coldness always. Marginal effects show feeling cold always results in 0.07 decrease in probability of reporting being very satisfied with living environment.

4.6.2.4 **Economic Sustainability indicators**

The only economic indicator was type of housing at the project. Marginal effects show that ability to choose the type of house among the housing choice results in a 0.80 increase in probability of reporting being very satisfied with living environment.

4.6.3 Key Finding for Hay Al-Andalus Project

For Hay Al-Andalus project, 11 variables are found to be statistically significant by best-fit model and are shown in Table14. The distribution of these 11 variables consists of one resident's characteristic, six social sustainability indicators, two environmental sustainability indicators, and two economic sustainability indicators. Specifications for best-fit model are a McFadden Pseudo R-Squared of Log likelihood at convergence of -34.40 Pseudo R-Squared of 0.60 Table 15. The marginal effects computed at the means are shown in Table 16, page 210.

Table 14: Descriptive Statistics of Significant Variables for Hay Al Andalus Tripoli, Libya

Variable	Mean	SD
Residents Characteristics		
Number of people living in house	7.06	2.20
Social sustainability indicators		
Adequacy measures against crime (1 if Dissatisfied, 0 Otherwise)	0.77	0.41
Accessibility to educational facilities (1 if Dissatisfied, 0 Otherwise)	0.15	0.36
The importance to be within walking distance to the public garage (1 if Important, 0 Otherwise)	0.20	0.40
The importance to be within walking distance to the grocery store (1 if fair, 0 Otherwise)	0.08	0.28
Neighbors visiting in homes (1 if True, 0 Otherwise)	0.59	0.49
Borrowing things and exchanging favors among neighbors (1 if Untrue, 0 Otherwise)	0.33	0.47
Environmental sustainability indicators		
Intermediate thermal discomfort level that interfere with doing usual activities (1 if Yes, 0 Otherwise)	0.39	0.49
Usage of coal or fuel heater inside the unit in case there is no electricity (1 if Yes, 0 Otherwise)	0.91	0.28
Economic sustainability indicators		
Expanding the living areas as part of the modification (If Yes, Otherwise)	0.188	0.31
The average of using electrical heater is 12-18 hours per day (1 if Yes, 0 Otherwise)	0.03	0.18

Table 15: Best Fit Ordered Probit Model Specifications for Hay Al-Andalus Tripoli, Libya

Variable	Coef.	Std. Err.	T
Residents Characteristics			
Number of people living in house	0.49	0.13	3.70
Social sustainability indicators			
Adequacy measures against crime (1 if Dissatisfied, 0 Otherwise)	1.58	0.55	2.89
Accessibility to educational facilities (1 if Dissatisfied, 0 Otherwise)	2.30	0.62	3.71
The importance to be within walking distance to the public garage (1 if Important, 0 Otherwise)	1.46	0.53	2.76
The importance to be within walking distance to the grocery store (1 if fair, 0 Otherwise)	1.30	0.67	1.93
Neighbors visiting in homes (1 if True, 0 Otherwise)	1.19	0.43	2.75
Borrowing things and exchanging favors among neighbors (1 if Untrue, 0 Otherwise)	1.46	0.52	2.80
Environmental sustainability indicators			
Intermediate thermal discomfort level that interfere with doing usual activities (1 if Yes, 0 Otherwise)	-2.55	0.60	-4.20
Usage of coal or fuel heater inside the unit in case there is no electricity (1 if Yes, 0 Otherwise)	-1.64	0.94	-1.75
Economic sustainability indicators			
Expanding the living areas as part of the modification (If Yes, Otherwise)	-1.24	0.94	-2.10
The average of using electrical heater is 12-18 hours per day (1 if Yes, 0 Otherwise)	3.55	1.16	3.04
Threshold Parameters			
Threshold 1	4.14	0. 79	5.22
Model Statistics			
Number of Observations	89		

Log-Likelihood at Zero	-86.02
Log-Likelihood at Convergence	-34.40
McFadden Pseudo R^2	0.60

Table 16: Ordered Probit Marginal Effects at Hay Al-Andalus Tripoli, Libya

Variable	Marginal Effects at Parameter Means		
	Very dissatisfied = 0	Dissatisfied=1	Fair =2
Residents Characteristics			
Number of people living in house	-0.15614	0.15567	0.00047
Social sustainability indicators			
Adequacy measures against crime (1 if Dissatisfied, 0 Otherwise)	-0.56250	0.56164	0.00086
Accessibility to educational facilities (1 if Dissatisfied, 0 Otherwise)	-0.38328	0.32348	0.05980
The importance to be within walking distance to the public garage (1 if Important, 0 Otherwise)	-0.32503	0.31503	0.01000
The importance to be within walking distance to the grocery store (1 if fair, 0 Otherwise)	-0.26215	0.25151	0.01064
Neighbors visiting in homes (1 if True, 0 Otherwise)	-0.39065	0.38928	0.00137
Borrowing things and exchanging favors among neighbors (1 if Untrue, 0 Otherwise)	-0.38420	0.37832	0.00588
Environmental sustainability indicators			
Moderately thermal discomfort level that interfere with doing usual activities (1 if Yes, 0 Otherwise)	0.76732	-0.76110	-0.00622
Usage of coal or fuel heater inside the unit in case there is no electricity (1 if Yes, 0 Otherwise)	0.27909	-0.25406	-0.02503
Economic sustainability indicators			
Expanding the living areas as part of the modification (If Yes, Otherwise)	0.26294	-0.25450	-0.00844
The average of using electrical heater is 12-18 hours per day (1 if Yes, 0 Otherwise)	-0.28994	-0.19350	0.48344

4.6.3.1 4.3.1 Residents Characteristics

For the final model, one resident's characteristic was found to be statistically significant which is the number of people living in house. Marginal effects show that increase the number of people living in the household by one-person results in a 0.15 decrease in probability of reporting being very dissatisfied. A unique explanation related to Libyan cultural aspects for this result is provided in the discussion.

4.6.3.2 Social Sustainability Indicators

The six social sustainability indicators found to be significant are: (1) Adequate measures against crime, (2) Access to education facilities in the neighborhood, (3) being within walking distance to public garage, (4) being within walking distance to a grocery store, (5) visiting neighbors in their homes , and (6) borrowing things and exchanging favors among neighbors.

First social sustainability indicator was adequacy of measures against crime. Marginal effects show that inadequate measures against crime in the neighborhood results in a 0.56 decrease in probability of reporting being very dissatisfied with living condition.

Second social sustainability indicator was access to education facilities in the neighborhood. Marginal effects show that unavailability of accessing education facilities in the neighborhood results in a 0.38 decrease in probability of reporting being very dissatisfied with living condition accessibility to services in the neighborhood.

Third social sustainability indicator was the importance of being within walking distance to a public garage. Marginal effects show that access to a public garage within walking distance results in a 0.32 decrease in probability of reporting being very dissatisfied with living conditions.

Fourth social sustainability indicator was the importance of being fairly within a walking distance to grocery store in the neighborhood. Marginal effects show that being within walking distance to a grocery store results in a 0.26 decrease in probability of reporting being very dissatisfied with living conditions.

Fifth social sustainability indicator was visiting with neighbors at their houses in the project community. Marginal effects show that conveniently visiting neighbors at their homes in the neighborhood results in a 0.39 decrease in probability of reporting being very dissatisfied with living environment.

Sixth social sustainability indicator was borrowing and exchanging things or favors among neighbors in the project. Marginal effects show that reporting that it is untrue to borrow, and exchange things favors among neighbors' results in a 0.38 decrease in probability of reporting being very dissatisfied with living environment.

4.6.3.3 **Environmental Sustainability Indicators**

The two environmental indicators were found to be significant are: (1) Uncomfortable thermal conditions moderately interfere with doing usual activities in your unit and (2) Usage of coal or fuel heater inside the unit in case there is no electricity.

First environmental sustainability indicator was whether the uncomfortable thermal conditions interfere with doing usual activities in the unit. Marginal effects show that uncomfortable thermal comfort conditions moderately interfere with doing usual activities and results in a 0.76 increase in probability of reporting being very dissatisfied living conditions.

Second environmental indicator was usage of coal or fuel heater inside the unit in case there is no electricity. Marginal effects show that usage of a coal or fuel heater inside the unit as a result of no electricity results in a 0.27 increase in the probability of reporting being very dissatisfied with living conditions.

4.6.3.4 **Economic Sustainability Indicators**

Two economic indicators were found to be significant are: (1) modifying and expanding the living area inside the house to be livable and have extra spaces and (2) Using an electrical heater in your unit in winter about 12-18 hours.

First one was modifying and expanding the living area inside the house that have been done by the users. Marginal effects show that modifying living area at the unit to support users' activities results in 0.26 increase in probability of reporting being very dissatisfied with living environment. Second economic sustainability indicator was the average use of an electrical heater in winter. Marginal effects show that the average of using an electrical heater in winter is about 12-18 hours per day, which, results in 0.48 increase in probability of reporting being fairly dissatisfied with living environment.

4.7 5 DISCUSSION

The discussion section utilized the study approach to support the survey analysis results through the interview and the observation of physical traces.

4.7.1 Observation of Physical Traces

Physical traces of the three projects provide a great deal of residents redesigning of their built environment. Resident have changed the setting to enhance their physical environment performance, support their activities, and display themselves. Throughout the three projects, there were many physical traces of product of use, adaptation of use, and display of self.

4.7.1.1 Physical Traces of Product of Use

Some physical traces detected at the project were interpreting the residents' behaviors in using the spaces or space physical objects left as a result of some activities. For instance, the paths across the lawn at the two projects in the USA demonstrate that residents are created a short cut to laundry room through the lawn. Additionally, some leftovers objectives illustrate activities were carry out at the place. The leftover signs such as remnants of eating and drinking include disposable spoons, plates, and coffee cups where residents stand or sit in the evening with their friends or neighbors were found among the three projects. For instance, sign of changing cars' oil such as old car oil container was found in Hay Al-Andalus. Different signs of unexpected used of space also have been found in Hay Al-Andalus such as, used of the sidewalk as a parking as shown in figure 32. Some leftover objectives found at all the open area and the residential street at the three projects,

Figure 32: Physical Traces of Product of Use at Hay Al-Andalus

such as food and open cans, candy, and biscuit/ cookies are found in bedrooms where the eating intended to be in kitchen or dining room at the three projects, and cigarette butts even there is a specific assigned place for smoking at the Family Housing.

In addition, some missing traces were detected that imply the type of activities that residents do not do. No chairs were found on the balconies at Family Housing, because of the small unit size, the balconies were used as storage areas. In Hay Al-Andalus also, no chairs found on the balconies;

Figure 33: Physical Traces of Product of Use at Camas Commons

most balconies are used for storage or to hold clothes drying racks, because sitting on balconies is prohibited by culture. In Camas Commons, chairs were rarely found in the porches; most of them were used as a storage area figure 33. The front yard also is missing chairs and tables in Family Housing projects, it usually used as an outdoor storage area as shown in figure 34.

Figure 34: Physical Traces of Product of Use at Family Housing

4.7.1.2 **Display of Self**

Personalization can be clearly recognized throughout each unit in the three projects. Each unit has its own unique features, as seen in the furniture style and arrangement of outdoor spaces. In the USA projects, the sofas and dining table set the style, while the two units where Libyan families live, they have the traditional cushions used for sitting on the ground. Sitting on the ground is common in Libyan housing because it provides extra flexibility in use of the spaces; people can

Figure 35: Display of self, top: Camas commons; Bottom: Hay Al-Andalus

study, eat or lie down while having a conversation at teatime. In contrast, identification of affiliation to a group does not exist in the Libyan culture, while it is often clearly displayed in the two USA projects as shown in figure 35 (top). People in Libya tend to have prefer to paint their units to reflect their personalities as shown in figure 35 (bottom). In Hay Al-Andalus, being in separate units provide freedom to choose finishing materials and colors for the unit, especially because no laws or rules regulate such action.

4.7.1.3 **Adaptation of use**

Residents have redesigned their units to accommodate their activities. In both Family Housing and Camas Commons, residents have added play equipment to an empty lot to provide a play area. Residents at Camas Commons cover their ground -floor windows with a dark thick curtain to provide some privacy or added some privacy equipment in their balconies as shown in figure 36. In Family Housing, some families have changed the open living area upstairs by blocking the inside balcony with wooden pieces and using the space as a bedroom. In Family Housing, some families use curtains or wooden pieces to create a type of fence in their patio to provide privacy from neighbors. Other adaptations enable people to interact in new ways, such as blocking the main entrance of their units permanently and using the kitchen door as the only main entrance to their units in order to slightly enlarged their small unit.

Figure 36:Adaptation for use; left: Camas Commons; Right: Family Housing

In Hay Al-Andalus, residents have made modifications to their unit as shown in Figure 35. Residents modification have included turning the one-story units to two and three stories in order

Figure 37: Adaptation of use at Hay Al-Andalus

to be compatible with their needs. The residents also have changed the use of ground story from residential use to commercial use to increase their income. The residents have turned the entire first story or part of it to stories or clinic such as shown in figure 37.

4.7.2 Discussion of Interview Results in Relation to Best Fit Models Indicators

This section incorporates the interview analysis results with the significant indicators from the best-fit model to interpret residents' perspective.

4.7.2.1 Resident Characteristic Indicators

Household size in general was a significant indicator in both Camas Commons and the Hay Al-Andalus project; however, in the Family Housing project the more specific indicator was number of children with ages from 5-17.

Residents of Camas Commons indicated that there is an essential shortage of four-bedroom units at the project and there are not enough rooms to accommodate their needs. In addition, some residents have relatives visiting and there is not enough room for a visitor to stay overnight. In order to have enough room, most residents sleep on the sofa in the living space. They add that the bedrooms are very small and do not hold multiple beds.

The Hay Al-Andalus project includes two- and three-bedroom units; the family size is larger and usually extended family live in the same unit. Increasing family size by increasing the number of children is favored by religious teaching. Religious teaching requires providing a clear separation of female from male bedrooms, which leads to a shortage of bedrooms in the project. Libyan residents do not have a problem with increasing family size, but they do have problem with satisfying the bedroom requirement. Many solutions have been created to solve the lack of needed bedroom, such as multi-uses for spaces during the day and night, modifications, and constructing another floor to accommodate the family needs. Large modifications and expanding the unit is not possible in Camas Commons because it is a rental project; however, in Libya residents own their units.

In the Family Housing project, increasing the number of children aged 5-17 years decreased satisfaction level. Family Housing apartments are quite small, and residents indicate that there is no flexibility for multi-use in the space. Even though there are three playgrounds in the project, there are many children, which makes it hard to arrange for children to have a peaceful playtime. Most families who have children in this range prefer to take their children to other parks or recreation areas. Some studies have found that social interaction can lead to conflict and have suggested different strategies to eliminate such conflicts (Arthurson 2010; Riazi and Emami 2018). In addition, it is hard to find a place for teens to have activities together in the project; the only place that can be used is the community center, which is usually reserved for family gatherings.

4.7.2.2 **Social Sustainability Indicators**

Social sustainability indicators are discussed based on the four sustainability categories developed during the interview analysis: (1) personal and property safety, (2) social cohesion (3) accessibility to services in neighborhood (4) access to work opportunities.

4.7.2.2.1 Personal and property safety

Two indicators related to personal and property safety in this study were significant. In both the Camas Common and the Hay Al-Andalus projects "Inadequate measures against crime" was a significant indicator that decreased the satisfaction level. "A moderate level of recurrent thievery" was a significant indicator decreasing satisfaction level in both Camas Commons and Family Housing projects.

Feeling safe in a PH project is crucial for its residents' satisfaction. Even though, residents of both projects were dissatisfied with adequate measures against crime, in Hay Al-Andalus the dissatisfaction level is higher than it is in Camas Commons. That could result from many factors. First, conditions in Tripoli after the revolution in 2011 are generally unsafe in comparison to Corvallis. Second, the Hay-Andalus project is terrace houses where the houses share side walls, which make it easier to move among the units on the roof. Third, the plot of land per unit is small in Hay Al-Andalus and the area designed to be a garage inside the unit was often modified by the residents to a room or bathroom. This has led to use of the side street as parking for most units and increases the occurrence of thievery if a car is left unlocked even for a short time. In addition, all the equipment in the front yard or service court is usually at risk of theft on a daily basis. Fourth, there is a lack of security measures to control trespassers. Fifth, residents mention that it is unsafe to leave children outside without supervision because the project does not include any designed play area; children usually play in the street, which increases unsafe conditions. Finally, the project is located near an area frequented by drug dealers, which increases the risk of repeated thievery by drug addicts. In order to increase crime preventions, residents have used steel windows and doors, raised the shared walls and the street wall, and installed security cameras.

"A moderate level of recurrent thievery" was a significant indicator in both Camas Commons and Family Housing and the residents of both projects have similar stories related to theft, including car break-ins and stolen bikes, electric scooters, children's toys, furniture, electric devices, clothes and shoes. In contrast, even though the interviewees of Hay Al-Andalus project were aware of the security measures at their units and throughout the project and they described many occurrences of thievery, the thievery level at this project was not significant in the best-fit model.

4.7.2.2.2 Social cohesion

Different indicators related to social cohesion were significant in the three projects. First, at Camas Commons, the indicator "Community planning as a ""we", not a "they" activity" was significant. Second, at Family Housing, the indicator "unimportant to have cohesion/community (e.g., sense of community among neighbors)" was significant. Finally, at Hay Al-Andalus two indicators were significant: (1) “visiting neighbors in homes” and (2) “borrowing things and exchanging favors among neighbors”.

In order to understand those indicators, it is important to discuss each one related to residents’ perspective. In Camas Common, a strong sense of community increases residents’ satisfaction. The residents have a similar social structure related to their income level, and they look to form a sense of community to enhance their living. From the interviews, a sense of community and social cohesion is related to reduced stress and enhanced quality of life in the project, in addition to enhancing social integration among residents.

In Family Housing, residents consider community cohesion to be unimportant; however, a lack of community cohesion reduces their satisfaction level. Family Housing is a diverse community with a wide variety of backgrounds, cultures, religions and languages. Many of the students do not have time to communicate with other residents; however, they usually have birthday parties, religious festivals, or cultural organization parties, and they host parties at the community center for their friends who live outside of the project. Residents join the communities based on their cultural backgrounds, religions and languages while they live in Family Housing. During the interviews, they pointed out that it is more important to keep relationships affiliated with their background, even if their friends live outside the project than to form new relationships in the project with residents from different backgrounds. They add that ‘there is not enough time’ to do so. Other interviewees demonstrated that most of the relationships among neighbors are formed by children. In contrast, in most cases in this project conflicts among children usually leads to avoiding communication. The office and residential area director have offered many opportunities to strength the sense of community; however, the diversity and different backgrounds could be barriers.

In Hay Al-Andalus, convenient visiting with neighbors decreases dissatisfaction level; however, they are still dissatisfied. This indicator is related to tradition and religious influence. Neighbors usually visit each other at their home on many different occasions, such as death, sickness and weddings, even if they do not know each other well, just because they are neighbors. However, if they start to know each other, such visiting could change to a daily or weekly event. Borrowing is slightly different and depends on the favors that neighbors could exchange and the level of relationship among them. People should know each other well to borrow and exchange expensive things. Thus, inability to borrow or exchange thing among residents does reduce the dissatisfaction level here.

4.7.2.2.3 Accessibility to services in neighborhood

The five significant indicators for accessing services in the neighborhood in the three projects are being within walking distance to; (1) a ballfield at Camas Common project, (2) a dry cleaner at Family Housing, (3) education facilities at Hay Al-Andalus, (4) a public garage at Hay Al-Andalus, and (5) a grocery store at Hay Al-Andalus.

The residents of Camas Common consider that being within walking distance to a ballfield is essential and increases their satisfaction level. They mention that they must exercise to be healthy and keep in good shape. Regarding walkability quality residents of the Camas Common highlight the importance of having sufficient lighting and a safe path to the ballfield. Residents also mention personal safety and secure neighborhood as important factors while deciding when to exercise. Most of them indicate that they prefer to use the ballfield during the day for safety concerns.

Connecting to health concerns was surprising but indicates a high level of health awareness among the residents.

Regarding the walkability quality at Family Housing, residents highlight that they can walk through the project at any time; it is safe and secure as the project is part of the campus, and police patrol the area. Some ladies mention that they can walk even at 2:00 am morning with their children; they have enough lighting. The sidewalk is safe and smooth; it accommodates for people with disabilities and children. One of the ladies in the projects mentioned that “my daughters are using the roller skates and roller blades on the project sidewalk.”

The residents in Hay Al-Andalus considered it important to be within walking distance to educational facilities. Maybe this indicator was not important in the other two projects because of availability of school busses to the projects. At Hay Al-Andalus the school adjoins the project; however, the residents are dissatisfied with having the school near the project for two reasons. First, the project is very overcrowded, and it is hard to find parking space in the project streets at drop-off and dismissal time on school days. In addition, residents mention that the school in the area has a low ranking, and they prefer to send their children to higher-ranking schools. A second indicator was being with walking distance to a public garage. Being close to the mosque garage decreases their dissatisfaction level; however, the project is in the commercially important area in the Hay Al-Andalus municipality, which increases the load on the project site from outsiders who use the residential street for parking. Residents stated that a public garage would reduce the load of parking in residential street. The third indicator was being in walking distance to a grocery store. The residents in Hay Al-Andalus see having a grocery store in the neighborhood as moderately important; their dissatisfaction level is reduced because the project is in the commercial area and thus convenient to several grocery stores.

Regarding walkability quality at the Hay Al-Andalus, residents highlight that lighting of the street was available unless there is no electricity, which is one of the results from war, but they mention that the sidewalk quality and finishing are not safe and secure to use primarily by children and older. There is no accommodation for people with disabilities to use.

4.7.2.2.4 Suitability to work opportunity

Only one indicator related to suitability and work opportunity was significant for the residents of Family Housing: high unemployment. The residents of Family Housing say it is true that there is high unemployment among the occupants; however, that has increased their satisfaction level. For students, that saves them time to study; for their spouses, being unemployed gives them flexibility to take care of their children, do their daily activities, and join some social organizations, such as a weekly international mothers meeting at the community center. In addition, most spouses do not have a work permit to work in the USA.

In Libya, the project is in a revitalization area with many opportunities to access work. In Camas Commons, most families have part-time jobs and the parents divide the day so as to take care of their children. Some women babysit at their apartment to have some income.

4.7.2.3 Environmental Sustainability Indicators

This section discusses some significant environmental indicators related to design criteria that provide a comfortable use of spaces, a high level of privacy, healthy and durable indoor quality, and acceptable thermal comfort.

4.7.2.3.1 Privacy level

in Camas Commons, clear separation between guest areas and family areas provides comfortable living conditions and a satisfactory level of privacy. A Muslim woman who lives in the project noted, “I have been in another affordable housing unit in the north of Corvallis, but I moved to this project because the design of the unit provides a high level of privacy between family and guests”. She added that privacy is prioritized for her family. Another American woman mentioned that “I like my unit; I have a friend of mine over and my husband and my children are not distracted. They feel comfortable and they are doing their activities just fine”.

The residents of Family Housing were satisfied with the unit design, which provides a high level of privacy from neighbors and increases their satisfaction level overall. The residents mention that even though the units are attached, there are acceptable levels of visual privacy inside the unit and the acoustic privacy is controlled by the quiet hours. Some Muslim families have made some adjustments to provide extra visual privacy for outdoor spaces to improve their efficiency and functionality. For instance, they use a curtain to the entrance of their back yard or partitions to their patio.

4.7.2.3.2 Thermal Comfort Level

Three thermal comfort indicators were significant. In Family Housing, the residents dissatisfied with the thermal comfort level of their unit in winter; they always feel cold even while using the electric heater.

The two other significant indicators were related to the indoor air quality in Hay Al-Andalus: (1) a thermal discomfort level that interferes with usual activities inside the unit and (2) use of a coal or gasoline heater inside the unit when there is no electricity. Both indicators increase dissatisfaction among the residents regarding the thermal condition of the indoor environment, which affects building performance. The residents mention that, because of the project location, the air temperature and relative humidity are high in summer, and the winter is cold and windy. Lack of electricity as a result of conflict in Tripoli makes it difficult to maintain a comfortable temperature level in the units. In order to adapt to such conditions and because electricity has been sporadic since the war started in Tripoli, residents tend to use coal or gasoline heaters inside their units. Such a choice has many health and safety hazards. Users depend on sir conditioner or fans to mentain thermal comfort on summer, bit these are not available when there is electricity.

4.7.2.3.3 Comfortable and healthy indoor environment quality

The residents of Camas Commons were satisfied with the indoor environment and comfortable design of their units. Adequacy of daylight inside the unit increased the satisfaction level among the residents. Residents mention that all the spaces have windows that allow daylight to enter the unit; the design of the windows also provides a good view, which enhances living conditions in addition to providing natural ventilation.

4.7.2.3.4 Accessibility to services at the project site

One indicator related to suitability of services in the project site was significant: inadequate parking at residences in Camas Commons. Residents think one parking spot per family is not enough because most families have two cars. They add that there are not enough disabled parking spots, and visitors usually find it hard to find parking and must park far from the visiting place.

4.7.2.3.5 Durability of construction and finishing materials

Two features related to the quality of built environment inside the units of Family Housing decreased satisfaction level: (1) durability of the construction materials of balconies, and (2) durability of finishing materials for the kitchen and bathroom floors. The residents complained about the construction materials of the balconies. They feel they are in bad condition and there is lack of maintenance of this part of the unit. There are many cracks and broken parts, mold covers the surfaces and corners, there is water leakage inside the slabs and water stagnates in some parts, especially in the corners. The residents also were dissatisfied with the finishing materials of the kitchen and bathroom in the floor areas that were covered in vinyl. They mention that vinyl is a cheap finishing choice, and the kitchen floors have many spots and are hard to clean. They added that vinyl has many harmful impacts on health, presents a fire hazard, and emits dioxins. In general, residents do not like vinyl, and they complain about the durability of floor surfaces and their level of cleanness. Some of them add that the many damaged areas contribute to health hazards, especially with adhesive and reinstallation in inhabited units. Most of the residents added that they usually cover such area with carpets or multiple rugs to eliminate unfavorable features. The apartments in general are satisfactory and such features can be managed, but providing better choice is important to providing better living conditions.

4.7.2.4 **Economic Sustainability Indicators**

This section discusses some of the significant economic indicators related to energy, type of housing and modifications by residents.

4.7.2.4.1 Energy Consumption

Resident in both Camas Commons and Hay Al-Andalus were dissatisfied with the average use of the electric heater in winter, even though average use differed by about 6 hours. In the Camas Commons project, it was 6-12 hours per day; in Hay Al-Andalus it was 12-18 hours per day. In the USA, residents usually do not use a heater, or they reduce the temperature during the night; in Libya; however, residents prefer a warm unit during the night.

The construction materials and thermal insulation used in the building play a role in indoor air temperature. The Hay Al-Andalus project is built from concrete and there is no thermal insulation in the walls or roofs. In Camas Commons, the housing is built from wood with thermal insulation in the walls and roofs. In addition, windows in the Hay Al-Andalus project are single-pane window with wooden frames; in Camas Common they are thermal windows that reduce heat loss.

4.7.2.4.2 Type of Housing

The Family Housing project was built in 2 phases during 1961-1965 and 2002 with different unit types, sizes, construction materials, and rents. The residents consider the housing type is moderately important because they can choose from a have variety of housing types which increases their satisfaction.

4.7.2.4.3 Modifications

The residents of Hay Al-Andalus mention that expanding the living areas is important, because the designed space is not enough for family needs. Most units were modified in order to provide extra space for families to meet, eat, and do their daily activities. Even though the residents were moderately satisfied with such adaptations, they were done by residents without any review by designers or other professional experts, which resulted in insufficient space (Sharafeddin 2004). Most of those spaces suffered from inadequate daylight and natural ventilation, which decreased indoor air quality and building performance and increased health concerns.

4.8 Similarities and Differences among the Three Projects

(Table 17, page 235) summarize the similarities and differences among the three projects. An arrow in Table 17 indicates that the variable is significant for a specific project. The direction of the arrow shows the contribution of this variable to increase or decrease the overall satisfaction. The similarities section in Table 17 presents shared categories among the three project that include seven categories that are shared by two or three projects. The differences section in Table 17 present the seven categories that are significant in one project but not significant in the other two.

4.8.1 Similarities

The 18 indicators identified included four sustainability characteristics: residents (1), social (11), environmental (5), and economic (1). The residents' characteristics include only one category, relevant household size shared by the Camas Commons and the Hay Al-Andalus project, and includes the same indicator (family size). Family size variable decreases the satisfaction level in the Camas Common; however, it increases the satisfaction in the Libyan project because of the ability to expand the unit size and increase the number of children is favorable in Libyan society. The social sustainability characteristics include three categories shared among the three projects: (1) personal and property safety, (2) social cohesion, and (3) proximity to services in the project site and neighborhood. For example, two indicators of personal and property safety were shared among the projects: "adequate measures against crime" in Camas Commons and Hay Al-Andalus, and "level of recurrent thievery" in both Camas Commons and Family Housing. Inadequate measures against crime decrease satisfaction level in Camas Commons, while it increases overall satisfaction level in the Libyan project, because of the ability to control such factors by increasing the fence height or adding metal doors. The current thievery levels decreased the satisfaction levels in the two Corvallis projects.

The social cohesion category included four indicators shared among the three projects. Two were found in the USA: “thinking of community planning in my neighborhood as a "we" not a "they" activity,” at Camas Commons and “unimportant to have cohesion/community (e.g., sense of community among neighbors)” at Family Housing. These two variables indicate that social cohesion is important, and it should be considered for SPH. In Camas Commons it increases the satisfaction levels, while it decreases in Family Housing. The Libyan project have some features of social cohesion that increased overall satisfaction. Two were found in Libya: “visiting with my neighbors in their homes” and “borrowing things and exchanging favors with my neighbors” at Hay Al-Andalus. Social cohesion and sense of community were perceived differently by the residents of these projects based on their living conditions, backgrounds, and cultural norms. For instance, in Libya, people tend to form deeper interaction and more stable relationships with their neighbors based on religious teaching.

Regarding proximity to services in the project site and neighborhood, five indicators were pertinent to being within walking distance of a facility (ballfield, dry cleaner, education facilities, public garage, and grocery store) were shared among the three projects. Access to “ballfield” was significant in Camas Commons and increased the satisfaction level. Access to “dry cleaner” was important for Family Housing residents and being far from such services has decreased the satisfaction levels. These variables indicated the priority of residents in each project. On the other hand, in Libya, three different services were important: educational facilities, public garage, and the grocery store at walking distance increased the overall satisfaction levels.

The environmental sustainability characteristics include two categories shared among the three projects: (1) privacy level, and (2) thermal comfort. The privacy level category includes two shared indicators in Camas Commons and Family Housing: “clear separation between guest areas and family areas” and “unit design provides a high level of privacy from the neighbor.” This was surprising because the level of privacy is critical in Middle Eastern countries; however, it was just as significant in the USA projects, which indicates that privacy is considered a high priority internationally. Each project had different indicators depending on the type of project and the community structure of the residents. For instance, at Family Housing, there are more diverse nationalities and many backgrounds among the residents and privacy concerns were about the privacy from neighbors. In Camas Commons, however, the concern was about providing a high level of privacy inside the unit.

The “thermal comfort level inside the unit” category includes three shared indicators: ‘Always I felt cold’ in Family Housing and ‘Intermediate thermal discomfort’ and ‘Usage of coal or fuel heater’ in Hay Al-Andalus: At Family Housing, the thermal comfort indicator was “Always feeling cold.” At Hay Al-Andalus, two indicators express the level of thermal discomfort: “intermediate thermal discomfort level that interferes with doing usual activities” and “Usage of coal or fuel heater inside the unit in case there is no electricity.” Each response indicates the residents’ perception of their living conditions based on their cultural and norm identification and their existing situation. In Tripoli, electrical service is sporadic thus, residents tend to choose electricity as an alternative to maintain thermal comfort.

Lastly, the economic sustainability characteristics include only one category, energy consumption. This category shared one indicator, “average use of electrical heater” in both Camas Commons (6-12 hours) and Hay Al-Andalus (12-18 hours). The Hay Al-Andalus project is close to the sea, which increases coldness during winter, especially at night. Besides, with climate change Tripoli has recently been experiencing colder winters. In the USA, residents tend to lower the thermostat at night.

4.8.2 Differences

There are eight indicators of differences divided among the four sustainability characteristics: residents (1), social (1), environmental (4), and economic (2). The residents’ characteristics include only one category related to the age of children: “number of children aged 5-17,” at Family Housing. Such indicators reduce the satisfaction level, which draws attention to the importance of family size and the household growth curve. The PH projects required providing multi-use spaces in the projects to satisfy the needs of the different ages.

The social sustainability characteristics include only one category related to job opportunity: high unemployment among the occupants. Residents of Family Housing do not care about a job opportunity. Most of the residents are international students who consider living at Family Housing to be temporary until they graduate from OSU.

The environmental sustainability characteristics include three categories: (1) indoor air quality, (2) suitability and convenience of parking at the project site, and (3) durability of finishing and construction materials. The indoor air quality category includes one indicator related to Camas Commons: “adequacy of daylight entering the unit.” The residents of Camas Commons were satisfied with the daylight entering their units. Most of the rooms at the units include two windows, which is reflected in the satisfaction with living conditions. Such an indicator could be applied in a new project or use to retrofit built projects to enhance residents' satisfaction and provide SPH. One indicator of sustainability found at the Camas Commons project was "inadequate parking at the residence." The residents of Camas Commons were dissatisfied with parking available at the project.

The durability of finishing and construction materials category includes two indicators: "durability of the construction materials of balconies" and "durability of finishing materials for kitchen," both at the Family Housing project. Residents of Family Housing were dissatisfied with the durability of construction and finishing materials at their units. Even the maintenance team mentioned that the finishing materials are inexpensive and of low quality.

Finally, the economic sustainability characteristics include two categories: (1) housing type and (2) modification. The housing type category includes one indicator, "the importance of housing type (e.g., apartment in a tower, townhome, single-family home, etc.)." Residents of Family Housing were satisfied with the different types of units provided. This indicator was not important at Camas Commons, even though there are a few different choices of unit types. Similarly, such an indicator was not important in Libya, where there are just three-bedroom units with different models. Providing a different type of housing is a significant factor in designing more satisfactory projects.

The modifications category includes only one indicator, "expanding the living areas as part of the modification" at Hay Al-Andalus. Residents of Hay Al-Andalus were dissatisfied with the original design, and they modified different areas in their unit, especially the living area. Modifications were not found at the other two projects because residents do not own their units, and they are not allowed by laws and regulations to conduct such modifications. Such an indicator can be a leading indicator in creating a successful design for SPH.

The indicators discussed before were significant, based on the residents' perspective. However, we were expecting some other indicators related to housing and the neighborhood features to be significant, but they were not. The not significant indicators related to the units' features include unit size, the size and the number of rooms, the unit orientation, the natural ventilation, the aesthetic appearance of finishing materials, the maintenance plans, and the incorporation of the traditional housing features. The not significant indicators related to the neighborhood features include the planning of the public spaces, providing a community center, providing different street types such as pedestrians and features of the street furniture, and providing play structure areas and green areas.

Table 17: Comparison of Sustainability Indicators among the Three Public Housing Projects

Aspects	Category	Sustainability indicators	Public Housing Project		
	Similarities		Cams Commons	Family Housing	Hay Al-Andalus
Residents' Characteristic		• Family size	↓		↑
Social Sustainability	Personal and property safety	• Adequate measures against crime	↓		↑
		• Current thievery level	↓	↓	
	Social cohesion	• Community planning in neighborhood as a "we", not "they"	↑		
		• It is unimportant to have social cohesion		↓	
		• Visiting neighbors in their homes			↑
		• Borrowing and exchange favors among neighbors			↑
	Accessibility to services	• Being within walking distance to ballfield	↑		
		• Being within walking distance to a dry cleaner		↓	
		• Being within walking distance to educational facilities			↑
		• Being within walking distance to a public garage			↑
		• Being within walking distance to a grocery store			↑
Environmental Sustainability	Privacy level	• Clear separation between guest areas and family areas	↑		
		• Unit design provides high level of privacy from neighbors		↑	
	The thermal comfort	• Always I felt cold		↓	
		• Intermediate thermal discomfort			↓
		• Usage of coal or fuel heater			↓
Economic Sustainability	Energy consumption	• Average of using electrical heater 6-12 hours per day	↓		
		• Average of using electrical heater 12-18 hours per day			↓
	Differences				
Residents' Characteristic		• Number of children with age from 5-17 years		↓	
Social Sustainability	Job opportunities	• Unemployment rate among the occupants		↑	
Environmental Sustainability	Indoor air quality	• Adequacy of daylight entering the unit	↑		
	Parking	• adequate parking at the residence at Always I felt cold	↓		
	Durability	• Durability of the construction materials of balconies		↑	
		• Durability of finishing materials for kitchen floor		↓	
Economic Sustainability	Housing type	• the importance to have different housing types		↑	
	Modifications	• expanding the living areas as part of the modification			↑

4.9 Conclusion

This study has identified a set of significant indicators related to TBL based on the residents' perspective of the three PH projects in the two countries. Paying attention to those indicators could clarify significant factors that affect residents' satisfaction for policy makers, planners, designers, engineering project managers, and property managers and developers. Satisfaction indicators need to be promoted in SPH criteria to enhance living conditions, while dissatisfaction indicators require more attention in order to solve existing PH situations and to avoid such mistakes in future projects. This study revealed seven indicators of satisfaction: three social, three environmental and one economic. First two social sustainability satisfaction indicators were at Camas Commons and the third at Family Housing: (1) accessibility to a ballfield, (2) level of social cohesion, and (3) unemployment rate among residents. Of the three environmental sustainability satisfactory indicators, the first two were found at Camas Commons and the third at Family Housing: (1) adequacy of daylight entering the unit, (2) adequate privacy inside the unit, and (3) high level of privacy from neighbors. Only one economic sustainability satisfactory indicator was found, at Family Housing: provision of different types of units at the project site.

The study revealed 23 indicators of dissatisfaction: 3 residents', 11 social, 6 environmental, and 3 economic characteristics. The three sustainability indicators based on residents' characteristics included large family size (Camas Commons and Hay Al-Andalus) and the number of children 5-17 years old (Family Housing).

The study revealed 11 social sustainability dissatisfaction indicators. Four indicators were related to personal safety and property at projects; 2 were related to thievery level at both Camas Commons and Family Housing, and 2 related to inadequate measures against crime at both Camas

Commons and Hay Al-Andalus. Four dissatisfaction indicators were related to accessibility to services in the neighborhood, such as, a dry cleaner at Family Housing, and schools, grocery stores and a public garage at Hay Al-Andalus. Three indicators were related to sense of community and social cohesion: 1 at Family Housing ("it is unimportant to have cohesion/community among residents,") and 2 at Hay Al-Andalus ("ability of visiting neighbors in their homes," and "inability to borrow and exchange favors among neighbors.")

The study identified 6 environmental sustainability dissatisfaction indicators. One indicator related to "adequacy of parking in the project site" was found at Camas Common. Three dissatisfaction indicators were found at Family Housing: 1 related to thermal comfort in the unit ("feeling cold always"), and 2 related to weakness of construction and finishing materials. Finally, 2 dissatisfaction indicators were identified at Al-Andalus: intermediate thermal discomfort and use of a coal/fuel heater.

In respect to economic sustainability. The study identified 3 indicators of dissatisfaction: 2 were related to average use of g electrical heater in both Camas Commons and Hay Al-Andalus, and 1 related to modifications by residents at Hay Al-Andalus (expanding the living areas).

In fulfillment of the second objective of the study, by compare the significant indicators of residents' satisfaction between three PH projects. Seven equal similar and different categories were found in the comparison of the three projects. In general, the categories indicated general needs that required in each project in different regions, cultures and background. In particular, some indicators reflect the residents' needs based on their existing living conditions. For instance, residents of Family Housing perceive high unemployment rate as a satisfaction indicator; that could not be applied in other situations or locations of low-income housing. Additionally, ability to visit neighbors or borrowing and exchange favors with them could not be the case in every culture at the same level.

Similar categories included 16 indicators: 1 residents characteristic related to household size; 11 social sustainability indicators included in 3 categories: personal and property safety, social cohesion, and accessibility to services in the site and surrounding neighborhood; 5 environmental sustainability indicators included in 2 categories, privacy and thermal comfort; and 2 economic sustainability indicators included in 1 category, energy consumption.

The two indicators related to safety level are “adequate measures against crime” at Camas Commons and Hay Al-Andalus and “current thievery” at Camas Commons and Family Housing. The 4 indicators related to social cohesion are “community planning the in neighborhood as a "we", not a "they"” at Camas Commons, “unimportant to have social cohesion and sense of community” at Family Housing, and lastly, “visiting neighbors in their homes,” and, “borrowing and exchanging favors among neighbors” at Hay Al-Andalus. The five indicators related to accessibility including being within walking distance to a ballfield at camas Commons, a dry cleaner at Family Housing, and educational facilities, the public garage, and the grocery store at Hay Al-Andalus.

The two indicators related to privacy level are “clear separation between guest areas and family areas” at Camas Commons, and “unit design provides high level of privacy from neighbors” at Family Housing. The three indicators related to thermal comfort are “always feeling cold” at Family Housing and “intermediate thermal discomfort level that interferes with doing usual activities” and “ use of coal or fuel heater inside the unit in case there is no electricity” at Hay Al-Andalus.

Finally, the two indicators related to energy consumption are “average use of electrical heater about 6-12 hours per day” at Comas Commons, and “average use of electrical heater about 12-18 hours per day” at Hay Al-Andalus.

Different categories included 8 indicators: 1 residents’ characteristic related to age of children; 1 social sustainability indicator related to unemployment rate and job opportunity; 4 environmental sustainability indicators included in 3 categories: indoor air quality, suitability, and durability; and 2 economic sustainability indicators included in 2 categories: housing type and modifications.

The only indicator related to residents’ characteristic was “the number of children 5-17 years old” at Family Housing. The only social sustainability indicator was “an unemployment rate among the occupants” also at Family Housing. The 1 indicator related to indoor air quality was “adequacy of daylighting entering the unit” at Camas Commons. The one indicator related to suitability was “inadequate parking at the residence” at Camas Commons. The 2 indicators related to durability were at Family Housing: “durability of the construction materials of balconies” and “durability of finishing materials for kitchen floor.”

The only indicator related to the type of housing was “the importance variety of housing types (e.g., apartment in a tower, townhome, single-family home, etc.)” at Family Housing. Finally, the only indicator related to modification was “expanding the living areas” at Hay Al-Andalus.

The identified indicators were significant based on the residents perspective, however, we were expecting some other missing indicators related to housing size, number of rooms, orientation, natural ventilation, aesthetics appearance of finishing materials, maintenance plans, traditional housing and neighborhood features, public spaces, community center, street and furniture, play structure areas, and green areas that do not included in the identified indicators.

4.10 Recommendations

This section addresses the third objective of the study by providing a set of recommendations that highlight the significant factors affecting residents' satisfaction in order to assist policymakers, planners, designers, construction project managers, property managers, and developers with making decisions regarding SPH development.

1. Policymaker should create a management plan to absorb the shortage of SPH for families in need. In Libya, for instance, it was clear that a shortage of PH led many residents to convert one-story units to two and three stories to accommodate extended family.
2. Planners should conduct POEs for existing projects in the region where new PH is planned in order to have a realistic perspective of residents' needs.
3. Enhancing resident involvement in decision making to solve existing and future problems in PH is critical to reach SPH.
4. Regarding social sustainability indicators, providing a variety of unit types at the PH project can meet the needs of families of different sizes.
5. Social study of the family growth curve is critical to development of acceptable planning and design criteria that accommodate existing and future family member needs and achieve SPH.
6. Addressing general social needs such as personal and property safety and access to educational, commercial, and recreational services is critical for SPH.

7. Some specific social requirements relevant to residents' culture and background, such as social cohesion and privacy level, should receive a good deal of attention in order to meet residents' expectations.
8. Providing job opportunities is essential to enhance residents' economic status; the ability to own and modify the PH unit at Hay Al-Andalus have encouraged some residents to turned room or front yard in their units to a store, to increase their incomes. In contrast, residents of Family Housing were satisfied with unimportant rate; such project has its own conditions for international students where most of the spouse who stay home do not have a work permit in the USA.
9. General environmental sustainability needs such as indoor air quality, thermal comfort, and planning and designing of public space are critical to having SPH. The main problems with Libyan PH projects are the absence of green areas, play structures for children that include landscaping or furniture that is planned and designed to enhance usage of space, and even well-designed parking lots. Such project components are ignored in most PH projects in Libya (Sharafeddin and Arocho 2017).
10. Providing energy alternatives is key factor to SPH.
11. Modifications by residents provide guidance to policy makers, planners and designers about residents' expectation for new SPH. In Hay Al-Andalus, modifications to PH by private owners have led to development of a socially mixed community that increases equity and interactions among residents. Most one-story projects have evolved to have two or three stories, which has changed the project's visual features toward more typical private neighborhoods that reflect a higher social status.

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5. Chapter 5: An Integrated conceptual framework for Sustainable Public Housing the project's life cycle

5.1 Introduction

Around the world, cities are growing in population need adequate housing. UN-HABITAT defines affordable housing as that which is "adequate in quality and location and does not cost so much that it prohibits its occupants from meeting other basic living costs or threatens their enjoyment of basic human rights" (UN-HABITAT 2011). The Queensland Department of Public Works (QDPW 2008) coined the term "Triple Bottom Line" (TBL), which defined sustainable housing as housing that is environmentally, socially, and economically sustainable. Availability of sustainable affordable or sustainable public housing (SPH) that meets the needs of and adds value to its residents, surrounding communities, and society is crucial. Sustainability in affordable housing is facing many challenges that imply many opportunities. Construction of SPH projects has many steps, including project scope, planning, design, construction, use and finally demolition. These stages incorporate many constraints and opportunities to deliver a successful project. Innovative practices and sustainability in project management are the keys to tackling SPH challenges. Serious constraints and requiring certain features, affordable housing has similar profit and productivity challenges to those in the construction industry; thus, application of effective management techniques is critical to successful SPH projects (Reinbold et al. 2017).

Many frameworks have been identified to assess PH sustainability and provide a solution for PH problems. For instance, Ibem and Azuh (2011) aimed to fill the gap between theory and application in a sustainability approach, creating a framework that includes four dimensions (environmental, technological, economic, and social and cultural aspects). They highlighted the limitation of use of an environmental basis to assess PH sustainability. The terms affordable housing and public housing (PH) will be used in this paper interchangeably.

The integration of sustainability into project management to satisfy all the stakeholders' needs and values with respect to the TBL throughout project construction have been introduced by many authors. For example, Marcelino-Sádaba et al. (2015) provides a conceptual model for managing sustainable projects based on the TBL approach. Carvalho and Rabechini (2017) highlight the importance of applying sustainable management to enhance social and environmental impacts and achieve project success. Silvius (2013) identified the integration of sustainability into project management as a comprehensive incorporation of the TBL pillar of sustainability into project delivery systems and management practices in order to achieve effective project management.

This paper aims to develop an integrated conceptual framework as a step toward an integrated management plan for SPH that will meet the need of PH residents and add value to PH projects and society. In addition, provide specific sustainable performance checklist criteria for the project cycle as an applicable approach for achieving SPH. Orient previous results included in literature review using a systemic literature review with results of previous work (Sharafeddin et al 2019 and other work in reviewing) to develop the integrated conceptual framework.

5.2 Methodology

Previous work on the topic is incorporated with a systematic review to develop an integrated framework for SPH. SPH is a complex topic that requires an interdisciplinary approach covering social sciences, planning, architecture, economics, policies and management, environment, sustainability, sociology, psychology, health, history, and other academic and professional disciplines. The systematic review was chosen by the authors because it provides a holistic understanding of theoretical synthesis of a specific topic relevant to the research stream; and it draws a starting point for further development, and verifies the finding for best practices (Macpherson 2007). This study aims to develop an integrated framework for SPH by exploring and evaluating the existing frameworks relevant to SPH practices and sustainability in project management. The research methodology adopts the three-stage research design used by Tranfield et al. (2003), Burgess et al (2006), Macpherson (2007), Bask and Rajahonka (2017), Yigitcanlar et al. (2018), and Armenia et al (2019) that comprises (1) planning, (2) conducting the review and evaluating, and (3) reporting and dissemination.

5.2.1 Stage One: Planning

Stage one involved exploration of an extensive survey of journal articles, governmental and non-governmental reports and conference proceedings accessed at the following online databases: ScienceDirect, Web of Science, Directory of Open Access Journals, Wiley Online Library, Google Scholar, and governmental websites. The research key words are included in Table 18.

No	Keyword
1	Affordability assessment frameworks
2	Sustainable affordable housing
3	Performance indicators for affordable housing

Table 18: Identified keywords

4	Sustainable project management
5	Project management success factors
6	Sustainability models for low income-housing
7	Sustainability assessment
8	Success factors for sustainable project management
9	Sustainability framework in project management
10	Risk management and sustainable project management
11	Lean construction (LC) and sustainable project management
12	Feasibility studies and sustainable affordable housing
13	Project management performance
14	Integrated project delivery

5.2.2 Stage Two: Evaluating the resources

Stage two involved refining research boundaries to sources that are full-text and published in English or Arabic. A total of 150 resources were identified based on the key words. The 'eye-balling' technique for consistency and accuracy was used to evaluate the abstracts, executive summaries and conclusions (Yin, 1994). The review pool included 60 full text resources after the duplicate resources were removed, and the abstracts were reevaluated against the research objective. These resources were screened and then read against the study aim. The final selection of 45 resources then were re-read, reviewed, categorized and analyzed (Figure. 38).

The qualitative techniques of pattern matching, and explanation building were used to categorize the selected resources (Yin, 2015). The selection criteria of the formulated categories are presented in Table 19.

5.2.3 Stage Three: Representing the findings

The emphasis in Stage three was in representing the findings of the literature to fulfill the aims of the paper. Additional publications were incorporated at this stage as in order to better analyze the topic provide supporting evidence and elaborate the overall findings. The inclusion of additional literature increased the total number of references to (168).

Table 19: Selection criteria for the identified categories

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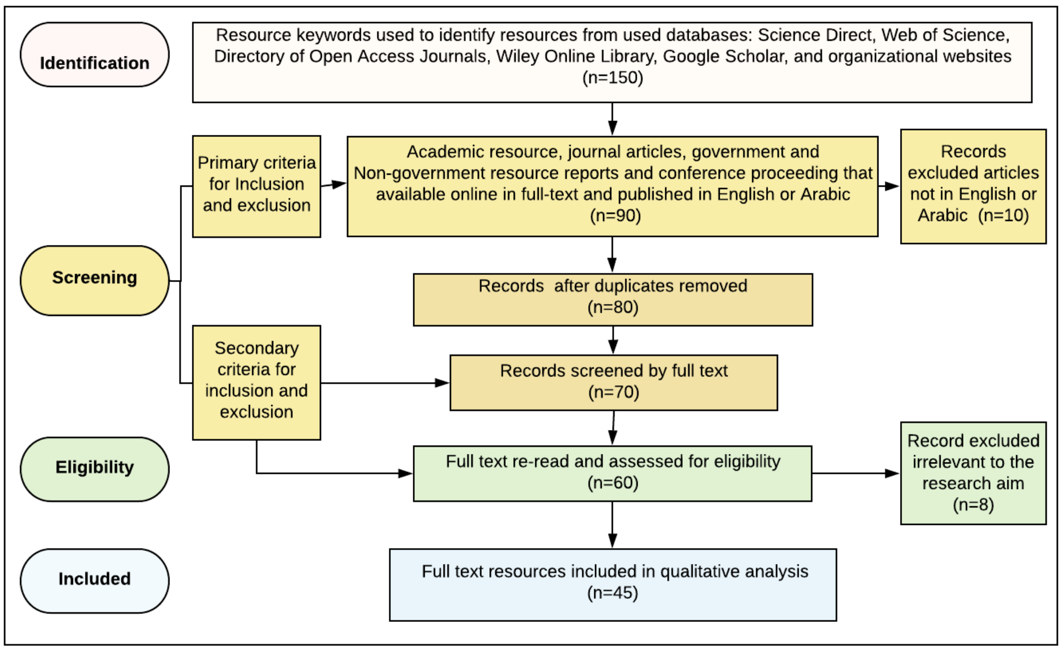

Figure 38: Flowchart for the literature selection (after Yigitcanlar, 2018).

5.3 Literature Review Analysis

The reviewed articles by year showed increased attention with time toward sustainability implementation in affordable housing, or in project management in general and particularly in project management for affordable housing. Applying sustainability in affordable housing projects showed a positive trend in the past few years with a peak in 2017 (Figure 39); this highlights the increased academic interest in the integration of sustainability into project management. Silvius (2017) declares that sustainability is a new school of thought in project management that pays attention to social aspects of a project, satisfaction for all stakeholders, application of TBL criteria, and a values-based approach to the projects and the project management. The positive trend reflects the growth of integrated implementation of a sustainability approach in affordable housing management with construction management for organizations and firms. It is consistent with the trend toward implementing sustainability in some specific topics such as the feasibility studies, lean construction, risk management and innovation in PH (Othman, 2008; Shen et al., 2010; Reinbold et al. 2017; WEF 2019).

The selected papers include different topics having specific domains and reflections of the sustainability perspective. Two steps were followed in reviewing and analyzing the selected papers to develop the framework.

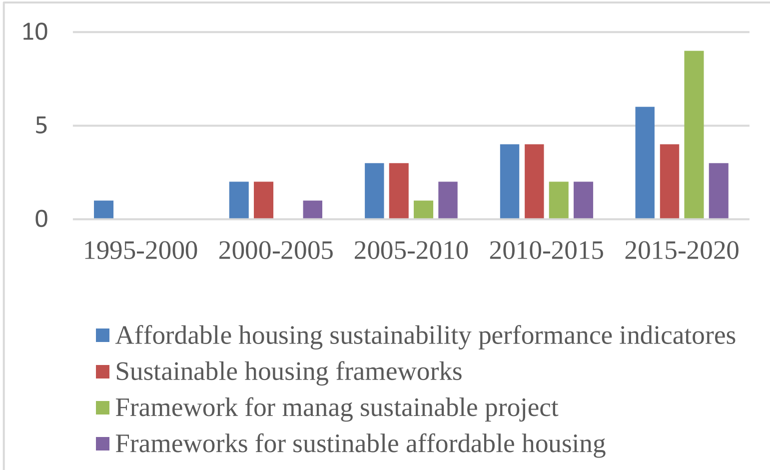

Figure 39: Number of papers relevant to sustainability implementation in affordable housing by year

5.3.1 Step One: Grouping of Selected Papers Relevant to SPH

Step one included defining the selected articles based on four groups related to SPH: (1) affordable housing sustainability performance indicators, (2) sustainable housing frameworks, (3) frameworks for managing sustainable projects, and (4) frameworks for sustainable affordable housing (Tables 20, 21, 22, and 23).

Table 20: Affordable housing sustainability performance indicators

Reference	**Sustainability Performance Indicators**
Mulliner and Maliene (2015); Gan et al. (2017); Oyebanji et al. (2017)	TBL- Housing
Blair et al. 2003; 2004; Emsley et al. 2008; Meir et al. 2009; Aribigbola 2011; Jiboye 2012; Tapsuwan et al. 2018	TBL -Housing and neighborhood
Hoffman 1996; Gifford 2007; Jonsson 2013; Weisman 2016	Social - Social housing
Pattinaja and Putuhena (2010); Oyebanji (2014); Dixon and Woodcraft (2016)	Social- Social housing

Indicators are tools to measure and express important qualitative and quantitative conditions over time (Sinha et al. 2017). Numerous sets of indicators have been created to evaluate affordability and sustainability of affordable housing based on the TBL aspects (Blair et al. 2003, 2004; Mulliner and Maliene 2015; Oyebanji 2014; Dixon and Woodcraft 2016). The residents' perspectives based on the Post Occupancy Evaluation (POE) have been utilized to define sustainability indicators for affordable housing (Blair et al. 2003; 2004; Emsley et al. 2008; Meir et al. 2009; Aribigbola 2011; Jiboye 2012; Tapsuwan et al. 2018). Sustainability performance indicators defined by residents provide robust results to develop SPH. Table 20 presents the articles relevant to sustainability performance indicators.

Table 21 Sustainable Housing Frameworks

Reference	**Sustainable Housing Framework**	**Sustainability Dimensions**
Blair et al. (2003); (2004)	Affordability and sustainability case study evaluation	TBL
Rahman et al. (2005)	Evaluation of sustainable housing	TBL
QDPW (2008)	Define and assess sustainable housing	TBL
Ibem and Azuh (2011); Ibem et al. (2015)	Framework for evaluating the sustainability of PH programs	TBL, cultural and technological
Pullen et al. (2010a; 2010b)	Framework to assess affordable and sustainable housing	TBL
Burford et al. (2013); Sharifi and Murayama (2013); Sharifi and Murayam 2014; Mulliner et al. 2016)	Examine the existing frameworks Expand the frameworks to assess sustainability	TBL+1
Yip et al. (2017)	Develop a conceptual framework for sustainable housing	TBL and physical
Gan et al (2017)	Evaluate sustainable affordable housing from stakeholders' perception	TBL

Table 21 presents the articles relevant to the sustainable housing framework. Most of these articles develop the frameworks for sustainable housing assessment based on the TBL; however, some authors have extended the framework to include other dimensions. For instance, Yip et al. (2017) developed a conceptual framework for sustainable housing development that includes physical, social, environmental, and economic dimensions. Burford et al. (2013) explored the theoretical and practical frameworks to assess sustainability. They examined missing pillars that include cultural-aesthetic, political-institutional, and religious-spiritual and recommended political-institutional as the fourth pillar for sustainability assessment. Adding governance to the TBL is related not only to involvement of other stakeholders in making the decisions, but also to inclusion of norms, laws, and regulations that govern interactions among stakeholders (Sharifi and Murayama 2013; Sharifi and Murayam 2014; Mulliner et al. 2016). Governance has been chosen as a fourth dimension to add to the TBL in this study.

Table 22: Frameworks for Managing a Sustainable and Successful Project

Reference	Frameworks for Managing Sustainable and Successful Project
Shen et al (2007)	Developing a checklist for assessing sustainability performance of construction projects
Shen et al (2010)	Applying feasibility study for sustainable and socially responsible construction management
Orihuela et al. (2011)	Developing a matrix of responsibilities
Marcelino-Sádaba (2015)	Create a conceptual model for managing sustainable projects
Silvius & Schipper (2015)	Developing a maturity model for assessing sustainable project management

Serrador & Turner (2015)	Examining the relationship between the project success and stakeholders' satisfaction
Carvalho and Rabechini (2017)	Developing a conceptual model and hypotheses for sustainable management impact on project success
Banihashemi et al. (2017)	Developing a conceptual model for project management based on integration of sustainability into project management practices
Radujković & Sjekavica 2017a	Investigating the project management success factors
Radujković & Sjekavica 2017b	Developing a model to enhance a project management by analyzing risks changes and constraints
Langston et al. (2018)	Developing a (i3d3) framework for
Armenia et al (2019)	Conducting a conceptualization-oriented review and proposing a framework for future studies relevant to sustainable project management

Indicators in project management are utilized to measure project success. Indicators such as key performance indicators (KPIs) and critical success factors (CSFs) were considered as the key to monitoring development, ensuring that the projects' performance complies with the established goals and allowing for corrective actions as needed. In the past few years, however, several studies have highlighted using indicators to measure project success turns out to be a challenge. Orihuela et al. (2017) argue that the vast combination of construction indicators does not provide effective monitoring of construction projects. Project management success is hard to measure exactly because of many reasons: (1) it produces both tangible and intangible benefits (Radujković & Sjekavica 2017a), (2) it is difficult to reduce the factors to a manageable number (Langston et al. 2018), and (3) no model including all CSFs has been created to measure project management success (Mir and Pennington 2014), and such a model may be impossible (Radujković & Sjekavica 2017b).

Several studies underline the importance of social aspects in project management practices; they assert that project success implies the involvement of a wide range of integrated stakeholders' requirements at all stages of the project to meet project targets (Silvius 2017; Radujković & Sjekavica 2017a; PMBOK 2013). Serrador & Turner (2015) state that both project success and the satisfaction of stakeholders contributed to successful project management (60% and 56%, respectively).

In this context, diverse frameworks have been developed to assess project success by incorporating a sustainability approach. Table 22 presents the articles relevant to frameworks for managing a sustainable and successful project as an effective way to measure project success. Orihuela et al. (2011) clarify that the aim of any project is to satisfy the needs and values of its owners and users. They suggest combining users' needs and values with the POE results of previous projects to identify and understand users' needs, and They provide a specific matrix that includes both owners' and users' needs and their values. Armenia et al. (2019) propose a framework for sustainable project management that included five key dimensions: corporate policies and practices, resource management, life cycle orientation, stakeholders' engagement, and organizational learning.

Radujković & Sjekavica (2017a) create a framework for enhancing the success of management activities at three hierarchical levels in the organizational structure and link project management success and project success. Langston et al. (2018) create a framework (i3d3) to measure the success of construction projects based on the project time phases, where i3 indicates three generic phases of projects (initiate, implement and influence), and the d3 refers to the projects' generic objectives of the three phases (design, deliver, and delight). This framework considers stakeholders' communication throughout these phases to be critical to achieving a successful project.

Table 23: Frameworks and models for managing a SPH project

Reference	Framework and Model for Managing SPH Project
Schramm et al (2004)	Design production system for low-income housing projects based on lean construction approach
Bakar et al (2009)	Develop a theoretical framework for project management success factors in sustainable housing development
Susilawati (2009)	Determent contribution of risk management to enhancing affordable housing development and management
Ibem & Azuh (2011)	Develop a framework for evaluating SPH programs in developing countries
Ihuah & Fortune (2013)	Develop a framework for the sustainable management of social PH in Nigeria
Ihuah et al (2014)	Investigate the project management success factors for sustainable social housing in Nigeria
Ganiyu et al (2017)	Develop a sustainability housing financing model to reduce South Africa affordable housing deficits
Orihuela et al. (2017)	Develop a biaxial control panel to control the housing project during its life cycle
Synnefa (2017)	Developing a holistic approach to minimize the energy consumption of low-income housing in Athens, Greece
(WEF) (2019)	Review of holistic approach to make affordable housing a reality in cities
Nichols & Trinh (n.d.)	Application of risk management to create an early warning system for affordable housing properties

In general, different sets of frameworks and models for managing SPH projects have been developed; however, most of them discuss a specific issue of sustainability application in affordable housing and do not provide an integrated approach (Table 23). For instance, Ihuah & Fortune (2013) asserted the importance of creating a post-construction management strategy to assure sustainable social housing in estates in the country of Nigeria. They cite Franks (2006), who emphasizes that sustainability is crucial in any project management. Ihuah et al. (2014) list critical project management success factors for sustainable social housing in the country of Nigeria, highlighting the importance of creating housing policies that are sustainable with all stakeholders and ensuring that changes in government do not affect or alter such policies. Orihuela et al. (2017) propose a biaxial control panel to control the housing project during its life cycle that takes into consideration the TBL sustainability aspects. They provided a set of five indicators for the design phase of housing projects.

5.3.2 Step Two: Identified Recognized Dimensions to Develop SPH

Step two of the analysis includes scrutinizing and examining content of the grouped articles to define the themes related to develop the integrated framework. The nature of affordable housing sustainability and its connection to project management involves multidimensions. Several of the articles selected have some common themes, such as TBL, TBL+1, needs, values, the key performance of sustainable housing, challenges, and opportunities. Others focused matters related to operational and practical matters, such as risk management, lean construction, feasibility study, and innovation. These themes were grouped and reorganized based on the need to develop the structure of the integrated framework. The reorganized themes resulted in three dimensions in the framework:

- SPH Requirements (general needs and values)
- Challenges (project constraints and specific needs)
- Opportunities (feasibility study, innovation, risk management, and lean construction)

The following section describes the literature pertinent to an integrated framework. Tables 24 and 25 are based on the extracted dimensions and their application throughout the project stages. Table 24 shows published frameworks for managing sustainable and successful projects that identify some general needs and values, apply some of the sustainability aspects related to TBL+1; utilizes key sustainability performance indicators (KSPIs), needs and values; and apply some project management tools such as feasibility studies (FS), lean construction (LC), risk management (RM), and innovation (INN). Table 24 shows high consideration of social aspects followed by equal level of consideration for environmental and economic aspects and less consideration for political aspects. The needs and values have a high level of consideration in the selected frameworks, while less consideration is paid to KPSIs. A high consideration to the construction stage followed by project scope and design stages, which can indicate that the construction and scope identification and design stages influence project delivery where the project management could have high involvement. (Figure 40, page 267) represents the information extracted form Table 24 related to the application of project management tools in the management frameworks. Innovation has a higher application (38%) followed by risk management (33%) and feasibility study (24%) lean construction has the lowest percentage (5%). LC. LC has a low level of application because the frameworks in this table are intended to provide a sustainable management framework, and LC is a new trend in construction that has its specific applications; thus, only one article has discussed the LC implementation as a tool to design a management project (Allison et al. 2018).

Table 24: Contribution of reviewed frameworks (sustainable and successful projects)

Articles related to framework for successful Projects	Sustainability aspects				KSPIs[5]	Needs	Value	Management throughout project stages						Tool			
	Soc[1]	Env[2]	Eco[3]	Pol[4]				I[6]	II[7]	III[8]	IV[9]	V[10]	VI[11]	FS[12]	LC[13]	RM[14]	INN[15]
Marcelino-Sádaba (2015)	✓	✓	✓	✓	✓	✓	✓	✓			✓					✓	✓
Orihuela et al. (2017)	✓				✓					✓					✓		✓
Orihuela et al. (2011)	✓					✓	✓				✓			✓			
Gomes & Romão (2016)						✓	✓	✓			✓					✓	✓
Serrador & Turner (2015)	✓	✓	✓		✓	✓	✓				✓						
Langston et al. (2018)	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		✓	
Radujković & Sjekavica 2017a						✓	✓				✓						✓
Radujković & Sjekavica 2017b	✓	✓	✓			✓	✓				✓					✓	✓
Shen et al (2007)	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓			
Silvius (2015)	✓	✓	✓				✓				✓	✓		✓		✓	✓
Carvalho and Rabechini (2017)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				✓	✓
Armenia et al (2019)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓	
Shen et al (2010)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓			✓

1 Soc: Social
2 Evn: Environmental
3 Eco: Economic
4 Pol: Political
5 KSPIs: Key Performance Sustainability Indicators
6 I: Scope
7 II: Planning
8 III: Design
9 IV: Construction
10 V: Occupancy
11 VI: Demolish
12 SF: Feasibility Study
13 LC: Lean Construction
14 RM: Risk Management
15 INN: Innovation

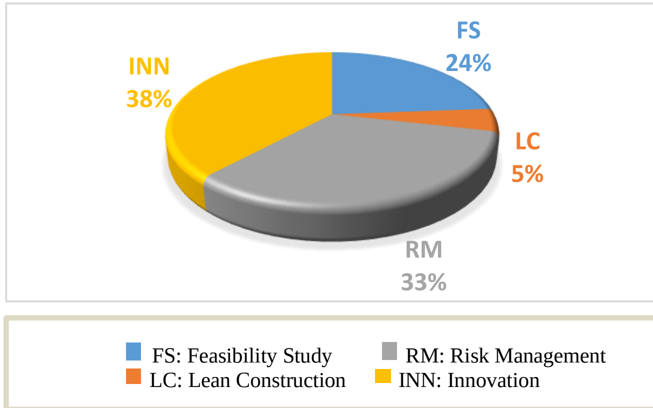

Figure 40: Application of construction management tools extracted from the frameworks for successful sustainable projects

(Table 25, page 269) shows information extracted from frameworks for managing SPH that represent consideration of needs and values, sustainability aspects related to TBL+1, KSPI, and application of some project management tools such as FS, LC, RM, and INN. Table 25 shows a high consideration of TBL and lower consideration of political aspects. General needs and values have a high level of consideration in the selected frameworks, while less consideration is been paid to KPSIs, which reflects similarly outcomes that found in Table 24. A high consideration of the construction stage was followed by project scope, design, and occupation stages. Consideration of the occupation stage in Table 25 is much higher than in Table 24, which can be presented a high dependence of most the studies on POE to develop satisfying projects for their residents. Figure 39 represents the application of project management tools in the management frameworks for SPH presented in Table 25. The chart shows a balanced relationship with construction management tools. The innovation and RM have a higher and equal application (33% each), while FS and LC are the (17% each). LC has higher level than that found in Table 24 because LC principles is to provide satisfactory product which can be indicated to the opportunity for pH and low-income housing development in many countries (Kyere 2016).

Table 25: Contribution of the reviewed frameworks (sustainable public housing projects)

Articles related to framework for successful Projects	Sustainability aspects				KSPIs	Needs	Value	Management throughout project stages						Tool			
	Soc[1]	Env[2]	Eco[3]	Pol[4]				I[6]	II[7]	III[8]	IV[9]	V[10]	VI[11]	FS[12]	LC[13]	RM[14]	INN[15]
Ihuah & Fortune (2013)	✓	✓	✓	✓		✓	✓	✓			✓	✓					
Orihuela et al. (2017)	✓	✓	✓		✓	✓	✓			✓					✓		
Ibem Azuh (2011)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓			
Ihuah et al (2014)	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓				✓	
Bakar et al (2009)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	
Susilawati (2009)	✓	✓	✓	✓		✓		✓			✓	✓	✓			✓	
Synnefa (2017)	✓	✓	✓	✓	✓	✓	✓				✓	✓					✓
Ganiyu et al (2017)	✓		✓	✓	✓	✓	✓	✓				✓		✓			
Schramm et al (2004)	✓	✓	✓			✓	✓				✓				✓		
(WEF) (2019)	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				✓
Nichols and Trinh (n.d.)	✓	✓	✓			✓	✓	✓						✓		✓	

1 Soc: Social
2 Evn: Environmental
3 Eco: Economic
4 Pol: Political
5 KSPIs: Key Performance Sustainability Indicators
6 I: Scope
7 II: Planning
8 III: Design
9 IV: Construction
10 V: Occupancy
11 VI: Demolish
12 SF: Feasibility Study
13 LC: Lean Construction
14 RM: Risk Management
15 INN: Innovation

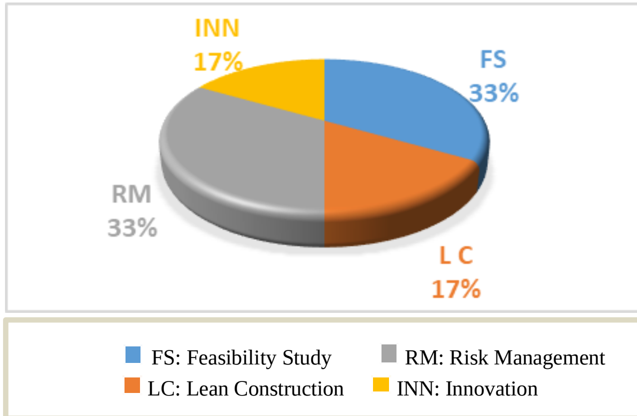

Figure 41: Application of construction management tool extracted from the frameworks for SPH

5.3.3 Generated a Logical Flow to Develop Integrated SPH Framework

A logical flow to develop an integrated SPH framework based on extraction dimensions is shown in Figure 41. Developing a framework consists of four steps (1) identifying SPH requirement (needs to add and values to meet) in both sustainable development approach and project management practices; (2) identifying challenges related to developing design concepts based on the key sustainability performance indicators (KSPIs); (3) discussing the opportunities to tackle identified challenges; and (4) developing an integrated sustainable management conceptual framework.

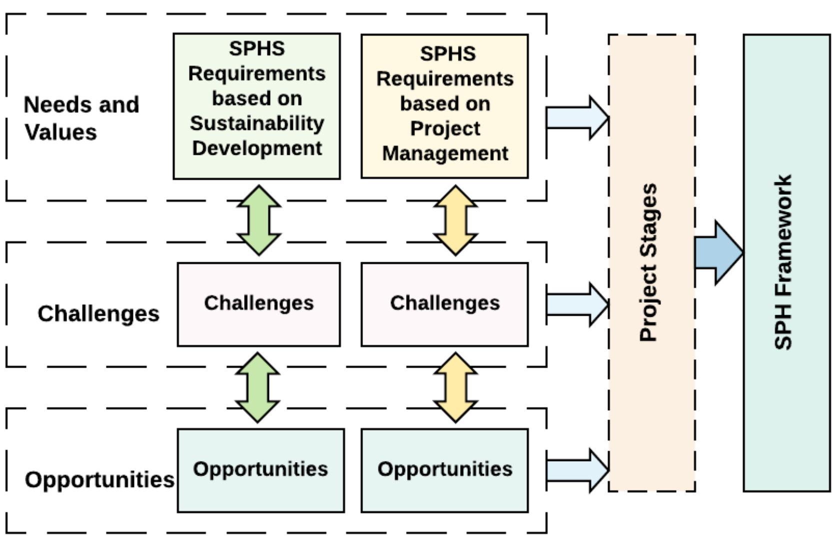

Figure 42: The flow of developing the integrated management plan

5.4 Discussion

This section will discuss the elements of an integrated SPH Framework based on the logical flow that was explained earlier. These dimensions of an integrated conceptual framework include the SPH requirement, challenges, opportunities, and design concepts.

5.4.1 SPH Requirement: The General Needs and Values

Generally, sustainable development aims to meet the needs of the present generation without compromising of the future generations to meet their needs (WCED, 1987). Different definitions have been used to identify the needs; for instance, some consider needs as “the material basis of people's livelihood”, such as food, housing, and clean water (Littig and Griessler 2005; Arman et al. 2009). Others consider non-material factors, such as education, social relationships, and recreation, that adds value to the life (Arman et al. 2009). Adding value also has different meanings in sustainability (Silvius & Schipper, 2014); some studies refer to value as normative concepts (Eid 2009; Eskerod and Huemann 2013; Schieg 2009); others state that the values are relevant to risk reduction (Gareis et al. 2010; Goedknegt, 2012). To some extent, value refers to choosing “opportunity costs” rather than to the economic value created by return on investment. Opportunity costs refer to choosing the best use of environmental resources and social and financial capital (Figge and Hahn 2005, Arman et al. 2009).

SPH indicates housing that is socially acceptable, environmentally responsible, economically affordable, and governed by law and regulations that support its sustainability. The socially sustainable house satisfies its users’ needs through all their life stages. It is functional, flexible, comfortable, and secure. Environmentally sustainable house saves money and efficiently uses resources, such as energy and water, and minimizes waste. The economically sustainable housing indicates homes that save cost in construction, in running and living costs, and in long-term maintenance, as well as in future modifications, provides good resale value and cost efficiency to the community. Governance points out the laws and regulations that govern such housing throughout its life cycle. Analysis of the needs and the values perceived by the stakeholders of SPH will provide a better understanding of important requirements to meet.

5.4.2 The Stakeholders Needs and Values

Takim (2009) defines the stakeholders as the parties who have influenced the project development process, whose lives or environment are affected by the project, and who receive a direct and indirect benefit from the project. Figure 43 shows the SPH stakeholders. These stakeholders include the project owner, its users, and the project team, including the planner, designer, and project manager who is in charge of delivering the project with minimum loss and satisfying other stakeholders needs, as well as the other government entities that are intended to enhance the society living conditions and operation/ occupancy related management.

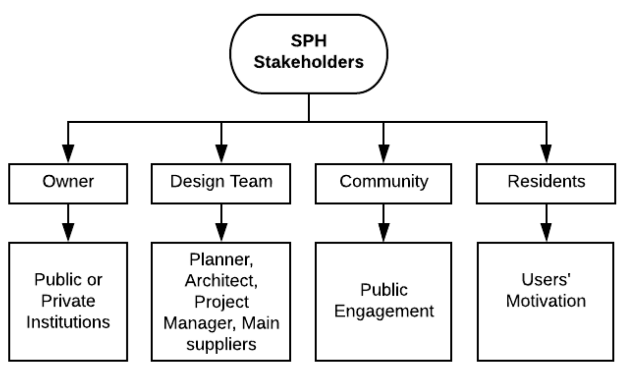

Figure 43: SPH Stakeholders

5.4.2.1 **Owner**

Orihuela et al. (2011) highlight needs and value for the owners; they state that the owner is usually looking for profitability; however, in some cases, owners sacrifice profitability because of their image. Orihuela et al. (2011) state that profitability indicators minimum rate of return, minimum utility, risk level, minimum margin, while image indicators include social responsibility and reputation. Social responsibility can lead the private sectors and nonprofit organizations to the entire PH sector. In contrast, social responsibility can lead the government as an owner to provide more PH to meet the demand without taking into consideration the quality of the product, which led to unsatisfactory PH and increases housing sector problems. Swarup et al. (2011) found that owner commitment to sustainability and setting clear goals for the sustainable features at the early involvement with the design team is a step toward establishing an integrated team for a successful product.

5.4.2.2 **The Projects' Residents**

Users' needs and values can explain based on their motivation to live in the PH. Orihuela et al. (2011) developed a matrix based on the multi-criteria analysis to identify the users' needs and values created by Roche and Vejo (2005). Orihuela et al. (2011) conclude that the users need price, comfort, aesthetics, security, and warranty. They also provide some indicators related to those needs. For instance, the need for comfort has indicators such as view, lighting, ventilation, and area; aesthetics has indicators such as interior and exterior aesthetics and finish of the bathrooms and kitchens; security needs include indicators such as structural design, materials, and construction process; finally, warranty needs include indicators such as support and resale value. Post-occupancy evaluation has been used to evaluate the housing performance from residents' perspective.

5.4.2.3 **Design Team**

The design team is composed of multidisciplinary professionals, such as planners, architects, project managers, main suppliers, and the owner. Communication among the design team and engagement with the community and expected users is the key to ensure the successful performance of the design team and final projects. Several studies provide evaluation criteria of the design team, such as knowledge, experience, image, flexibility, and delivery time (Orihuela and Ulloa 2009; Orihuela et al. 2011). The responsibility of the design team is to develop the proposed design concepts. The project design concepts are developed based on the identified needs and values of the stakeholders that categorized as constraints for the project and combined with other regulating requirements and site conditions. Delivering a product that minimizes loss and generates value is the responsibility of the design team. The design team is responsible for proposing the design concepts basis on the alignment with project purposes, rules and regulations, and site conditions. For instance, the planner should create a plan of SPH that considers adding value and fulfills the needs of the community and society while remaining compatible with other site conditions, and constraining regulations.

5.4.2.4 **Community**

Early engagement of the public in decision-making regarding affordable PH projects proposals is critical to get public acceptance and reduce future conflict. There are different ways to engage the public. For instance, the Institute of Local Government (ILG) created an online ‘toolbox’ to engage the public in decisions making regarding housing. This approach has many benefits such as identifying the public values, improving communication and speeding project development (ILG n.d.).

5.4.3 The Challenges facing SPH

SPH as construction projects are facing general challenges related to project constraints and specific needs for residents. The specific needs of the residents of PH and affordable housing of three projects in the USA and Libya have been identified in previous work (Sharafeddin et al 2019; and other work in review) and will be utilized in this step toward developing an integrated SPH framework.

5.4.4 Project Constraints

Not only SPH has inherited challenges related to providing short-term solutions, but it requires a long-term strategy to meet sustainability development goals. SPH in this context exceeds affording housing to buy or rent and providing the operation and maintenance costs to creating livable condition that satisfy its users' needs and enhance the society. Creating a balanced relationship among the project constraints throughout the project stages to ensure overall success with consideration, of the likely effects on other factors if one of them is changed is project team responsibility. The Project Management Institute (PMI 2013) indicates that project constraints "… include but are not limited to: scope, quality, schedule, budget, resources and risks…" Rules, regulations, and site conditions are the main constraints that the design team should consider. Langston et al. (2018) state that a trade-off among the factors affecting project success to meet minimum expectations for all is key to achieving a successful project; for example, some solution may be made to reduce the financial return in order to minimize negative impacts on the environment.

5.4.4.1 Rules and Regulations

Rules and regulations govern design and construction. The design team is required to have an in depth-awareness of the requirements of those regulations and have them updated to time and geographical locations. Orihuela et al. (2011) suggested developing an online updated list of legal provisions that can be reached by the entire design team to save time and eliminate rework. For instance, land use and zoning are used by many cities drive the affordable housing. The regulation related to such aspects is usually changing, depending on available and expected growth in the cities. Keeping track of such changes can save time in the development of design principles.

5.4.4.2 Site Conditions

An extensive site analysis is an important step in defining site conditions and establishing the design concepts based on the site features and sustainability goals to be included in the design principles. Site analysis provides precise details through visiting the site and gathering information such as neighborhood context, field topography, climate, sensory, human cultural that include density, population ethnic patterns, and values. Site analysis should take into consideration sustainability requirements such as protecting the natural resources, improving local infrastructure, and assessing safety at the public and project levels (Shen et al. 2007).

5.4.5 Identified Needs for SPH

Significant key sustainable performance indicators (KSPIs) of SPH based on residents' characteristics are listed in (Table 26, page 280). The four aspects of sustainability include resident characteristics and social, environmental, and economic sustainability. Each sustainability aspect includes specific categories; for instance, the social sustainability aspect includes categories personal and property safety, social cohesion, job opportunities, and proximity to services within walking distance. Walking distance indicates to the commute time to access specific activities and facilities which found to be from 15-20 minutes.

In Libya, the walkability distance in the neighborhood to the daily services and other public transportations options is recommended to be at the range of 15- 20 minutes, 15 minutes to access the mall, and 20 minutes to access the local schools (Dubeh 2002; Hammad 2006). A similar range of times was found for both the US and Libya. However, the type of activities and facilities was differed among the case studies. In Libya, accessibility to a public garage, educational facilities, and a grocery store were significant while at the two Corvallis project accessibility to ballfield was significant at Cams Commons and to a dry cleaner at OSU Family Housing. The significant types of facilities and activities reflect the different needs of the residents in specific areas. For instance, in Libya, the project is located at a highly commercial area, which increases the traffic in the project and requires a public garage.

Each category has its own identified KSPIs. The identified KSPIs are matched with the relevant stages of project development in a step toward an integrated framework. for instance, residents' characteristic features related to family size and structure can be discussed during the project identification as a goal to define the beneficiary residents of the project. The social sustainability aspect comprises different needs related to personal and property safety, social cohesion, and accessibility to job opportunities and services. Safety is a significant need for residents of PH, which requires providing a high level of personal and property safety in design concepts during project scope, planning, design, use, and even demolishment. Social cohesion is another need to ensure project sustainability that should be involved in design concepts at the early stages including scope, planning, and design.

The use stage will indicate the success of considering such a concept during the early project stages. Accessibility to job opportunity is considered necessary to enhance their quality of life for low-income residents; this need should be placed at the scope and planning stage of the project. The assessment of the outcome can be determined at the use stage based on the POE. Accessibility to a specific service at a walkable distance is another category of needs; residents require services such as a ballfield, educational facilities, and a grocery store at a walkable distance with consideration of the walkability quality.

Regarding environmental sustainability, categories of needs defined by the residents include privacy level, thermal comfort, indoor quality, suitability, and the durability of the residences. Residents consider provision of privacy inside and outside the residence a significant factor in satisfaction living conditions. Providing the required level of privacy should be considered in the design concept and discussed during planning, designing, and construction and it evaluated at the use stage. Residents are also requiring an acceptable level of thermal comfort and indoor air quality. These needs should be highlighted in the design concepts and incorporated at the project definition, planning, design, and construction stages. Building performance can be evaluated during the occupancy stage. Suitability level is the critical need for residents that should be reflected in the design concepts and discussed during project scope, planning, design, and demolishment; it can be assessed during occupancy. The durability of construction and finishing materials and needed maintenances should be considered in design concepts that influence the project throughout development and occupancy.

Regarding economic sustainability, different types of units in the projects are required to include in order to provide options for different family sizes and eliminate future modifications. Flexibility options, such as ability for expand the spaces and unit growth or creating multi-use spaces can be incorporated in the design concepts and discussed during the entire project stages.

Table 26: The Key Performance Sustainability Indicators (KPSIs) distributed according to the project stages

Aspects	Category	Sustainability indicators	Public Housing Project		
	Similarities		Cams Commons	Family Housing	Hay Al-Andalus
Residents' Characteristic		• Family size	✓		✓
Social Sustainability	Personal and property safety	• Adequate measures against crime	✓		✓
		• Current thievery level	✓	✓	
	Social cohesion	• Community planning in neighborhood as a "we", not "they"	✓		
		• It is unimportant to have social cohesion		✓	
		• Visiting neighbors in their homes			✓
		• Borrowing and exchange favors among neighbors			✓
	Accessibility to services	• Being within walking distance to ballfield	✓		
		• Being within walking distance to a dry cleaner		✓	
		• Being within walking distance to educational facilities			✓
		• Being within walking distance to a public garage			✓
		• Being within walking distance to a grocery store			✓
Environmental Sustainability	Privacy level	• Clear separation between guest areas and family areas	✓		
		• Unit design provides high level of privacy from neighbors		✓	
	The thermal comfort	• Always I felt cold		✓	
		• Intermediate thermal discomfort			✓
		• Usage of coal or fuel heater			✓
Economic Sustainability	Energy consumption	• Average of using electrical heater 6-12 hours per day	✓		
		• Average of using electrical heater 12-18 hours per day			✓
	Differences				
Residents' Characteristic		• Number of children with age from 5-17 years		✓	
Social Sustainability	Job opportunities	• Unemployment rate among the occupants		✓	
Environmental Sustainability	Indoor air quality	• Adequacy of daylight entering the unit	✓		
	Parking	• adequate parking at the residence at Always I felt cold	✓		
	Durability	• Durability of the construction materials of balconies		✓	
		• Durability of finishing materials for kitchen floor		✓	
Economic Sustainability	Housing type	• the importance to have different housing types		✓	
	Modifications	• expanding the living areas as part of the modification			✓

5.4.6 Opportunities for SPH

This section discusses some opportunities and innovative approaches that can be applied to develop solutions for SPH throughout all stages of the project. The opportunities for developing SPH include feasibility studies, innovative practices throughout the project stages, risk management, and lean construction.

5.4.6.1 Feasibility Studies

Feasibility studies and market analysis help to refine the project concept during the development process. they are used to determine the success of projects by many entities, such as government agencies, city planners, elected officials, developers, lending institutions and real estate investment trusts (REITs). For instance, the U.S. Department of Housing and Urban Development's (HUD's) Office of Policy Development and Research (PD&R) has created a Comprehensive Housing Market Analyses (CHMA) as a guideline for HUD operations at local and national levels (PD&R 2020). The CHMA report provide a source of information related to changes and development in the economy, population, demographic data, estimates of employment, and housing inventory characteristics for interested entities.

The market analysis assesses the existing demand and supply of housing; it usually aims to define “the point where the supply and demand curve intersect to supply the right quantity of a good at the right price” (Miles et al. 2000). To help in filtering the project concept, developers target questions such as: what percent of market demand will the project capture and why? What opportunities and constraints should be considered? (Miles et al. 2000).

Feasibility study exceeds the economic aspect of the project decision-making that is related to the time value of money as a basic framework to make the investment decisions to test the ability to execute the projects. Graaskamp (1972) indicates that a real estate project is 'feasible' when the reasonable likelihood of satisfying explicit objectives …ethical, regulatory, political, and financial aspects fit to a context of specific constraints and limited resources. This definition covers four components of the feasibility studies that include ethical, regulatory, political, and financial aspects. For each area, the specific constraints should be listed, risks weighed, and potential alternatives recommended (Graaskamp, 1972).

Shen et al. (2010) evaluated 87 feasibility studies; they found economic performance is of more concern than social and environmental performance in achieving successful projects. They highlight that a feasibility study is key to applying sustainable development principles and enhancing building performance because it is the road map for all project decisions; mistakes at this stage can 'permanently handicap' the project performance. They identify the primary challenge that faces such implementation to be the lack of stakeholders understanding the importance of implementing such decisions in the feasibility study. They state that actions are needed to shift the traditional approach of a feasibility study from economic concerns to sustainable development principles.

Shen et al. (2010) identify some attributes in a project feasibility study that should be considered related to TBL aspects for instance, economic performance attributes, such as life cycle cost, profit, finance risk assessment, market competition, and technology advantage. Social performance attributes include features, such as influence on local social development and public health; provision of employment, services, and public infrastructure facilities for other economic activities; culture and heritage; safety standards; development of new settlements and local communities. The environmental performance attributes include features such as eco-environmental sensitivity of the project location, waste assessment, air impacts, environmentally friendly design, noise assessment, water impacts, and energy consumption. Nichols & Trinh (n.d.) reviewed ten failed nonprofit organizations and introduced a systematic warning strategy for affordable housing that detected the property risk. They highlighted the importance of a feasibility study and a financial analysis because these identify the risks associated with the projects. They emphasized that a feasibility study is a stage to develop "Go/No-Go criteria" for the project regarding financial and risks associated.

Architects, engineers, government planners, and developers usually conduct feasibility studies and market analysis in order to improve the products, satisfy the users' needs, and provide tangible value and revenue in the future. Architects use market and feasibility analysis to determine the design concepts. The unit design has marked effects on the cost and marketability; if the unit does not include the right selection of amenities, it will be hard to have the right tangible value in the present and revenue return value in the future. Since the units' scale, the maximum density, and level of amenities will generate the cost constraints of the design.

5.4.6.2 **Innovation in SPH**

Many studies have considered innovation to be the established way to integrate sustainability into project management (Johansson 2012; Mollaoglu et al. 2016; Banihashemi et al. 2017). Slaughter (2000) asserts that the application of innovation methodology throughout the project stages depend on the nature of the stage. Additionally, Banihashemi et al. (2017) and Liu et al (2016) suggest prioritizing sustainability in decision-making. The following section reviews the applications of the innovation approach through some of the PH project stages.

5.4.6.2.1 Planning

The planner of SPH should consider adding value and meeting the needs of the users in addition to applying the regulations that govern such a project. For instance, locating PH within walking distance from education and health services, markets, and recreation facilities is one of the important concepts of SPH sustainability. Residents choose to move out of PH that is located of the cities (Belgasem, 1992; 2007; King et al. 2017; WEF 2019). WEF (2019) cites Duren (2017), who indicates that Puebla, Mexico, residents of PH spend twice as much money and three times as much more than those who live in the center of the cities.

Planning PH project close to transit stations and walking/cycling infrastructure is key to enhancing the living conditions (WEF 2019). Several studies provide solutions for planning neighborhoods in the way that reduces traffic and provides access to public transit. Increased walkability and bike-ability will improve the health and financial situation of the neighborhood households (Litman 2003; Choi 2013; Cloutier & Pfeiffer

2015). The 20-minute neighborhood is a long-term planning strategy that …Victorian Government in Australia is considering allowing residents of the Melbourn to 'live locally'. The plan aims to provide everyday needs within 20-min from home by walking, cycling, or using local transportation (VSG 2019; WEF 2019). According to WEF (2019), Risom & Madriz (2018) show how a well-planned and designed street network can enhance quality of life and lead to a successful project. They use the Villa 31 transformation project in Buenos Aires, Argentina, which score higher based on indicators of urban vibrancy than wealthier neighborhoods because of the design of wide parallel streets and narrow alleys that increase walkability, in addition to good proximity to public transportation that provides access to workplaces.

Communicating decisions support sustainable design practices among all stakeholders and the design team during the beginning of the project based on the potential level of value desired by the stakeholders are essential to achieving SPH. For instance, incorporating green construction practices or passive house concepts that include siting and designing buildings in accordance with smart growth principles and using environmentally friendly features contributes to increasing the upfront construction costs, based on the level of sustainability required, while reducing the operation cost.

5.4.6.2.2 Designing

Applying green building and smart growth principles in both existing and newly constructed low-income housing can contribute to improving the performance of affordable housing in stock. Reducing the operating costs and the negative impacts on the environment, promoting residents' health, and productivity, and enhancing society.

Incorporating of green building practices in development of low-income housing tax credits (LIHTCs) in the USA in order to ensure sustainability has been discussed (PD&R 2014; GG 2017; Scally et al. 2018). Such an approach from the governmental agencies can encourage developers to enter the PH sector. Office of Policy and Development quoted James (2014), the president of Urban Green, LLC, who states that the cost of including green features in affordable housing development is considered as a depreciable cost in the LIHTC eligibility basis and can increase the projects' eligibility for a higher LIHTC subsidy (2014).

Application of the 'biophilic design' principles that are intended to improve the health and well-being of the residents in the built environment is a way to achieve satisfactory PH. Browning et al. (2014) define biophilic design is creating the design as it is a biological organism that harmonizes with the mind-body systems to achieve health and well-being of the users with respecting to local solutions and respond to the socio-cultural norms and expectations. Biophilic design involves identified desired responses and outcomes of the project by an integrated and flexible approach to enhance the user experience; for instance, it incorporates a local approach to meet climate requirements and restore vernacular architecture solutions. Biophilic design includes 14 patterns, such as creating a visual and non-visual connection with nature, thermal and airflow variability, biomorphic forms and patterns, and dynamic diffuse light (Browning et al. 2014). Browning et al. (2014) indicated that the application of visual connection with nature in the design process has many positive effects on users' physical and psychological health. They also cited many studies identifying the positive impacts of connection to nature; for instance, Biederman & Vessel (2006) identified its impacts on increasing mental engagement and attentiveness, while Barton & Pretty (2010) identified its positive impacts on emotion, mood, and overall happiness.

Application of innovative sustainable design approaches that aim to improve the energy efficiency on the basis of long-term benefits for the users, the community, and the environment is critical for achieving the SPH project. The 'fabric first' principles is one of innovative sustainable design approach to improve the durability of the building envelope and orientations to maximize the performance of building materials and components, while minimizing operation and maintenance costs. Applying 'passive housing' features is part of 'fabric first' principles. Passive housing reduces the energy consumed for heating by 86% and for cooling by 46% compared with non-passive buildings (PHIUS 2017). The passive house is very energy-efficient, healthy, comfortable, affordable, predictable, and resilient (NYPH 2018). The green roof is another approach to lower heating, cooling, and maintenance costs. WEF (2019) cited CREJ (2018) that required a new low-income development in Denver to have green roofs and solar panels to improve energy efficiency because of their long-term benefits for the users, society, and environment. Innovative space optimization is another approach to reduce cost and provide a smaller space that is comfortable, and functional, and consumes less energy (Rhodes 2015; Littman 2018; WEF 2019).

5.4.6.2.3 Construction

Silvius & Schipper (2015) summarize many definitions of sustainability in project management. For instance, they include the definition given by Tam (2010), who defined sustainable project management as “the promoting of positive and minimizing of negative sustainability impacts (economic, environmental, and social) within the process by which projects are defined, planned, monitored, controlled and delivered such that the agreed benefits are realized and contributing to a sustainable society.” They also cited Silvius et al. (2012), who defined sustainability in project management as “the development, delivery and management of project organized, change in policies, processes, resources, assets or organizations, with consideration of the six principles of sustainability, in the project, its result, and its effect.” The six principles involve balancing TBL aspects interests, considering short- and long-term, local and global orientation, values and ethics, transparency and accountability, and finally, consuming income, not capital (Silvius & Schipper, 2014).

Taking responsibility for sustainability in construction management is a new approach that faces many challenges (Carboni & Reeson 2012; Haugan 2013; Silvius 2017). Studies highlighted that application of sustainability is about shifting the scope of management from managing the Iron Triangle elements (time, budget, and quality) of projects to managing the TBL (social, environmental, and economic) aspects that influence the projects and society (Carboni & Reeson 2012; Haugan 2013; Silvius et al. 2012; Ebbesen & Hope 2013; Silvius & Schipper, 2014). Shifting toward a sustainability approach requires enhancing practices and standards of project management to increase flexibility, addressing the complex interactions among disciplines involved, and engaging opportunities to empower sustainability development in the organization and society (Silvius & Schipper, 2014).

Many studies addressed the impacts of integrating sustainable development on project management during the project lifecycle (initiating - planning - executing – controlling – closing) (Eid 2009; Maltzman and Shirley 2010; Silvius et al. 2012; Tharp 2013). Each stage of a PH project has its challenges and opportunities in responding to sustainability challenges. Risk management and lean construction as a management approach will mitigate the associated risk and maximize the opportunities to increase the final product quality.

The project manager's responsibility has expanded to not merely delivering a successful project that satisfies the owners' needs and value but involves the requirements of all the stakeholders to meet the project goal. The project manager's responsibilities are integrated to define the project scope, human resources, communication, risk management, and procurement management (PMI 2013; Radujković & Sjekavica 2017a).

The importance of incorporating innovations in construction technology and alternative construction materials has been highlighted on several studies (Johnson 2007; Wallbaum et al. 2012; WEF 2019). For instance, 3D-printed homes have been introduced by companies and non-profit organizations in many cities (Debczak, 2018; Walsh, 2018; WEF 2019). Prefabricated (prefab) housing has been introduced in many countries such as the USA, UK, and Libya (Hammad 2006, Sharafeedin 2004: Nacamulli, 2017, Howard; 2018; RICS, 2018; WEF 2019).

The provision of alternative construction materials that reduce construction costs and time is considered an essential option for SPH. Wallbaum et al. (2012) evaluate the materials and construction techniques that can be applied for PH from a sustainability perspective, and they conclude that local materials such as bamboo or timber are the most promising to meet the indicators for sustainability and affordability. They add that a combination of multiple technologies is the way to tackle the affordability and sustainability of low-income housing. Other studies have investigated replacing cement or a portion of it in the concrete with cheaper alternatives such as fly ash or pozzolana material (Shinde & Karankal, 2013) or explored alternative materials for concrete and cement, such as cement-coated expanded polystyrene (EPS) and glass-fiber-reinforced gypsum (GFRG). WEF (2019) discusses such an alternative and cites a study by Kagai (2017) of use of cement-coated expanded polystyrene (EPS) panels to construct housing. WEF (2019) also discusses the use of GFRG panels that have been approved in India as a construction material that is resistant to fire and earthquake (Diwaker 2018; Anam 2018). WEF (2019) is also cites a study by Guo et al. (2017), who indicate that cross-laminated timber (CLT) saves 9.9% of energy and 13.2% of carbon in comparison with reinforced concrete (Guo et al. 2017).

5.4.6.3 **Risk Management**

Construction projects are characterized by various risks, which are defined as the uncertainty of outcome that affects project objectives. Such effects may offer a positive opportunity or negative consequences (Webb, 2003; Hillson & Murray-Webster, 2007; Susilawati, 2009). According to the PMBOK® Guide (5th ed., 2013), project risk management includes identification and analysis of risks, response planning, and applying a risk management plan to maximize positive and minimize negative risks

(PMI, 2013). Four risk-response strategies can be followed to promote the efficient organization of management risk: avoidance, risk transfer, risk mitigation, and risk retention.

Langston et al. (2018) mention that conducting risk management based on the stakeholders' expectations is a key step in achieving sustainability in a construction project and its surrounding. They addressed that the risk management is one element, in addition to scope, cost, and time, that contributes to developing successful and sustainable projects. Dvir et al. (2003) mentioned that project success views as meeting design goals and the benefit to the customer. Value in construction management is about balance-providing a product at the function level and quality to satisfy the users' needs and expectations while being at an optimum cost (Othman, 2008). Langston's model (2013) identifies six key performance indicators (KPIs): value, efficiency, speed, innovation, complication, and impact. Value is the ratio of scope over cost and assessed to maximize the stakeholders' management, where the scope indicates to the stakeholders' communication to meet their expectations and is assessed the output and cost (Langston 2013; Langston et al. 2018). Efficiency is the ratio of cost over time and assesses in the context of resource management. Speed is the ratio of scope over time and assesses in the context of procurement management (Langston 2013; Langston et al. 2018). Innovation is the ratio of risk over cost and is assessed to maximize communication management (Langston 2013; Langston et al. 2018). Complexity is the ratio of risk over time and is assessed in the context of quality management (Langston 2013; Langston et al. 2018). Finally, impact is risk over scope and is assessesd in the context of environmental management. In Langston's model, risk was one of the core constraints for achieving successful projects (Langston 2013; Langston et al. 2018). Figure 44 shows how risk is the basis for an integrated management process during the project cycle.

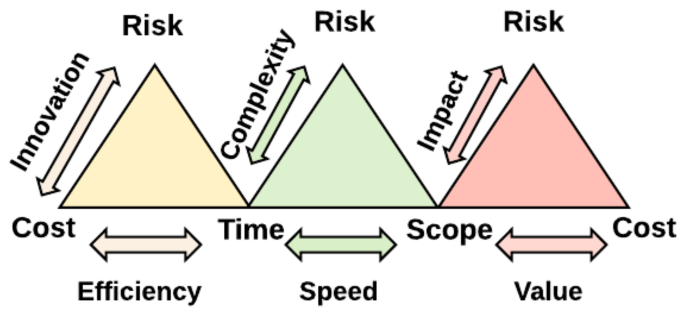

Figure 44: 3D integration model (after Langston, 2013; Langston et al, 2018)

Affordable housing, like other construction projects, has a high level of uncertainty, which requires effective risk management from initiation of the project to demolishtion. Developers consider affordable housing to be a high-risk project, and many studies have discussed the opportunities of applying risk management to boost the affordable housing supply (Othman 2008; Susilawati, 2009).

5.4.6.4 **Lean Construction**

The Lean Construction Institute (LCI), defines Lean Construction as a "production management-based project delivery system emphasizing the reliable and speedy delivery of value. It challenges the generally accepted belief that there is always a trade between time, cost, quality and safety." According to LCI (2017) the successful implementation of LC and integrated project delivery (IPD) have been rated 80% better than the traditional delivery approach. Also, LCI (2017) indicates that LC reduces risk because it provides a better understanding of scope and owner requirements. It also respects users by producing a satisfactory outcome that optimizes the whole, generates value, eliminates waste, and improves performance by focusing on flow and continuous improvement (LCI 2017). Based on the characteristics of the project (Allison et al. 2018), SPH can be considered for IPD because of its complex interactions and interdependency of systems and participants and the high level of opportunity for design and technical innovation. However, the application of LC in PH is a new approach (Kyere 2016; Reinbold et al. 2017). Reinbold et al. (2017) perceived the application of LC in affordable housing as a way to improve the quality of PH that satisfies its users and improves profitability to the constructors. Kyere (2016) reviewed the benefits of LC identified in the literature and categorized them into environmental, economic, and social benefits. For instance, environmental benefits include elements such as reduction in energy consumption and waste, optimization of design and materials usage, improvement of health and safety. Economic benefits include elements such as enhancing construction project value and quality, providing a higher return on assets, reducing cost and lead time, and increasing productivity. Social benefits include satisfactory products, improved sustainable innovation, and corporate image.

Kyere (2016) states that LC and affordable housing share common goals including waste minimization, value maximization, and cost reduction. Aziz & Hafez (2013), provides additional common areas between LC and affordable housing, such as resource management, design optimization, quality improvement, health and safety improvement, performance maximization, resource management, energy minimization, and elimination of unnecessary processes. Ballard et al. (2002) categorize the most frequent use of lean tools and techniques in construction. Kyere (2016) highlights that value stream mapping, value analysis, daily huddle meetings, and visualization tools, and just-in-time are the appropriate LC tools for affordable housing.

Schramm et al. (2004) developed an integrated model for manage design and construction stages for low-income housing projects in Brazil, based on the production planning and control model proposed by Bemardes and Formoso (2002) and the Last Planner system for production control (ballard, 2000). They established the production system design as part of the design stage before the construction stage. They cited Askin and Goldberg (2002), who stated that "production system design and operation involve managing production resources to meet customer demand". Schramm et al. (2004) developed a production system design in a low-income housing project as an approach to reduce cost by minimizing the effects of variability and lead time. They highlight the importance of considering improving the whole production system and conclude that the implementing their model in six case studies has positive impacts in reducing production cost and lead-time. Reinbold et al. (2017) review three strategies to apply LC in affordable housing projects in Brazil, Ecuador, and Nigeria. They summarize the benefits of LC in the case studies they reviewed in saving time, labor waste, material waste, space, and space cost. For instance, the application of the Last Planner in Nigeria allowed finishing the construction of one unit in 72 days, while it takes more than 120 days using traditional management methods. They conclude that providing successful construction of PH related to applying LC.

5.4.7 Design concepts

The sustainability approach to achieve successful SPH projects requires fulfilling the stakeholders' needs and delivering value to enhance society. The design team's responsibilities are to identify the challenges that face the application of the sustainability approach in PH and explore the opportunities in project management practices and other related areas that could be applied to achieve SPH. For instance, application of innovative design and construction pracrices, and efficient use of project management tools such as feasibility studies, risk management, and LC could be considered by the design team. The design team should be able to trade-off among the project constraints, needs, and applicable opportunities to develop the design concepts and deliver a satisfactory project that enhances society. Figure 45 present the design team responsibility.

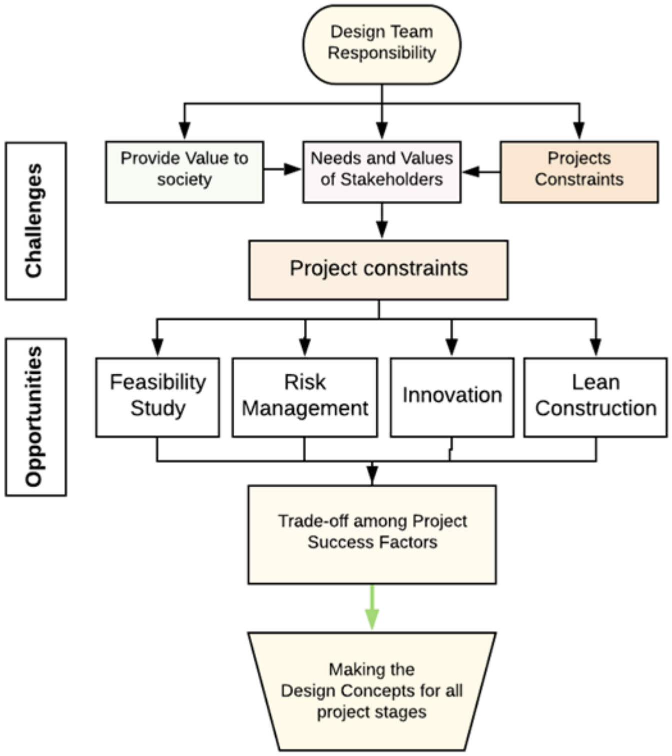

Figure 45: Design team responsibility

5.5 An Integrated SPH Conceptual Framework

Based on the conceptualization of the dimensions that emerged from the literature review and incorporated with the specific needs for SPH from previous work in the topic; an integrated conceptual framework for SPH developed. Figure 46 shows the key components of the developed framework and the relation among them. Three dimensions: SPH requirements, challenges, and opportunities have been described earlier providing the critical factors for the practical integrated framework for SPH that incorporates the application of a sustainability approach for PH and project management. The conceptual framework provides a practical approach for each stage of the project that ties back to the wider system of TBL+1 requirements and other constraints and incorporates opportunities to implement of the process effectively to achieve SPH.

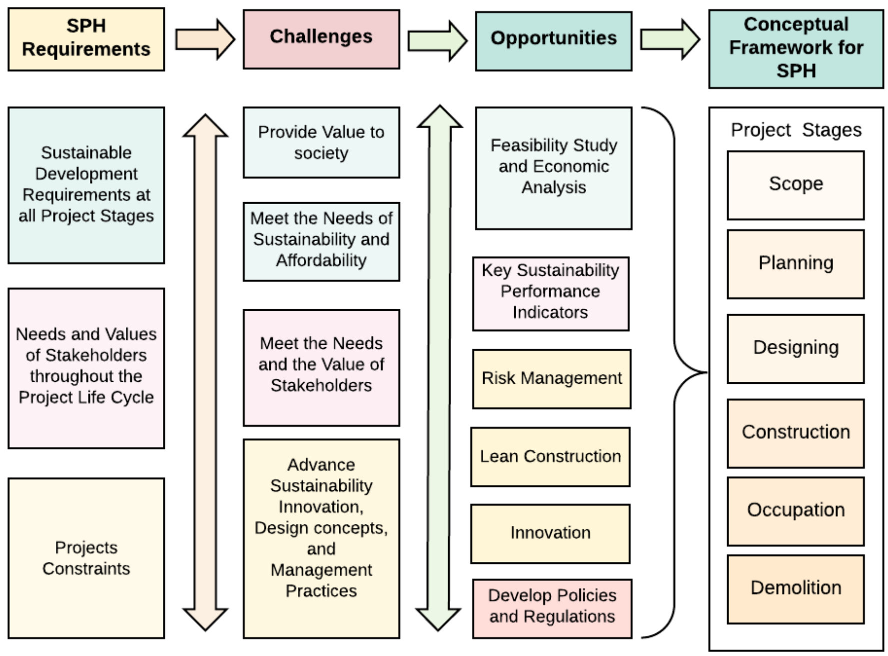

Figure 46: The integrated conceptual framework for SPH. Note: To simplify understanding of the structure, some arrows are not shown

5.5.1 Project scope

The project scope includes a detailed presentation of the project description, production, validation, and control. Different scenarios of the project are compared at this stage in order to develop the project proposal. Making right decisions related to the required level of sustainability for the PH project should be aligned with analysis of feasibility study. Macroeconomic scale to assess project co-impacts, the associated risks, level of usability, and environmentally and socially desirable project impacts based on the all stakeholder's agreement (Langston et al. 2018), as well as fulfill the political legislation requirements for PH. For instance, prospective application of a Net

Zero-Energy District (NZED) approach through renewable energy or self-production within the neighborhood of project has environmental, health and economic effects on the residents of SPH, and society; such alternative requires more deliberation economic and feasibility analysis of evaluation (EPRI, 2010; Giordano et al., 2012).

Several factors influence project implementation at this stage, such as satisfying the users' needs and expectations in making decision about the total project budget; considering the life cost analysis over the project lifecycle, not just for specific stages; enhancing communities by providing a level of employment and amenities that harmonize with existing conditions; and analyzing potential ecological risks and social impacts associated with the project (Shen et al. 2010). The project sustainable performance checklist criteria are presented in Table 27.

Table 27: Project Sustainable Performance Checklist criteria for the Scope Stage

Social aspects
• **Safety assessment**
Identification of future risks for the society and project residents
• **Proximity to services:**
Location and land use, infrastructure capacity, proximity to community amenities, and other services within walking distance
• **Social risks**
Analysis of potential risks associated with social aspects of SPH, such as community acceptance and social cohesion level
• **Job opportunities**
Employment opportunities for project residents and local community
• **Stakeholders needs**
Identification and evaluation of the level of socially desirable requirements of the stakeholders should be met
Harmonize the stakeholders' needs and enhance communication among stakeholders
Environmental aspects
• **Environmental sensitivity**
Analyze risk of potential environmental impacts on the society and the environment
Evaluate ecological risks and their impacts on the project and society (Shen et al 2010)

Make decisions related to environmental sustainability-for instance: materials choice, and suitability
• **Public health**
Evaluate prospective applications related to energy consumption and their effects on residents' health and public health overall
Economic aspects
• **Project scope**
Define project scope, size, budget and evaluate different scenarios
• **Cost effectiveness**
Analyze feasibility and market ability
Analyze and evaluate supply and demand
Develop of investment and finance plans (Shen 2007)
• **Lifecycle analysis**
Total cost for construction, operation, maintenance, and demolishment (Shen 2007)
Political aspect
Incorporate the requirements of the political legislation for PH and develop the stakeholder's agreement

5.5.2 Planning

The planning stage is critical to achieving project sustainability. The planning objectives intend to create the layout of housing and other project facilities to meet the local planning standards and policies and sustainability requirements. The planning of SPH implies the implementation of planning principles such as equitability, accessibility, aesthetics, compatibility, safety and security, comfort, and provision of quality conditions for the well-being of users (Latfi and Karim 2012). In general, planning for SPH should maximize the advantages of the natural environment and enhance outdoor and indoor quality, minimize ecological impacts, conserve water, and reduce energy consumption, optimize the operation and maintenance practices, and be in accordance with planning regulations. Planning of SPH faces many challenges, such as lack of coordination among key stakeholders, issues regarding social equality and justice, and the issue of squatters (Yakob et al 2013). Thus, recognition and analysis of

SPH characteristics and site conditions can be utilized to develop an effective plan that enhances the project and its surroundings. For instance, play space in low-cost housing is a significant amenity for the project and the neighborhood, but it usually receives little attention during the structure of a project plan or after completion. Paying attention to such subjects in SPH can be effective in achieving a healthy neighborhood and a project that enhances the quality of life of the residents, especially for children (Latfi and Karim 2012).

Decisions related to project location, layout, and connections with existing and future social and physical networks should comply with the local planning and expectations for public and sustainable development to ensure accessibility and security. Housing orientations and cluster size are connected to energy planning and the innovative solutions, such as renewable energy, street lighting, urban mobility, waste collection, and public safety (Becchio 2018). Sustainability environmental principles such as reduced site paving, water management, landscape and shading, and acoustical, visual, wind, and wildfire buffers should be considered during the planning stage. Traditional neighborhood development features and specific climatic needs also should be adequately considered (Sidawi et al. 2013). Effective communication among the stakeholders during the design of PH should be on going in order to ensure its acceptance (Yakob et al. 2013). The project sustainability performance checklist criteria for planning stage are present in Table 28.

Table 28: Project Sustainable Performance Checklist criteria for the Planning Stage

Social aspects

• **Traditional neighborhood features**
Restoration of traditional neighborhood features such as to create acceptable living conditions
Consider privacy during planning of building and unit clusters and open space to eliminate modifications and ensure the maintenance of the architectural project image
• **Aesthetics**
Create an attractive plan for SPH that support residents' well-being, enhance their quality of live, and create attached to SPH built environment
• **Land use**
Mixed use and planning to create facilities to serve the community and provide employment for the project inhabitants
Comfortable and suitable site use that connects with project amenities and eliminates disturbance
Project components planned to enhance the social interaction among project users
Connect to the existing local infrastructure with consideration to future development of infrastructure plans (Boz & El-Adaway 2015)
• **Security and safety**
Enhance security and safety of project components to prevent crime and increase safety
Environmental aspects
• **Resource preservation**
Implement low-impact site development best practices such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels and permeable pavements (EPA 2018)
• **Landscaping practices**
Reduce of paving and provide enough parking
Optimize landscaping to identify the project areas, control trespassers and prevent crime, define privacy levels in the site, enhance walkability quality (aesthetics and shading), and integrate social and environmental benefits for the residents and society
Apply of vernacular architecture landscaping because of its connectivity to the natural environment
• **Orientation**
Lay out project components relative to sun, wind, and views to maximize comfort and reduce energy consumption
• **Accessibility**
Integrate site plan to optimize accessibility to surrounding facilities transportation network, educational and recreation facilities, markets, health facilities …. etc.
Include walkability and its quality in planning concepts (the 20-minute neighborhood strategy)
Enhance walkability and bicycling to increase healthy habits
Include accessibility standards for people with disabilities
Economic aspects
Implement renewable energy applications, water management, and other innovations to reduce energy consumption
Support passive design and minimize environment impacts
Political aspects
Consider application of sustainable neighborhood and development regulations

Communicate information regarding SPH policies among the stakeholders to support project sustainability

5.5.3 Design

The design stage of project development is a significant step in creating sustainable living conditions. Design of SPH aims to balance the housing components that meet the residents' needs and expectations and satisfy other stakeholders, meet the sustainable development requirements, comply with the site conditions, fulfill the local policy constraints, and provide successful solutions. Sustainable design objectives are to reduce resource depletion during project operation and to provide livable, comfortable, safe, secure, and productive living conditions (WBDG 2016a). The design of SPH implies the implementation of design principles, such as functionality, aesthetics, cost-effectiveness, sustainability, flexibility, accessibility, productivity, comfort, and a healthy indoor environment (WBDG 2016b).

Cultural contexts are critical to achieving sustainable units: public housing in Arabic countries such as Libyan PH has suffered from many modifications by residents to accommodate their living environment to their needs (Sharafeddin 2004; Hammad 2006). Thus, recognition and analysis of such modifications' understanding needs that led to them and paying attention to traditional solutions to meeting the needs could be utilized to develop a successful solution for SPH in specific regions. For instance, the privacy is critical in most cultures; however, in Muslim culture, expectations are higher than others. Thus, consideration of privacy provision is one of the most critical criteria in the design of project development. Additionally, organization and size of the unit meet the current and future needs of residents, such as flexible space and the ability to change, expand, and replace, is critical to ensure meeting families' needs without harming the building structure and durability. Creating acceptable healthy and productive indoor conditions that optimize the use of daylight, and natural ventilation is essential to achieve SPH. Table 29 provide checklist for specific criteria for project planning stage.

Table 29: Project Sustainable Performance Checklist Criteria for the Design Stage

Social aspects
• **Traditional housing features**
Renovating the traditional housing design principles and features are critical to develop more acceptable living conditions, for instance, the 'Mashrabiya' in Islamic architecture provides a required level of privacy that compatible with social needs and climate requirement
• **Aesthetics and Comfort**
Creating attractive design that visually and non-visually connects to nature, improving comfort and pleasure (Browning et al 2014).
Choosing natural materials and biomorphic building forms that support connection to nature to enhance comfort level and improve resident health and well-being (Browning et al 2014).
• **Security and safety**
Integrating design to ensure security and perception of safety from crime and electrical safety.
Considering emergencies as earthquake and flood (Shen 2007)
Environmental aspects
• **Functionality and Flexibility**
Providing of mixed use of spaces, enough size and spaces suitable for different needs and activities with respect to the family size.
Adaptation "loose fit, long life" concept to develop a flexible design (WBDG 2016b)
Providing opportunities for accommodating future needs through expanding building systems and equipment (WBDG 2016b)
Designing units to support social interaction among the family members and built strong relationships
Applying diverse range of design strategies to satisfy the needs of various groups and sizes of different cultural and demographics (Browning et al 2014).
Choosing durable material in construction and finishing of the units
Designing project for constructability based on modular and standardized components to reduce waste and enhance durability and flexibility
• **Productivity and Health**

Orienting unit layout relative to sun, wind, and views to maximize thermal comfort, natural lighting and ventilation and connection with nature, enhancing a productive and healthy living condition
Choosing finishing materials that support healthy and safe performance during practical use and maintenance
Providing acoustical quality and moisture control to improve indoor conditions
Economic aspects
• **Cost effectiveness**
Applying of 'fabric first' and 'passive house' principles and other sustainable design innovations such as green roofs and solar panels to improve energy efficiency
Providing different options of unit types to satisfy residents' needs, based on the family size
Political aspect
Applying policies and regulations that support sustainability and enhance living environment
Highlighting the policies that support a traditional approach and implementing such trend in designing SPH
Communicating information regarding local and global SPH policies and regulations with the stakeholders to support sustainability application in PH
Encouraging discussion of design concepts that support crate developing a regulation support sustainability application

5.5.4 Construction

Construction is a critical stage that affects the development of SPH and its surroundings, because it transfers previous stages to reality. The construction stage usually described as the pre-construction and the construction stage; pre-construction involves detailed planning for financial and human resources, as well as equipment and materials. Construction involves managing and coordinating various organizations to deliver the project officially within budget and on time through maximizing resource, procurement, and communication management, and innovation, and minimizing complications and environmental impacts (Langston et al 2018). This stage involves balancing scope, cost, time, and risk during project execution (Langston 2013). In general, construction management for project production at this stage derived from Corporate Social Responsibility (CSR), placed in eliminating social, environmental, and economic consequences of construction operations. CSR has been defined by The World Business Council for Sustainable Development (WBCSD 2006) as "…the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large". The Commission of European Communities (CEC 2001) defined CSR as "integration for social and environmental concerns business operations and interactions with their stakeholders in a voluntary basis" (Martens & Carvalho 2017).

Construction stage of SPH intends to deliver projects based on the values and needs of stakeholders, consideration of the requirements of the sustainable project management approach, and regulatory authorities. Management practice at this stage involves fulfillment of the needs for social responsibility, cost management, environmental impact assessment, and management concerning regulations governing construction. Social responsibility is related to elements such as public health and safety during construction that are critical to ensure continuance and acceptance of the construction process in society. Social responsibility also considers safe and healthy production conditions for workers and job creation, education, and training. At this stage, incorporating the stakeholders' management is linked to social and ethical aspects through improving their participation and coordination (Marcelino-Sádaba et al. 2015).

Environmental management during construction incorporates waste management, water, air, land, and energy resources depletion (Labuschagne and Brent 2008).

Environmental management can be achieved through developing effective methods to control and balance the use of lower-cost resources with advanced technologies, reducing/ recycling waste, controlling risks and reducing pollution (Glavič and Lukman, 2007). Economic management considerations in the construction stage incorporate financial health, economic performance, trading opportunities, and potential financial benefits (Labuschagne and Brent 2008). Table 30 present a check list of the specific sustainable performance criteria for construction stage of the project.

Table 30: Project Sustainable Performance Checklist Criteria for the Construction Stage

Social aspects
• **Social responsibility regarding human resources (health and safety risks)**
Ensure high on-site emphasis for healthy and safe conditions for the workers during construction, site organization, materials choice, and construction technology alternatives
Consider public health and safety during construction process
• **Traditional practice to support social needs**
Restore some traditional features that support social needs during construction process or adapted some traditional approach to filter construction technology choice
• **Employment**
Considering local labor markets to enhance employment and provide benefits to community
Create jobs and enhance education and training
• **Improving services in the community**
Consider improve services and infrastructure related to project
• **Stakeholders management**
Create effective relationships with society and local community
Manage human rights
Engage stakeholders
Environmental aspects
• **Construction materials (renewable, local, and alternative)**
Consider more sustainable and local alternative materials such as bamboo and timber
Use of renewable and reproducible materials such as cork and bamboo (Shen 2007)
Use of alternative materials such as fly ash, pozzolana material, GFRG, EPS, and the CLT
• **Materials reuse**
Reuse some materials such as rubble, earth, timber, steel, and concrete (Shen 2007)
• **Reduce pollution**

Apply effective measures to reduce noise, chemical, air, emission, and land pollution during construction
• **Environmental management**
Take into account water quality and quantity
Take into account air quality
Take into account land quality
Take into account energy resources and energy efficiency
Reduce use of hazardous, harmful, and toxic materials (Gimenez et al., 2012)
• **Waste management**
Reduce resource use and waste generation
Consider recycling
• **Innovation management**
Research and development to develop solutions
Economic aspects
• **Cost management**
Apply of innovative construction technology such as 3D-printing and prefabrication
Apply multiple technologies as needed to achieve SPH
economic performance management and coordination
Political aspects
• **Regulations**
Include governance authorities in stakeholder's management
Consider environmental policies related to sustainability during construction activities

5.5.5 Occupation

Building performance after occupation determines the success or failure of project sustainability. This stage of the project requires attention to detail because building performance involves the interaction of multiple social, environmental, financial, and management issues. Thus, it is essential to continuously monitor project operations at a different level and based on the integration approach. For instance, collection of the integration feedbacks of parties including end-users, developers, neighbors, local community organizations, and relevant government organizations can be utilized to improve effectiveness, use, planning, design, construction, and operation of existing and new projects. The residents' perspective is critical in assessing building performance, it records day-to-day interaction of the occupants with their built environment, evaluates residents' satisfaction, and anticipates providing a KSPI to improve building sustainability. Residents feedback provides multiple indications of the built environment performance at different levels related to social, environmental, economic, and governance concerns.

Management of SPH requires continuous monitoring and the ability to take reasonable action as needed. Nichols and Trinh (n.d.) indicate that some problems require immediate action and develop a stabilization strategy that ensures the involvement of all stakeholders. The creation of trust and transparency relationships among the stakeholders and the industry is critical to achieving SPH; for instance, addressing challenges that arise during construction and proposing or asking for solutions can help fix problems before they develop into severe defects (Nichols and Trinh (n.d.). Periodic inspection and revisit of the physical conditions of the project, as well as evaluation and review of the vacancy level are significant to ensure the performance and acceptance of the project. Nichols and Trinh (n.d.) provide a sample of a "portfolio performance dashboard" that property managers should use to manage and monitor the PH project performance.

Additionally, maintenance during operation is a significant indicator of project performance. Periodic maintenance to ensure project performance at the expected level that satisfied the users and surrounding should be part of management during occupation. A responsible strategy during planning, design, and construction regarding to reduce the required level of maintenance during occupation is critical to achieving

SPH. In addition, consideration of the social, environmental, and economic impacts of project features during operation is necessary to ensure its sustainability.

Furthermore, educate residents to adapt their attitudes and actions of using the sustainable building features that applied in the SPH projects to fill the gap between the construction and use and eliminate the required maintenance as a result of inappropriate use (Priemus 2005). For instance, households member are needed to understand that in the water-recycling system, not all the wastewater can be allowed to go straight down the plughole, also family members should remember not to turn on in the central heating or air conditions.

Refurbishments during project occupancy to maintain efficient performance are critical to extending the project service time, which should be considered in the project management plan and during planning, design, and construction (Shen 2007). The provision of appropriate information on the operation of sustainable features can contribute to enhancing health and safety in the project as well as reduce the ongoing cost for users. Table 31 shows the project sustainable performance checklist criteria for occupation stage.

Table 31: Project Sustainable Performance Checklist Criteria for the Occupation Stage

Social aspects
• **Sustainability reports and practices**
Evaluate of the social effects of SPH operation on the residents, community, and society
Train and educate residents regarding the use of sustainability features in the project
Educate property management staff regarding sustainability in SPH
• **Employment**
Enhance employment in the local community

• **Benefits to local community**
Provide services spaces and facilities to improve living conditions in local community (Shen 2007)
Environmental aspects
• **Filling the gap between construction and management**
Provide transparency and good engagement with industry, the community, and other stakeholders to ensure sustainable living conditions that improve the environment
Evaluate repair to ensure low environmental impact
• **Environmentally friendly operation**
Train management staff to improve productivity and reduce air, water, and noise pollution (Shen 2007)
• **Maintenance**
Periodically inspection, and assess SPH to guarantee sustainability performance and measure impacts on the environment
Apply maintenance strategy
Evaluate the environmental impacts of maintenance and refurbishment
• **Waste management**
Consider recycling as an approach to waste management
Educate residents about the waste management that lowers the environmental impacts
• **Resource consumption**
Assess and measure energy consumption for electrical, heating and lighting
Assess and measure water consumption and other renewable and non-renewable raw materials
Economic aspects
• **Operation costs**
Assess ongoing costs and consider economics choice to satisfy users
Develop a balance sheet for project operation and expenses to ensure continued improvement
Evaluate operation and maintenance cost alternatives
• **Improve the local economic environment**
Choose options that benefit the environment and local society and have long-term benefits
Evaluate the cost of project impacts and develop a long-term approach that benefits the project users and local community
Develop training programs to enhance residents' incomes and employment opportunities
Political aspect
• **Regulations**
Apply regulation and assessment practices to measure sustainability of PH projects
Highlight weaknesses in SPH performance that can be considered by policy makers
Encourage involvement of residents in discussion with local authorities more realistic approach to improving PH

5.5.6 Demolition

Demolition is the last stage of project life. In PH projects, this stage result from different reasons. For instance, in the USA, combinations of reasons, such as insufficient performance and deterioration resulting from inadequate decisions made during the scope, planning, design, and construction, or changes in occupancy policies have led to demolishment of PH projects. Insufficient performance is discovered during occupancy which has led to demolishment of projects. In general, failure to meet sustainability requirements and the needs and values of users and other stakeholders' have led to unsuccessful projects and their demolishment.

Project demolition involves activities that can affect the environment, society, and economic development. Countries have developed laws and regulations to reduce the negative impacts of building demolition. For instance, OSHA standards have a primary demolition standard reregulation (Standards -29 CFR 1926), that covers different stages of demolition such as 1926.854 (Removal of walls, masonry sections, and chimneys), and 1926.855 (Manual removal of floors), and 1926.859 (Mechanical demolition) (OSHA 2013).

The US Environmental Protection Agency (EPA) Region 5 also developed an on the road to reuse: residential demolition bid specification development tool as a guideline to eliminate impacts and enhance the community (Furio et al. 2013). Furio et al. (2013) provide the best management practices of residential demolishment operation to improve the environmental results. They highlight the importance of pre-demolition inspection and the development of a pre-demolition survey and waste management plan, raise awareness of environmental concerns about common demolition practices, and describe modifications that can be applied to reduce environmental impacts.

Making the right decision regarding the demolition of the PH project should be considered relocating the residents to reduce the low-income family in needs for PH. Also, the demolition decision should consider different legislations and goals of the city's development plan to ensure sustainable development. Additionally, the project management plan for demolition should consider the direct and indirect demolition costs, evaluate the short and long terms goals, provided a positive social, economic, and environmental benefits to the community, reduced associated risk to workers and society, follow the health and safety protections for worker and the public, manage waste and recycle and reuse demolished materials, and study the opportunities to benefit the community, such as the installation of green infrastructure (Furio et al. 2013). Effective planning and management of the demolition project can benefit the community, stabilize and revitalize the neighborhood, and improve end-use aesthetics (Furio et al. 2013). Table 32 shows the checklist of the project sustainable performance criteria for demolish stage.

Table 32: Project Sustainable Performance Checklist criteria for the Demolish Stage

Social aspects
• **Benefits to local community**
Ensure the demolishment of PH decrease the PH impacts on the users and society
Ensure the demolishment complies with the development plan for the sustainable development for cities growth
Engage the community to ensure the acceptance of demolition process
Incorporate demolition process to enhance the existing infrastructure such as incorporate with other infrastructure project in the site or its surrounding

Assess the opportunities to transform vacant properties resulting from the demolition to add value and support community such as amenities
Engage community to use the land for a new development according to the local community needs
• **Employment**
Enhance employment in the site work, transportation, and disposal of demolishment materials (Shen 2007)
• **Safety and public health**
Raise public awareness regarding its possible impacts on safety and public health
Raise public awareness regarding demolition policies and environmental techniques to alleviate its consequences on the neighborhood environment
Ensure the operation will not impact the worker health and public health such as by fugitive dust that can affect health affect, especially those with respiratory illnesses
Environmental aspects
• **Demolition plan**
Conduct pre-demolition inspection identify and classify waste and hazard materials, and evaluate proper waste disposal to reduce negative impact on the environment and public health and allow efficient treatment and disposal
Ensure that the demolition and waste management plans protect the environment and treat toxic materials (Shen 2007)
Control demolition to ensure it is environmentally friendly
Train the contractor and workers regarding waste management to avoid inadequate practices (Shen 2007)
Adapt technologies to lessen negative impacts on workers, environment, and the neighborhood (Shen 2007)
Economic aspects
• **Demolition cost**
Consider long term benefits and eliminate the future cost than short term and low-cost operations; for instance, using the demolition debris to fill the basement excavation will increase the future use and impact the community (Furio et al. 2013)
Evaluate the cost of demolition practices, especially regarding labor, energy consumption, waste disposal, compensation for stakeholders and unemployment, and compensation for damaged environment to residents, land, water and ecosystem (Shen 2007)
Consider the cost balance regarding modification to reduce environmental impacts and open communication with other stakeholders to encourage such actions
Assess the opportunities of recycling, salvage, and building disassembly and materials reuse (Furio et al. 2013)
• **Improve the local economic environment**
Consider options that generate long term revenue and improve the local economy and environment; for example, recycling and reusing materials from resident building saves energy and reduce greenhouse gas emissions and other pollution associated with the extraction of raw materials
Political aspect

Regulations
Raise awareness of the environmental regulations associated with demolition and waste management (Furio et al. 2013)
Develop and support recycling and reusing materials through local regulations
Communicate information regarding to environmental policies, regulations, and legislations

5.6 Conclusion and Future Studies

The study analyzed the literature relevant to sustainable frameworks for affordable housing and also the approaches that have been utilized to develop an integrated framework. It found increased attention to sustainability in project management by academic researchers and construction managers for organizations and firms. Sustainability implementation in affordable housing focuses on general aspects such as generating sustainability indicators for affordable housing and developing frameworks and models to evaluate the sustainability of affordable housing. An applicable approach utilizing construction management tools to develop an integration framework for SPH has been lacking. The integrated framework developed in this study includes (1) identifying the sustainability development requirement, based on the TBL+1 pillar and specific requirements of the users and other stakeholders, (2) identifying the challenges and project constraints and the key sustainability performance indicators, (3) utilizing construction management tools, including feasibility study, innovation, risk management, and lean construction, to cope with SPH challenges.

An integrated framework covers the six project stages (project scope, planning, design, construction, occupancy, and finally, demolition). The specific checklist of applicable performance attributes to SPH success related to TBL+1 presented consistently and holistically across the project lifecycle. The checklist provided in the integrated framework is the start for creating an integrated management plan for SPH by the housing authorities; future research is needed to explore and adapted the opportunities to achieve the best sustainability performance for PH projects based on the regional requirements. The checklists provided present the fundamental requirements for SPH success that could use as a tool that allows all parties involved in PH development to evaluate and improve sustainability implementation on SPH projects throughout their life cycle. For instance, policymakers can establish discussions to develop laws and regulations to achieve SPH.

An integrated framework for SPH incorporated interdisciplinary studies that include civil engineering, architecture, environment, economics, public health, and psychology to enhance the built environment. Future researches can explore the dynamic interaction among different interdisciplinary and parties to improve SPH. For instance, a combination of architectural and engineering perspectives is a good practice to enhance building performance and develop a satisfactory built environment. The vernacular architecture reflects optimum interactions between people and their place; evaluating the sustainability of traditional built environment (planning concepts, design strategies, construction techniques, and the use of local materials) is critical to improving SPH.

Future fields of study, are also regarding opportunities (feasibility study, innovation, risk management, and lean construction) introduced in framework development that will improve sustainability in PH in particular and in construction in general. Future research includes studies, such as lifecycle cost analysis and innovation in sustainable design, construction technology, productivity improvement, alternative materials, and risk mitigation, that are the guarantee for a better-built environment.

5.7 References

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6. Chapter 6: General Conclusion

PH globally is facing many problems and the criticism against it is also increasing; this research introduced sustainability as a solution approach to tackle PH dilemma. The goal for this research is to develop an integrated framework for SPH that provides an applicable process to evaluate and achieve PH sustainability. Different stages have been applied toward fulfilling this goal.

Chapter 2 represents the application of the TBL+1 framework as approach to evaluate PH in two different countries with reviewing of some examples of PH in each country to provide a rich understanding of programs changes and developments. The main opportunities and challenges faced each program identified throughout the comparison of the two programs, and the important lessons learned were extracted and the potential indicators for SPH based on the TBL+1 were identified. Recommendation related to TBL+1 aspect to enhance PH programs are provided such as respecting social aspect and residents' needs in designing PH, avoiding high-rise, and enhancing studies related to socioemotional health. In addition, the recommendation emphasizes the important of conducting the POE to examine the PH performance form the resident point of view.

Chapter 3 exploring the social aspect of PH in the USA and Libya. The chapter reveals poor social conditions and similar social problems related to architectural design and neighborhood planning are experiences at the two countries' PH projects such as unsafe living conditions, and poor psychological health. In the USA demolish stressed project and restore others using tradition neighborhood provide a great solution for PH that should Libya government followed.

Chapter 4 provides a realistic evaluation of PH living conditions based on the TBL+1 aspect of sustainability. A multi-dimensional approach includes (The POE, an observation of physical traces, and a semi-structured interview) use to evaluate three PH among different groups. Three different models of sustainable performance indicators provided one for each project. Three models are compared to explore the similarities and differences and provide better understanding of residents' satisfaction. Dissatisfaction indicators require more attention form the policy makers, developers, planners, designers, project managers, and property managers. Enhancing such indicators in affordable housing will enhance living conditions and promote resident satisfaction.

Chapter 5 highlights increased attentions toward sustainability in project management that found by academic researchers and construction managers. Contradictory, less attention regarding implementation of sustainable project management application in affordable housing based was found on the literature review.

Chapter 5 provides an integrated conceptual framework for SPH based on the TBL+1 aspect. The development of the integrated framework has been developed based on the TBL+1 through identifying the needs of (sustainability development requirement, and the specific requirements of the users and other stakeholders) that coupled with identified challenges (project constraints and the key sustainability performance indicators) and utilized of the construction management tools (feasibility study, innovation, risk management, and lean construction) as approach to cope with SPH challenges.

Chapter 5 provides an applicable project sustainable performance checklist criterion for the project stages (project scope, planning, design, construction, occupancy, and demolition).

6.1 Recommendations

This section includes a specific recommendation to assess to achieve a SPH during the projects' stages.

The Project Scope Stage

- Developing SPH Projects in a sustainable neighborhood required high coordination among all stakeholders from the beginning of the project and across the project life cycle from scoping to demolishing.
- Chose long-term benefits options related to improving the TBL+1 sustainability aspect during the evolution of the new SPH different scenarios, or the redevelopment and revitalization of constructed PH.
- Conduct cost-effectiveness and life cycle cost analysis at the beginning of the SPH discussion to ensure its sustainability.

The Planning Stage

- Choose an appropriate SPH location that supports accessibility for daily needed facilities and reduce dependency on the personal automobile by incorporating 20-minute neighborhood planning.
- Support the mix-use community and develop a satisfactory neighborhood that includes a variation of building types and housing choices with different densities while promoting overall buildings in terms of height and bulk.

- Create a sense of space by incorporating the surrounding culture, traditional neighborhood, and landscape features to enhance the site's quality. Also, incorporate the planning principles with design criteria to create a building facade and streets that identify the projects and enhance the sense of space.
- Maximize the nature advantage by planning open spaces, cluster size, and housing orientations to enhance the outdoor and indoor quality and reduce the environmental impacts.
- Connect the project to energy planning and innovative solutions, such as renewable energy usage, street lighting, and urban mobility.
- Apply sustainability environmental principles such as reduced site paving, water management, landscape and shading, and acoustical, visual, wind, and wildfire buffers.
- Create amenity facilities in the project's components to enhance safety, security, healthy social interaction among the project, neighborhood, and society.
- Support developing a supplementary code approach to improve the neighborhood based on their specific needs to have a satisfactory built environment.

The Project Design stage

- Evaluate design options such as "fabric first" and "passive house" to develop cost-effectiveness units because of the unit's operation const for PH users.
- Apply a diverse range of design strategies to satisfy the needs of various groups and sizes of different cultures and demographics that would use SPH in

heterogeneous societies.

- Incorporate traditional architectural principles in the design of PH to provide acceptable units that are compatible with the surrounding, users' and culture's needs, and climate needs and avoid future modifications.
- Identify the residents' needs to provide flexible and functional housing that satisfies the residents' current and future needs. Adaptation of the "loose fit, long life" concept can help to develop a flexible design. Also, consideration of the constructability options based on modular and standardized components can reduce waste and enhance durability and flexibility.
- Enhance comfort level, productivity, and healthy living conditions and overall well-being by visually and non-visually connect with nature, choose natural materials, orient the layout relative to sun, wind, and views to maximize visual, acoustic, and thermal comfort, and natural lighting and ventilation.
- Ensure secure and safe living conditions for residents by using adequate measures against crime and emergencies such as earthquakes and floods in the unit design objectives.
- Design the units to support social interaction among the family members and build strong relationships concerning cultural needs regarding privacy among the units' users.
- Communicate information with the stakeholders related to other SPH local and global policy regulations, and encourage discussion of design concepts toward developing regulations that govern sustainability application in PH.

- Highlight the importance of implementing the traditional approach in design SPH and enhance policy development toward such an approach.

The Project Construction Stage

- Utilize a flexible construction management approach that can balance the use of elements such as risk management, lean construction, feasibility studies, and innovation.
- Incorporate social responsibility principles to eliminate the social, environmental, and economic consequences of construction operations, meet the stakeholders' needs, and add value to the assigned budget.
- Ensure social responsibility as pertinent to the construction process. This should include safe and healthy conditions for workers, community and society, consideration of local communities and employment, improve services in the community, and engage all stakeholders.
- Ensure environmental responsibility by incorporating waste management, reducing depletion of water, air, land, energy resources, have effective measures to reduce pollutions, applying innovative construction techniques such as 3D-printing and prefabrication, using local alternative and renewable materials, and adapting traditional construction approaches.
- Achieve sustainable environmental management by developing efficient balance methods and using innovative approaches to control costs. For instance, using lower-cost resources with advanced technologies, reducing/ recycling waste, controlling risks, and reducing pollution can be balanced to

achieve successful SPH.

- Ensure economic sustainability management by incorporating and assessing options for financial health, economic performance practices, and evaluation of potential financial benefits.
- Managing all stakeholders and engaging governance authorities is critical to achieve sustainable project success.

The Project occupation Stage

- Continued monitoring and evaluation of PH performance is the way to ensure its sustainability. Researchers and government agencies can evaluate the performance of housing project. Property managers and developers can also be evaluated to ensure that they are following sustainability requirements.
- Highlight the results of POE surveys based on the end-users because it provides a day-to-day interaction with the built environment that can be representation at different levels of the TBL+1 aspect. The POE results allow to provide a KSPI to improve present and future building sustainability.
- Expand the target groups to collect information regarding PH development and performance; such groups can include developers, neighbors, local community organizations, and relevant government organizations.
- Monitor building conditions to enhance the ability of property managers to take reasonable action as needed, fill the gaps between the construction and management, and ensure the low environmental impacts of repaired materials.
- Ensure effective operation cost with long-term benefits by applying waste

management strategies and assessing resource consumption to reduce the environmental impacts on society.

- Highlight weaknesses in PH performance by encouraging discussion among stakeholders, especially the residents and local authorities, to develop a more realistic SPH solution.

The Project Demolition Stage

- Evaluate the PH demolition decision with consideration to the TBL+1 aspect to make sure that such a decision will enhance the overall living conditions in the society, and that it is compatible with the legislations and the goals of the city's development plan.
- Engage the community in the decision process to ensure their acceptance of demolition activities and discuss the land's use for new development according to the local community needs.
- Ensure the operation will not affect the worker's and public health. Raise public awareness regarding demolition policies and environmental techniques to alleviate its consequences on the neighborhood environment.
- Conduct a demolition management plan that includes pre-demolition inspection and a waste management plan to recycle and reuse demolished materials. The project management plan for demolition should also include the direct and indirect demolition costs, the associated risks to workers and society, the health and safety protections for workers and the public, and the short- and long-term benefits.

- Control demolition to ensure it will improve the local environment by using environmentally friendly demolition practices. The process should also benefit the community economically by employing the local community to complete the site work, transportation, and disposal of demolishment materials included in the demolition plan.
- Communicate information regarding environmental policies, regulations, and legislation associated with demolition and waste management

6.2 Limitation

SPH is an overlapping topic that includes aspects of sustainability and societal development that influence the neighborhoods, communities, and society. This research focuses on applying a sustainable management approach that can be used by the design team, especially the planners, architects, and project managers, to achieve SPH. The application of the introduced integrated framework can improve some social, economic, environmental, and governance aspects of SPH, which present some limitations in its performance to achieve the SPH. In order to improve the overall aspects of TBL+1 related to the SPH at the micro and macro levels and overcome these limitations, the collaborative researchers within other fields to expand the sustainability application to different involved parties than the design team and achieve the SPH require.

For instance, the limitation found in this research that related to social aspects includes depending on the interviews and observations of the physical trace to understand the residents' perception pertinent to sustainable social indicators. Collaborative research with a socialist to investigate residents' acceptance and adaptations to living environments in the PH is a way to understand the PH social aspect better and develop more realistic solutions.

The limitations pertinent to environmental aspects also include dependent on the interviews and observations of the physical trace to understand the residents' assessment of their indoor environment regarding the sustainable environmental indicators. We were planning to have a thermal comfort analysis using a Hobo sensor to measure the three case studies' indoor environment to have a more realistic analysis; such assessment will be part of future studies. It is crucial to conduct sensitive researches for the indoor living environment and analyze the local and global climate impacts on the built environment of PH. To better understand the residents' responses and to deliver a satisfactory SPH that is compatible with climate needs.

Similarly, the research finding on the economic aspects depends on the interviews and the observation of the physical trace to incorporate the results of the survey. Conducting in-depth analytic economic studies related to the overlapping of the economic aspect of the PH is critical to have real solutions. Other limitations are relevant to the governance aspects of PH and sustainability. The research depends on the analysis of the relevant literature reviews to provide sustainable governance recommendations to improve PH performance and high light the laws and regulations affect achieving the SPH. Conduction collaborative research with policy researchers can be a better way to achieve a more sustainable PH.

Another limitation of this research is related to the relationship between sustainability and satisfaction measurement based on the POE survey. The project's sustainability implies that the project will continue to operate efficiently and be satisfactory for many years. However, using the POE surveys to measure the satisfaction level of the project's sustainable performance in this research presented only the measure of satisfaction in a period. Thus, continued evaluation of the TBL+1 aspect during multiple project stages, and adding new technologies is a way to ensure more sustainable solutions for SPH.

There are limitations to generalizing the research finding; case studies used in this research limited to three low-rise projects in the USA and Libya. No middle or high-rise projects were studied. Examining other architectural design and planning features of PH can be explored in future researches. Also, the two projects in Corvallis, OR, are in an affluent area, and they do not have the same problems facing the PH project in other areas in the country. The family Housing project at OSU is student housing with very diverse residents who not expected to live there forever.

The results of this research regarding KPSIs can be generalized for Libyan PH programs because the government is only responsible for providing PH; however, in the USA, it is more complicated. The PH program is governed by different GOs and NGOs and at different levels: counties, big cities, states, and federal. There is a need for more evaluation studies at different levels of PH projects in the USA.

6.3 Future Studies

The future study included researches, such as explore the statistical correlation between neighborhood cohesion and other elements. This analysis anticipated to identify significant indicators related to social cohesion based on the TBL+1 aspect. The result will provide detailed indicators that are significantly related to social, environmental, economic, and governance.

Other relevant future research is to explore the opportunities to develop different Matric of KPSIs by changing the 6-point Likert scale 4-point by grouping the very satisfied and satisfied in one group and very dissatisfied and dissatisfied in one group. Some studies have found different results when they change the survey respondents rank level because residents sometimes do not have clear measures between very satisfied and satisfied.

This research incorporated the sustainable approach into the project management process; to enhance the final constructed product that resulted in developing an integrated conceptual framework for SPH and its checklist for sustainable performance criteria for the SPH projects' lifecycle. The framework and its checklist can be used to establish an integrated and strategic management plan for SPH. The integrated management plan for SPH can enhance the capacity of innovation and provide a reliable tool to empower the integration of sustainability and project management.

Expand the research toward applying a holistic approach in addition to POE, such as semi-interviews, conducting an observation of physical traces, monitoring the energy consumption, investigating the thermal comfort levels, and assessing the indoor quality and measuring its performance anticipated to deliver a better understanding of PH performance from resident perspectives. One of the undergoing researches is measuring the indoor built environment thermal performance for the research case studies using a HOBO sensor.

The following topics can be future studies that are relevant to this research. Expanding the evaluation of PH based on TBL+1 to include other countries could provide an in-depth understanding of the PH development and help develop and build more realistic PH solution scenarios.

Also, evaluating the sustainability of vernacular architecture in different regions based on TBL+1 and adapted some of these techniques and solution strategies to satisfy the current needs and create a contemporary vision of such architectural practices. Traditional architecture and construction approaches are inherently sustainable, taking advantage of local construction materials and renewable sources.

The rapid change in technology, practices, and social-political conditions requires conducting interdisciplinary research that can evolve to fulfill the needs for sustainable development. The collaborative among different fields that influence the SPH, such as social sciences, planning, architecture, engineering, economics, management, environment, sociology, psychology, health, history, and other academic and professional disciplines, is anticipated to enhance the sustainability of existing and future built environments.

Some examples of future studies related to collaborative research with other specialists in related fields include: improving the overall social aspects of SPH by conducting collaborative research with the socialist to investigate issues such as residents' acceptance, adaptations, motivations, needs, and expectations to improve the living environments in the PH. Most of the reviewed studies have highlighted the poor social conditions facing residents of PH projects, thus conducting a social performance evaluation of PH projects is one of the suggested future studies. Thus, gathering more specific details about PH in different locations and studying their local conditions and the communities' social structure are anticipated to enhance societies' overall living conditions.

Another field of future studies is conducting collaborative studies with local and global climatologists better to understand the real need for the project frame time.

Similarly, regarding the economic aspect for SPH, conducting collaborative and sensitive research with the economists to analyze the economic aspects of the PH development at the local and national levels is part of the future studies and anticipated to delivering a satisfactory SPH. Future researches also include studies, such as lifecycle cost analysis and innovation in sustainable design, construction technology, productivity improvement, alternative materials, and risk mitigation, that are the guarantee for a better-built environment.

Other future research is a collaborative emphasis on researches on the relation between the public policy and government agencies and sustainability application in PH as an effective way to ensure delivering SPH. Such an approach is a critical way to achieve sustainability, especially in Libya, where there is a lack of attention toward sustainability in the built environment in general and for PH, specifically. Collaboration among many agencies related to PH can be the right way to ensure its sustainability such collaboration could be between the government and economic authorities to ensure the SPH continence fund that has been critical in the two countries.

Besides, conducting a sustainability performance evaluation of PH projects and programs from other stakeholders' points of view. Understanding the intricacies of all stakeholders' needs and developing a short-term fix and long-term strategies are considered the best ways toward social and financial inclusion in the society.

7. Appendices

7.1 Appendix A

Satisfaction Levels in Public Housing in Libya in English

Satisfaction Levels in Public Housing in Libya

1. Assessment of Residential Satisfaction with Public Housing in Tripoli, Libya

This survey is part of a Ph.D. study to evaluate the performance of public housing in Libya from the users' point of view. This survey aims to determine the level of satisfaction of occupants who have lived in public projects in Tripoli for more than 10 years. The survey includes questions to assess the exterior and interior residential environment including functional performance, durability and constructional position, aesthetic appearance, sustainable features, thermal comfort, and the modifications made by users to adapt the living build environment in their residence units.

At the same time, the survey includes some questions to find out if this type of project has caused changes in occupants' social behavior in order to adapt to the built environment, and if those changes have led to disorder and social problems. The results of the survey will have a long- time benefit by providing feedforward for improving the design and construction criteria in order to provide sustainable public housing projects that satisfy the users' needs. All your answers will be used for educational studies. We appreciate your help in filling this survey.
This survey has been adapted from a survey originally developed by Dr, Mark Gillem. incorporating with survey questions developed by Asma Sharafeddin from results of her masters' thesis and additional materials. The questions relevant to thermal comfort have been adapted from different questions developed by following experts; Dr. Alison Kwok, Dr. Nadya Gabril, Manoj Kumar Singha , Sadhan Mahapatrab ,and Jacques Tellera.

1.Information about the occupants:

Name (optional)	
Address (optional)	
Education level	
Number of generations living in the house	
Number of people living in house	

2. Please indicate the number of people in your household in each category:

	Number of people
Child(ren) less than 5 years old	
Child(ren) between 5 and 17 years old	
Adults (including yourself) between the ages of 18 and 64	
Adults over the age of 65	

3.The number of children, distributed by school levels

Before Preschool	
Preschool	
Elementary school	
Middle school	
High school	
College	

4.Do you have children who have dropped out of school?

Yes	
No	
If yes, how many?	

5.Please indicate what type of housing that you currently live in:

6.How satisfied are you with the type of housing that you currently live in?

	6 (Very satisfied)	Satisfied	Fair	Dissatisfied	very satisfied	1 (Not applicable)
level of satisfaction	◯	◯	◯	◯	◯	◯

7. Please explain your level of satisfaction with the type of housing that you currently live in:

8.Do you prefer to move to another house?

9.Do you prefer your house to be:

10.Do you prefer to build your own house?

11. Do you or any members of your family have disabilities that require accommodations in your home environment (e.g., use a wheelchair and need wheelchair accessible accommodations)?

◯ NO

◯ Yes (please explain what accommodations are needed):

Part 2: Neighborhood Questions (neighborhood defined as within walking distance of the Project):

1.How satisfied are you with access to the following:

	6 (Very satisfied)	Satisfied	Fair	Dissatisfied	Very dissatisfied	1 (Not applicable)
Street network	○	○	○	○	○	○
Public transit	○	○	○	○	○	○
Education facilities (schools etc.).	○	○	○	○	○	○
Health facilities	○	○	○	○	○	○
Mosque	○	○	○	○	○	○
Places of recreation	○	○	○	○	○	○
Police office	○	○	○	○	○	○

2. Please rate how important to you it is to be within walking distance of each the following amenities:

	6 (Very important)	Important	Fair	Unimportant	Not at all important	1 (Not applicable)
Public Transportation	○	○	○	○	○	○
Mosque	○	○	○	○	○	○
Community Center	○	○	○	○	○	○
Grocery Store	○	○	○	○	○	○
Coffee Shop	○	○	○	○	○	○
Library	○	○	○	○	○	○
Neighborhood Park	○	○	○	○	○	○
Restaurant	○	○	○	○	○	○
Gas Station	○	○	○	○	○	○
Daycare	○	○	○	○	○	○
Tot lot (playground for children between 1-3 years old	○	○	○	○	○	○
Playground	○	○	○	○	○	○
Small Convenience Shop	○	○	○	○	○	○
Barber Shop	○	○	○	○	○	○
Beauty Salon	○	○	○	○	○	○
Dry Cleaners	○	○	○	○	○	○
School	○	○	○	○	○	○
Public Garage	○	○	○	○	○	○
Gym/Fitness Center	○	○	○	○	○	○
Workplace	○	○	○	○	○	○
Ballfields (e.g., soccer, basketball, volleynball)	○	○	○	○	○	○

Part 3: Facilities and Services Provided in the Project Site Itself

1. How satisfied are you with the following elements in the project

	6 (Very satisfied)	Satisfied	Fair	Dissatisfaied	Very dissatisfied	1 (Not applicable)
A fence and clear entrance to the project	○	○	○	○	○	○
Security measures to control trespassers	○	○	○	○	○	○
Good street network	○	○	○	○	○	○
Enough parking	○	○	○	○	○	○
Good sidewalks	○	○	○	○	○	○
Social and recreational buildings	○	○	○	○	○	○
Enough pleasant places to rest when walking	○	○	○	○	○	○
Green areas and enough plants	○	○	○	○	○	○
Play areas for children	○	○	○	○	○	○
Good lighting network	○	○	○	○	○	○
Water supply network	○	○	○	○	○	○
sanitary sewage network	○	○	○	○	○	○
Storm water network	○	○	○	○	○	○
Landline phone network in the project	○	○	○	○	○	○
Adequate system to collect garbage through the project	○	○	○	○	○	○
Fire extinguishing system	○	○	○	○	○	○

Adequate escape routes in case of fire						
Adequate escape or refuge areas in disaster						

2. If you live in a tower, please explain your level of satisfaction with the component elements of the tower

	6 (Very satisfied)	Satisfied	Fair	Dissatisfied	Very dissatisfied	1 (Not applicable)
Clearly distinguishable entrance to the residential building						
Safe use of the entrance						
Building anticrime security system or patrol						
Enough lighting inside and outside the building						
Use of the ground floor						
Large enough lobby leading to vertical circulation						
Adequate size and number of elevators						
Conditions of stairs						
Escape ladder						
Use of the roof						
Durability of external building finishing						
Durability of internal building finishing						

Cleanliness of the internal and external of the tower environment	◯	◯	◯	◯	◯	◯

3. How satisfied are you with the sustainable features applied in the building:

	6 (Very satisfied)	5 (Satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Adequate orientation of the building for sunlight	◯	◯	◯	◯	◯	◯
Day Lighting though building	◯	◯	◯	◯	◯	◯
Adequacy of natural ventilation	◯	◯	◯	◯	◯	◯
System to collect storm water	◯	◯	◯	◯	◯	◯
System of using gray water	◯	◯	◯	◯	◯	◯
Roof garden	◯	◯	◯	◯	◯	◯
Use of sustainable building material	◯	◯	◯	◯	◯	◯
Sustainable energy systems, such as solar panels or geothermal systems	◯	◯	◯	◯	◯	◯
Sustainable systems in garbage collection	◯	◯	◯	◯	◯	◯

Part 4: Social Structures:

1.Please consider your current neighborhood and rate how true each of the following statements is for you.

	5 (Very true)	FairlyTrue	Nether True Nor Fals	Fairly Unture	1 (Completely Untrue)
Living in my neighborhood gives me a sense of community	◯	◯	◯	◯	◯
A feeling of fellowship runs deep between me and others in my neighborhood	◯	◯	◯	◯	◯
I feel loyal to people in my neighborhood	◯	◯	◯	◯	◯
I like to think of myself as similar to the people who live in my neighborhood	◯	◯	◯	◯	◯
I regularly stop and talk with people in my neighborhood	◯	◯	◯	◯	◯
I agree with most people in my neighborhood about what is important in life	◯	◯	◯	◯	◯
If I needed advice about something I could go to someone in my neighborhood	◯	◯	◯	◯	◯
My friendships and associations with others in my neighborhood mean a lot	◯	◯	◯	◯	◯
I think of community planning in my neighborhood as a "we", not a "they", activity	◯	◯	◯	◯	◯
I believe my neighbors would help me in an emergency	◯	◯	◯	◯	◯

If I were given the opportunity to move, I would choose to stay in my neighborhood	◯	◯	◯	◯	◯
If I can, I will remain a resident of my neighborhood for a number of years	◯	◯	◯	◯	◯
Overall, I am very attracted to living in my neighborhood	◯	◯	◯	◯	◯
I feel like I belong in my neighborhood	◯	◯	◯	◯	◯
I visit with my neighbors in their homes	◯	◯	◯	◯	◯
I frequently have neighbors over to my house to visit	◯	◯	◯	◯	◯
I borrow things and exchange favors with my neighbors	◯	◯	◯	◯	◯
Isolation and boredom among the occupants because of the limited physical spaces	◯	◯	◯	◯	◯

Other reasons (please specify)

2. The community displays social disorder and conflict because of:

	5 (Very true)	Fairly true	Fairly untrue	Nether true or not false	1 (Completely untrue)
Lack of feeling belonging to the place and its people	○	○	○	○	○
Residents trust among each other losT	○	○	○	○	○
Lack of participatory activities among the neighbors	○	○	○	○	○
Disparate moral values and norms of behaviors among occupants	○	○	○	○	○
Weak commitment to the religious teachings among the occupants.	○	○	○	○	○
Lack of solidarity among the neighbors	○	○	○	○	○
Permanent quarrels with neighbors	○	○	○	○	○
High unemployment among the occupants.	○	○	○	○	○
Spread of illnesses among most of the occupants.	○	○	○	○	○
Children in the neighborhood are not playing together	○	○	○	○	○
Repeated occurrence of fire in the project.	○	○	○	○	○

3. The project displays high level of recurrent crimes:

	6 (Very high)	High	Fairly	Few	Too few	1 (Not applicable)
Theft.	◯	◯	◯	◯	◯	◯
Traffic accidents and violations	◯	◯	◯	◯	◯	◯
Rapes	◯	◯	◯	◯	◯	◯
Drug dealing	◯	◯	◯	◯	◯	◯
Murders	◯	◯	◯	◯	◯	◯

4. The living space in the project often is too crowded, which can lead, to problems in:

	5 (Very true)	Fairly true	Nether true or nor false	Fairly untrue	1 (Completely untrue)
Developing healthy social relationships	◯	◯	◯	◯	◯
Changing in your family patterns and plans.	◯	◯	◯	◯	◯

5. Please consider where you may live in the future and rate how true each of the following statements is for you.

	Very true (5)	Fairly true	Nether true or nor false	Fairly untrue	completely untrue (1)
I hope to live in a neighborhood with a strong sense of community	◯	◯	◯	◯	◯
I hope to have close relationships with people in my neighborhood	◯	◯	◯	◯	◯

Part 5: Overall design of housing unit components

1. If you lived in an apartment in a tower, how many floors above the ground would you be willing to live if the building had an elevator and could only be accessed by a shared entryway?

2. If you lived in an apartment in a tower, how many floors above the ground would you be willing to live if the building DID NOT have an elevator?

3.If you lived in an apartment in a tower, how many apartments are in the same story that you live in?

4. In case you have the opportunity to choose the unit before buying it, will you look for the same unit style you have now?

Other (please specify)

5.How many bedrooms are in your current residence?

6.In case you have the opportunity to choose the unit before buying it, will you look for the same number of bedrooms and bathrooms

7. In case you have the opportunity to choose the unit before buying it, will you look for the same unit with some modifications

Please specify modifications you would need to have before moving

9. what are the number and the areas of the following bed rooms in your house?

	5*5 m	5*4.5 m	4.5*4.5 m	4.5*4 m	4*4 m	3.5*3.5 m	3.5*4 m	3*3
Number of main bedrooms								
Number of seconder bedrooms								
Guset room								

Other areas (specify)

10. How satisfied are you with the bedrooms situation/ position in your house?

	6 (Very satisfied)	5 (Satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
The number of bedrooms	○	○	○	○	○	○
The areas of bed rooms	○	○	○	○	○	○
Enough sunlight inside the bed rooms	○	○	○	○	○	○
Adequacy of natural ventilation for the bedrooms	○	○	○	○	○	○
Use of bedrooms windows without distrusting neighbors	○	○	○	○	○	○
Durability of finishing materials for roof	○	○	○	○	○	○
Durability of finishing materials for wall	○	○	○	○	○	○
Durability of finishing materials for floor	○	○	○	○	○	○
Appearance of finishing materials for roof	○	○	○	○	○	○
Appearance of finishing materials for wall	○	○	○	○	○	○
Appearance of finishing materials for floor	○	○	○	○	○	○

Please explain your level of satisfaction with the bedrooms in your current residence:

11. How many bedrooms do you need in a residence?

	5*5 m	5*4.5 m	4.5*4.5 m	4*4 m	4*3.5 m	3.5* 3.5 m	3.5*3 m	3*3 m
Main bedroom								
Secondary bedroom								
Gestes room								

Other (please specify)

12. How satisfied are you with the living area in your current residence?

	6 (Very satisfied)	5 (Satisfied)	4 (Fire)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Adequate and enough area for daily use						
Easy accessible located from kitchen						
Easy accessible located from main bathroom						
Easy accessible located from bedroom						
Easy accessible located from entrance						
Flexibility of multi-use of the spaces						
Adequacy of accommodation for increased in family members						
Adequate nature daylight						
Adequate nature ventilation						

13. Please explain your level of satisfaction with the living area in your current residence:

14. What are the living areas features you prefer to have in you current residence?

15. How satisfied are you with the kitchen in your current residence?

	6 (Very satisfied)	5 (Satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Acceptable located for all family members	○	○	○	○	○	○
Adequate and enough areas for family desired	○	○	○	○	○	○
Enough storage areas for family events' equipments	○	○	○	○	○	○
Adequacy of accommodation for increased in family members	○	○	○	○	○	○
Adequate nature daylight	○	○	○	○	○	○
Adequate nature ventilation	○	○	○	○	○	○
Use of kitchen windows without distrusting neighbors	○	○	○	○	○	○
Good hot and cold water supply network	○	○	○	○	○	○
Good sewer network	○	○	○	○	○	○
Provide a wall hood	○	○	○	○	○	○
Provide anti-fire system	○	○	○	○	○	○
Durability of finishing materials for floor	○	○	○	○	○	○
Durability of finishing materials for walls	○	○	○	○	○	○
Durability of finishing materials for roof	○	○	○	○	○	○
Appearance of finishing materials for floor	○	○	○	○	○	○
Appearance of finishing materials for wall	○	○	○	○	○	○
Appearance of finishing materials for roof	○	○	○	○	○	○

16. Please explain your level of satisfaction in your current residence?

17. How many of the following types of bathrooms do you have in your current residence?

1/2 (sink and toilet only)	
3/4 (sink, toilet, and shower only)	
Full (sink, toilet, shower, and bathtub)	

18. How satisfied are you with the bathrooms in your current residence?

	6 (Very Satisfied)	5 (Satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very Dissatisfied)	1 (Not applicable)
Adequate and enough areas for family desired						
Acceptable located for all family members and gusstes						
Enough storage areas for family number						
Adequate nature sunlight						
Adequate nature ventilation						
Use of bathroom windows without distrusting neighbors						
Good hot and cold water supply network						
Good sewer network						
Provide a wall hood						
Durability of finishing materials for floor						
Durability of finishing materials for wall						
Durability of finishing materials for roof						
Appearance of finishing materials for floor						
Appearance of finishing materials for wall						
Appearance of finishing materials for roof						

19.Please explain your level of satisfaction with the bathrooms in your current residence?

20. How many of the following types of bathrooms do you need in a residence?

1/2 (sink and toilet only)	
3/4 (sink, toilet, and shower only)	
Full (sink, toilet, shower and bathtub)	

21. Where are the laundry facilities located in your current residence?

- Bathroom
- Kitchen
- Garage
- Laundry room
- Other (please specify)

22.How satisfied are you with the location of the laundry facilities in your current residence?

	6 (Very satisfied)	5 (satisfied)	4(Fair)	3(Dissatisfied)	2(Very Dissatisfied)	1(Not applicable)
level of satisfaction	◯	◯	◯	◯	◯	◯

23.Please explain your level of satisfaction with the location of the laundry facilities in your current residence:

24. where would you prefer to have them located?

- ◯ Bathroom
- ◯ Kitchen
- ◯ Garage
- ◯ Laundry room
- ◯ Other (please specify)

25. How many storage do you have in your current residence?

26.How satisfied are you with the number of storage do you have in your current residence?

	6 (Very satisfied)	5(satisfied)	4(Fair)	3(Dissatisfied)	2(Very Dissatisfied)	1 (Not applicable)
level of satisfaction	◯	◯	◯	◯	◯	◯

Other (please specify)

27. How many storage would you prefer to have in a residence?

Inside the residence	
Out side the residence	
Both inside and outside	

Other (please specify)

28. What type of parking do you have at your current residence?

- ◯ Community parking garage
- ◯ Private enclosed parking/private garage
- ◯ Private covered parking/carport
- ◯ Uncovered parking lot
- ◯ Street parking
- ◯ Driveway
- ◯ Other (please specify)

29. How many vehicles does your family have at your current residence?

Passenger vehicles (e.g., cars, trucks, etc.)	
Motorcycles	

30. How satisfied are you with the type of parking at your current residence?

	6 (Vary satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Level of satsfaction	◯	◯	◯	◯	◯	◯

31.Please explain your level of satisfaction with the type of parking at your current residence:

32.How many parking spaces do you need at a residence?

33. What type of parking do you see as ideal at a residence?

- Community parking garage
- Private enclosed parking/private garage
- Uncovered parking lot
- Street parking
- Driveway
- Private enclosed parking/private garage
- Other (please specify)

34.What type of outdoor space do you have at your current residence (check all that apply)?

	6 (Very important)	5 (important)	4 (Fair)	3 (Unimportant)	2 (Not at all important)	1 (Not applicable)
Back Yard	○	○	○	○	○	○
Front Yard	○	○	○	○	○	○
Side Yard	○	○	○	○	○	○
Balcony	○	○	○	○	○	○
Patio	○	○	○	○	○	○
Shared Yard	○	○	○	○	○	○
Deck	○	○	○	○	○	○
Porch	○	○	○	○	○	○
Roof Garden	○	○	○	○	○	○
None	○	○	○	○	○	○

Other (please specify)

35. How satisfied are you with use the following outdoor

	6 (Very satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Back Yard	○	○	○	○	○	○
Front Yard	○	○	○	○	○	○
Side Yard	○	○	○	○	○	○
Balconies	○	○	○	○	○	○
Patio	○	○	○	○	○	○
Shared Yard	○	○	○	○	○	○
Deck	○	○	○	○	○	○
Porch	○	○	○	○	○	○

Other (please specify)

36.Please explain your level of satisfaction with the use of our-door spaces

37.Please rate how important to you it is to have each of the following types of outdoor spaces in a residence:

	6 (Very important)	5 (Important)	4 (Fair)	3 (Unimportant)	2 (Not at all important)	1
Back Yard	◯	◯	◯	◯	◯	◯
Balcony	◯	◯	◯	◯	◯	◯
Deck	◯	◯	◯	◯	◯	◯
Front Yard	◯	◯	◯	◯	◯	◯
Patio	◯	◯	◯	◯	◯	◯
Porch	◯	◯	◯	◯	◯	◯
Side Yard	◯	◯	◯	◯	◯	◯
Roof Garden	◯	◯	◯	◯	◯	◯

Other (please specify)

38.Please indicate what type of trash/recycling collection you currently have:

- ◯ Within the building on the same floor
- ◯ Within the building on a different floor
- ◯ Trash chute
- ◯ Outside collection areas
- ◯ Other (please specify)

39. Please indicate what type of trash/recycling collection you would prefer:

- ◯ Within the building on the same floor
- ◯ Within the building on a different floor
- ◯ Trash chute
- ◯ Outside collection area

42. Which one of the following spaces do you consider to be the most important space in a residence?

Part 6: Modifications made by users:

1. Have you done any modifications in your unit?

2. What were your modifications:

Close the balconies and add that area to the house	
Use the balconies as a storage area	
Turn the balcony into the bathroom	
Turn the bathroom to store	
Build bathroom in the front yard	
Build new room in the back yard	
Build storage in the back yard	
expand the kitchen	
Expand the living aera	

Other (please specify)

3. Why did you do it?

4. How much did it cost you?

5. How long ago did you do it?

part 7: Thermal comfort

1. Have you added electrical air condition to your unit in summer?

2. If so, what is the average if hours that you turn it on?

- 0-6
- 6-12
- 12-18
- 18-24

3/ In case there is no electricity in your apartment in summer what do you do

- change clothes type
- opening the curtains
- opening the windows
- used hand fans
- Other (please specify)

4. What is you satisfaction level about the thermal comfort in your housing with out electrical devices to adjust indoor temperature

	6 (very satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
in summer	◯	◯	◯	◯	◯	◯
in fall	◯	◯	◯	◯	◯	◯
in winter	◯	◯	◯	◯	◯	◯
in spring	◯	◯	◯	◯	◯	◯

Other (please specify)

5.In case there is no electricity what do you do to make your unit more acceptable

6. In case there is no electricity in you unit in winter what do you do to make it warm?

- ◯ using Coal or fuel heater
- ◯ closing windows
- ◯ using the curtains
- ◯ add extra cloths on
- ◯ using blanket
- ◯ Other (please specify)

7. I f you have Hobo sensor in your unit what the is your thermal comfort feeling now

- ◯ cold
- ◯ cool
- ◯ slightly cool
- ◯ neutral
- ◯ slightly warm
- ◯ hot

8. If you have a hobo sensor what is the time and date

	MM		DD		YYYY	hh		mm	AM/PM
Date / Time		/		/			:		-

9. Are the conditions (thermal) acceptable to you right now?

- ◯ acceptable
- ◯ not acceptable

10. In case it is unacceptable you would prefer to be:

- cooler
- no change
- warmer

11. please explain you feeling pertains to air movement in your unit right now

- acceptable
- unacceptable

12. Right now do you prefer the air movement to be

- more air movement
- no change
- less air movement

13. Right now do you feel the humidity is

- acceptable
- unacceptable

14. do you prefer the humidity level to be

- more moisture in the air
- no change
- drier air (less humid)

15. How often have you felt too hot?

- never
- rarely
- sometimes
- usualy
- always

16. How often have you felt too cold?

- never
- rarely
- sometimes
- usually
- always

17. Do you use an electrical heater in your unit in winter?

18. If so, what the average if hours that you turn it on

- 0-6
- 6-12
- 12-18
- 18-24

19. Do you depend on the electric lights in your unit during the day?

20. What is the reason that you are depend on electrical lights?

- unavailable windows
- unavailability to open the windows
- preferable to use electrical lihging
- electrical lighting in day
- electrical lighting in night

21. why do you do not like the thermal comfort level in your house?

- low quality and quantity of day light
- coldness in winter
- hotness in summer
- hard to adjust the temperature in my unit

22. does the uncomfortable thermal conditions interfere with doing usual activities in your unit?

- not at all
- sometimes
- moderately
- very much
- Other (please specify)

2. We have to make decisions about how to allocate space in units, and therefore we want to know which spaces are a priority for you (e.g., you may really want a lot of bedroom closet space, and would be willing to sacrifice having larger bathrooms to have more closet space). Please rate the importance of each of the following spaces in your residence:

	6 (Very important)	5 (important))	4 (Fair)	3 (Unimportant))	2 (Not at all important)	1(Not applicable)
Bathroom						
Bedrooms						
Living room						
Kitchen						
Living room						
Office/Den						
storage						

Part 8: general design questions

1. How satisfied are you with the design of the following:

	6 (Vary satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Adequacy of various areas in the unit	○	○	○	○	○	○
Clear separation between gust areas and family areas	○	○	○	○	○	○
Suitability for use by elderly and people with special needs	○	○	○	○	○	○
Adequate measure against crime	○	○	○	○	○	○
Good view from the windows and balconies	○	○	○	○	○	○
Provide high level of privacy from neighborhood	○	○	○	○	○	○

2. Are there any cracks in the walls?

3. Please rate the following aspects of housing in terms of what is very important to not at all important to you

	Very important (5)	Important	Fair	Unimportant	Not at all important	Not applicable (1)
Type of housing (e.g., apartment in a tower,town-home, single-family home, etc.)	○	○	○	○	○	○
Amount of interior space (e.g., large size and number of rooms)	○	○	○	○	○	○
Amenities in the interior of a residence (e.g., appliances, laundry facilities, etc.)	○	○	○	○	○	○
Outdoor aspects of a residence (e.g., parking, yard space, porch, etc.)	○	○	○	○	○	○
Neighborhood cohesion/community (e.g., sense of community among neighbors)	○	○	○	○	○	○
Location of a residence (e.g., distance from work, school, shopping, etc.)	○	○	○	○	○	○

Other important aspects (please specify)

Part 9: construction performance and periodic maintenance:

1.How satisfied are you with the following component of your current residence unit?

	6 (Very satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Structure integrity	○	○	○	○	○	○
Durability of the construction materials of roof	○	○	○	○	○	○
Durability of the construction materials of walls	○	○	○	○	○	○
Durability of the construction materials of floors	○	○	○	○	○	○
Durability of the construction materials of balconies	○	○	○	○	○	○
Good electricity network	○	○	○	○	○	○
Good sewer network	○	○	○	○	○	○
Good storm water network	○	○	○	○	○	○
Appearance of finishing materials	○	○	○	○	○	○
Acoustic quality in the unit	○	○	○	○	○	○
Thermal insulation of walls	○	○	○	○	○	○

3. Are there any chipped tiles in the wall of the kitchen or bathroom?

Part 10: the unit cost:

1. Please mention the unit cost in the following

The unit cost when you bought it from the housing ministry	
The price of the unit compared with its area and quality	
The price of the unit compared with neighborhood services and facilitiies	
The price of unit now	

Part 8: sustainable feature applied in design your residence unit:

1. How satisfied are you with the following sustainable features in your residence unit?

	6 (Very satisfied)	5 (satisfied)	4 (Fair)	3 (Dissatisfied)	2 (Very dissatisfied)	1 (Not applicable)
Adequacy of daylight	○	○	○	○	○	○
Adequacy of natural ventilation	○	○	○	○	○	○
Enough sunlight in the important living areas during the winter	○	○	○	○	○	○
Adequacy of the design with the traditional needs	○	○	○	○	○	○
Flexibility of multi-use of the spaces in the unit	○	○	○	○	○	○
Adequacy of accommodation for increase in family members	○	○	○	○	○	○

2. Does the price now reflect the:

The value of the unit	
The market price	
The site reputation	
The cost of modifications you have added	
Do you have further comments	

4. There is any periodic maintenance of the dwelling

5. there is any landscape maintenance for your outdoor places?

6. What type of periodic maintenance of the following do you have for your dwelling?

- Twice a year
- Once per year
- 2 years
- 3 years
- 4 years

7. Is there are any treatment of modifications appearance of the unit?

7.2 Appendix B

Satisfaction Levels in Public Housing in Libya in Arabic

Copy of Arabic housing satisfaction

تقييم درجة رضا السكان لمباني الاسكان العام قي طرابلس ليبيا

هذا الاستبيان جزء من رسالة الدكتوراه لتقييم اداء المشاريع الاسكانية في ليبيا من وجه نظر السكان المقيمين. الهدف من هذا الاستبيان هو تحديد درجة رضا السكان المقيمين في مشاريع الاسكان العام لمدة تزيد عن عشرة سنوات. الاستبيان يتكون من عدة اسئله تتعلق بالبيئة السكنية الداخلية والخارجية من حيث تقييم ادائها الوظيفي , متانة وسلامة المباني , التقييم الجمالي للشكل الخارجي , عناصر الاستدامة في مكونات المشروع والراحة الحرارية و التعديلات والتحويرات التي تمت من قبل السكان.

في نفس الوقت هذا الاستبيان يحتوى عدد من الاسئلة المتعلقة بالنواحي الاجتماعية وهل السكن بالمشاريع الاسكانية العامة فرض علي السكان تغيير نمط حياتهم وسلوكياتهم وسبب في ظهور مشاكل نفسية واجتماعية في بيئة المشاريع السكنية. النتائج المترتبة عن هذا الاستبيان سوف تكون فعالة ومثمرة لتطوير كفاءة اداء المشاريع الاسكانية العامة من خلال تطوير معايير التصميم والانشاء للحصول على مشاريع اسكانية عامة مستدامه تلبي احتياجات قاطنيها.

كل الاجابات لاسئلة هذا الاستبيان سوف تستعمل فقط للغرض العلمي , شكرا جزيلا علي تعاونكم للاجابة علي تساؤلات هذا الاستبيان.

هذا الاستبيان جاء نتيجة تحوير عن استبيان للدكتور مارك جيلم لتقييم اداء المشاريع السكنية في الولايات المتحدة الامريكية , بالاضافة الي اضافات من استبيان تم تطويرة من نتائج دراسة الماجستير ل أسماء المهدى شرف الدين والعديد من المصادر العلمية الاخرى.الاسئلة المتعلقة بالراحة الحرارية تم تحويرها من استبيان للدكتورة اليسون كواك والدكتورة دادية جبريل و كلا من الاساتذة ماوج كيمر سنجه و سادهن مهابتراو جاكوبز تليرمع الاستناد الي عددمن المصادر العلمية الاخرى.

1.

الجزء الاول: الاسئلة الديموغرافية

1. معلومات عامة عن السكان

الاسم (اختيارى)	
العنوان (اختيارى)	
المستوى التعليمي	
عدد الجيال في المسكن	
عدد المقيمين في المسكن	

2.

2/ رتب اعداد المقيمين حسب العمربالاضافة الي مجيب الاستبيان

اطفال اقل من 5 سنوات	
المقيمين من 5-17 سنه	
المقيمين من 18-64	
المقيمين الاكبر من 65	

3.

3/ عدد الاطفال موزعين علي مراحل التعليم

الحضانه	
الروضه	
المدرسه الابتدائيه	
المدرسه الاعدادية	
المدرسه الثانويه	
الجامعه	

4.

4/ هل لديك اطفال تسربوا من المدرسه

نعم	
لا	
في حال نعم كم العدد	

5.

5/ ما نوع المسكن الذي تعيش فيه الان

6.

الجزء الثاني : الحي السكني

1/ (حددت مساحة الحي السكني لتكون مسافه المشي الممكنه)

ما درجه رضاك عن امكانيه الوصول الي المرافق التاليه

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
شبكه الطرق	○	○	○	○	○	○
النقل العام	○	○	○	○	○	○
المرافق التعليميه كالمدراس مثلا	○	○	○	○	○	○
المرافق الصحيه	○	○	○	○	○	○
المسجد	○	○	○	○	○	○
المرافق الترفيهيه	○	○	○	○	○	○
مركز الشرطه	○	○	○	○	○	○

7.

6/ ما درجة رضاك عن مسكنك

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
درجه رضاك عن نوع المسكن الذي تسكنه	○	○	○	○	○	○

8.

الجزء الثالث : المرافق والخدمات في موقع المشروع

1/ ما درجه رضاك عن توفر العناصر التاليه بموقع المشروع

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
الاسوارالمحيطة و المداخل المحدده للمشروع						
الحماية من المرور العابر داخل المشروع						
شبكة الطرق الداخلية بالمشروع						
كفايه مواقف السيارات						
ممرات مشاه آمنه						
مركز اجتماعي و ترفيهي بالمشروع						
أماكن مشوقه للتنقل مشيا خلال المشروع						
مسطحات خضراء و نباتات						
ملاعب اطفال						
اضاءه شكبه الطرق وممرات المشاه						
شبكة التزود بالمياه						
شبكة صرف صحي آمنه وصحيه						
شبكة صرف وتجميع مياه الامطار						
شبكة الهواتف الارضية						
نظام تجمع القمامه						
نظام اطفاء الحرائق						
مسارات امنه لمناطق الهروب						
مناطق هروب امنه ومجهزه						

9.

7/ هل انت أو أحد من أسرتك معاق او بحاجه لمتطلبات خاصه (مثلا كرسي متحرك)

لا

نعم

في حال نعم ما نوع التسهيلات المطلوبه في المسكن

10.

2/ إذا كنت تسكن في برج سكني, يرجي تحديد درجة رضاك عن مكونات البرج السكني التاليه

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
المدخل الواضح والمحدد للبرج السكني	○	○	○	○	○	○
آمان وسلامه استعمال المدخل	○	○	○	○	○	○
اساليب الحمايه الامان بالبرج	○	○	○	○	○	○
الاضاءه الداخليه والخارجية بالبرج السكني	○	○	○	○	○	○
أستعمال الطابق الارضي	○	○	○	○	○	○
مساحة كافية للمدخل وقرب المصاعد والسلالم	○	○	○	○	○	○
عدد وحجم المصاعد مناسب	○	○	○	○	○	○
حاله السلالم جيده	○	○	○	○	○	○
توفر سلالم للهروب	○	○	○	○	○	○
استعمال السقف	○	○	○	○	○	○
متانه الانهاء الخارجي للمبني	○	○	○	○	○	○
متانه الانهاء الداخلي للمبني	○	○	○	○	○	○
البيئة الداخلية والخارجية للبرج السكني صحية ونظيفة	○	○	○	○	○	○

11.

2/ حدد درجه أهمية ان تكون في مسافه المشي للمرافق التاليه

	6 (مهم جدا)	5(مهم)	4(معتدل)	3(غير مهم)	2(غير مهم جدا)	1(غير قابل للتطبيق)
النقل العام	○	○	○	○	○	○
المسجد	○	○	○	○	○	○
المركز الثقافي	○	○	○	○	○	○
محل المواد الغذائيه	○	○	○	○	○	○
المكتبه العامه	○	○	○	○	○	○
موقف سيارات الحي السكني	○	○	○	○	○	○
المطعم	○	○	○	○	○	○
محطه الوقود	○	○	○	○	○	○
حضانه	○	○	○	○	○	○
ملاعب اطفال من عمر 1-3 سنوات	○	○	○	○	○	○
ملاعب اطفال	○	○	○	○	○	○
محل بقاله صغير	○	○	○	○	○	○
حلاق رجالي	○	○	○	○	○	○
محل حلاقه نسائي	○	○	○	○	○	○
مغسله	○	○	○	○	○	○
مدارس	○	○	○	○	○	○
موقف سيارات عام	○	○	○	○	○	○
صاله رياضية	○	○	○	○	○	○
اماكن عمل	○	○	○	○	○	○
ميدان العاب رياضيه	○	○	○	○	○	○

12.

3/ حدد درجة رضاك عن مظاهر الاستدامه في المبني السكني:

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
توجيه للمبني مناسب	○	○	○	○	○	○
توفراضاءة طبيعيه مناسبه	○	○	○	○	○	○
كفاءة التهويه داخل المبني السكني	○	○	○	○	○	○
توفرشبكة تجميع مياه الامطار	○	○	○	○	○	○
توفر نظام لاعادة استعمال مياه المجاري	○	○	○	○	○	○
توفر حديقة علي السطح	○	○	○	○	○	○
استعمال مواد بناء مستدامه	○	○	○	○	○	○
استعمال تقنيات مستدامه لتوفير الطاقة مثل وحدات الطاقة الشمسيه أوالطاقة الحراريه الأرضية	○	○	○	○	○	○
طرق مستدامه لتجميع القمامه	○	○	○	○	○	○

13.

الجزء الرابع :الترابط و العلاقات الاجتماعية

1/ حدد درجة مصداقية الجمل التالية:

	5(صحيح جدا)	4 (صحيح لحد معتدل)	3(غير واضح)	2(غيرصحيح)	1 (غير صحيح ابدا)
السكن في هذه المنطقه يعزز الاحساس بالجيرة	○	○	○	○	○
علاقتي مع الجيران تتوثق كل يوم	○	○	○	○	○
أشعربالامتنان والوفاء لجيراني	○	○	○	○	○
اشعر اني متماثل مع جيراني في الحي	○	○	○	○	○
من المعتاد ان ادخل في حوارات ودودة مع سكان الحي	○	○	○	○	○
عموما انا متوافق مع سكان الحي السكني حول الاهتمامات الحياتيه	○	○	○	○	○
يمكنني ببساطة ان اتحدث مع احد سكان الحي السكني للحصول علي نصيحة	○	○	○	○	○
الصداقة والتوافق مع السكان في الحي السكني مهمه جدا بالنسبه لي	○	○	○	○	○
انا جزء من الحي السكني والسكان يتعاونون ككل	○	○	○	○	○
انا اعتقد السكان سيتعاونون معي في حاله الطوارئ	○	○	○	○	○
اود ان اعمل مع السكان للرقع من مستوى الحي السكني	○	○	○	○	○
سوف اختار البقاء بالحي السكني لو عرض علي الانتقال	○	○	○	○	○
سوف اختار البقاء بالحي السكني لعدة سنوات اخرى	○	○	○	○	○
انا اشعر بالانتماء لهذا الحي السكني	○	○	○	○	○
انا اشعر اني جزء من الحي السكني	○	○	○	○	○
انا اتزاور مع جيراني عادة	○	○	○	○	○
انا استعير اشياء من جيراني	○	○	○	○	○
العزله بين الجيران بسبب عدم توفر اماكن للتجمع في الحي السكني	○	○	○	○	○
اسباب اخرى تقترحها	○	○	○	○	○

14.

2/ المنطقة السكنيه تعكس مشاكل اجتماعية واضطرابات:

	5(صحيح جدا)	4 (صحيح لحد معتدل)	3(غير واضح)	2(غيرصحيح)	1 (غير صحيح ابدا)
نقص في الشعور بالانتماء للمكان وللمقيمين به	○	○	○	○	○
فقد الثقه بين السكان في الحي السكني	○	○	○	○	○
نقص في الانشطه الاجتماعيه بين المقيمين بالحي السكني	○	○	○	○	○
اختلاف وتفاوت العادات والتقاليد بين المقيمين بالحي السكني	○	○	○	○	○
ضعف التمسك بالتعاليم الدينية بين المقيمين بالحي السكني	○	○	○	○	○
نقص التضامن بين السكان	○	○	○	○	○
خلافات دائمه بين المقيمين بالحي السكني	○	○	○	○	○
ارتفاع معدل البطاله بين المقيمين بالحي السكني	○	○	○	○	○
انتشار الامراض بين المقيمين بالحي السكني	○	○	○	○	○
الاطفال لا يلعبون مع بعضهم عادة	○	○	○	○	○
تكرار اشتعال النيران في الحي السكني	○	○	○	○	○

15.

3/ المشروع يعكس ارتفاع مستوي تكرار الجريمه

	6 (عالي جدا)	5(عالي)	4 (معتدل)	3(قليل)	2(قليل جدا)	1 (غير قابل للتطبيق)
السرقات	○	○	○	○	○	○
حوادث سيارات وعنف	○	○	○	○	○	○
سلب واغتصاب	○	○	○	○	○	○
تجارة مخدرات	○	○	○	○	○	○
جرائم قتل	○	○	○	○	○	○

16.

4/ المشروع يعاني من الازدحام مما قد يسبب في المشاكل التاليه:

	1 (غير صحيح ابدا)	2(غيرصحيح)	3(غير واضح)	4 (صحيح لحد معتدل)	5(صحيح جدا)
يزيد العلاقات الإجتماعية الجيدة					
تغيير مخططات العائلة وتركيبتها					

17.

5/ حدد اين تفضل ان تسكن:

	1 (غير صحيح ابدا)	2(غيرصحيح)	3(غير واضح)	4 (صحيح لحد معتدل)	5(صحيح جدا)
في حي سكني يعزز الاحساس بالتعاون والانسجام مع المحيط السكني					
انا افضل ان تكون علاقتي قوية بالجيران والمقيمين بالحي السكني					

18.

الجزء الخامس : تصميم الوحدة السكنيه و مكوناتها:

1/ لو كنت تسكن في سقة ببرج سكني , كم عدد الادوار فوق الارضي التي تفضل ان تسكن بها اذا توفر المصعد ؟

19.

2/ لو كنت تسكن في سقة ببرج سكني , كم عدد الادوار فوق الارضي التي تفضل ان تسكن بها اذا لم يوفر المصعد ؟

20.

3/ لو كنت تسكن في شقة ببرج سكني , كم عدد الشقق السكنية في الطابق الذي تسكنه ؟

21.

4/في حال توفر امكانية اختيار نوع الشقة هل ستختار نفس الشقة التي تسكنها الان؟

22.

5/ عدد غرف النوم في شقتك؟

23.

6/ في حال توفر امكانية اختيار الشقة هل ستختار نفس عدد غرف النوم في الشقة التي تسكنها الان؟

24.

7/ في حال توفر امكانية اختيار نوع الشقة هل ستختار نفس الشقة التي تسكنها الان مع بعض الاضافات والتحويرات؟

نعم

لا

أخرى (يرجى التحديد)

25.

9/ ما عدد ومساحة غرف النوم في شقتك؟

	M 5*5	M 4.5*5	M 4.5*5	M 4*4	M 3.5*3.5	M 3.5*4	M 3*3
غرف النوم الرئيسية	○	○	○	○	○	○	○
غرف النوم الاطفال	○	○	○	○	○	○	○
غرف نوم الضيوف	○	○	○	○	○	○	○

أخرى (يرجى التحديد)

26.

10/ حدد درجة رضاك عن حاله غرف النوم في بيتك؟

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
عدد غرف النوم	○	○	○	○	○	○
مساحه غرف النوم	○	○	○	○	○	○
اشعة الشمس تدخل الغرفة	○	○	○	○	○	○
التهوية الطبيعية جيدة	○	○	○	○	○	○
يمكن فتح النوافذ دون ضررالجيران	○	○	○	○	○	○
متانه مواد انهاء الارضيه	○	○	○	○	○	○
متانه مواد انهاء الحوائط	○	○	○	○	○	○
متانه انهاء الارضيه	○	○	○	○	○	○
متانه انهاء الحوائط	○	○	○	○	○	○
جمالية و مظهرانهاء الارضيه	○	○	○	○	○	○
جمالية و مظهرانهاء الحوائط	○	○	○	○	○	○

أخرى (يرجى التحديد)

27.

11/ كم عدد ومساحة حجرات النوم التي تفضل في شقتك؟

	M 5*5	M 4.5*5	M 4.5*4.5	M 4*4	M 3.5*4	M 3.5*3.5	M 3*3.5	M 3*3
غرف النوم الرئيسية غ	○	○	○	○	○	○	○	○
رف النوم الاطفال	○	○	○	○	○	○	○	○
غرف نوم الضيوف	○	○	○	○	○	○	○	○

أخرى (يرجى التحديد)

28.

12/ ما درجة رضاك عن فراغ المعيشة في بيتك؟

	1 (غير قابل للتطبيق)	2(غير راضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
مناسبة للاستعمال اليومي	○	○	○	○	○	○
قريبة من المطبخ	○	○	○	○	○	○
قريبة من غرف النوم	○	○	○	○	○	○
قريبة من المدخل	○	○	○	○	○	○
يمكن استعمالها لاكثر من فراغ	○	○	○	○	○	○
يمكن استعمالها في حال زاد عدد المستعملين	○	○	○	○	○	○
توفر اشعه الشمس المباشرة	○	○	○	○	○	○
توفر التهوية الطبيعية بها	○	○	○	○	○	○

29.

13/ حدد درجة رضاك عن بيتك الحالي

30.

14/ ما هي مواصفات فراغ المعيشة الذي ترغب به؟

31.

15/ حدد درجة رضاك عن المطبخ في بيتك؟

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
سهل الوصول اليه من جميع افراد العائلة	○	○	○	○	○	○
مساحة مناسبه لجميع افراد العائلة	○	○	○	○	○	○
يمكن استعماله عند زيادة افراد العائلة	○	○	○	○	○	○
توفر اشعة الشمس المباشرة	○	○	○	○	○	○
يمكن فتح النوافذ دون ازعاج الجيران	○	○	○	○	○	○
توفر الماء الساخن والبارد به	○	○	○	○	○	○
توفر المجارى	○	○	○	○	○	○
توفر شفاط	○	○	○	○	○	○
توفر نظام حماية من الحريق	○	○	○	○	○	○
متانه مواد انهاء الارضيه	○	○	○	○	○	○
متانه مواد انهاء الحوائط	○	○	○	○	○	○
متانه انهاء الارضيه	○	○	○	○	○	○
متانه انهاء الحوائط	○	○	○	○	○	○
جمالية و مظهرانهاء الارضيه	○	○	○	○	○	○
جمالية و مظهرانهاء الحوائط	○	○	○	○	○	○

32.

16/ وضح سبب درجة رضاك

33.

17/ ما عدد ونوع دورات المياه في بيتك

- ☐ حوض ومرحاض 1/2
- ☐ حوض ومرحاض ودوش 3/4
- ☐ كامل

34.

18/ ما درجة رضاك عن دورات المياه

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
مشاحة الحام وعددهم مناسب لرغبة العائلة	○	○	○	○	○	○
مكان الحمام مناسب للعائلة والضيوف	○	○	○	○	○	○
مساحة تخزين مناسبة للعائلة	○	○	○	○	○	○
تصله اشعة الشمس	○	○	○	○	○	○
تهوية مناسبة	○	○	○	○	○	○
يمكن فتح نوافذ الحمام دون ازعاج الجيران	○	○	○	○	○	○
توفر ماء ساخن وبارد	○	○	○	○	○	○
توفر مجارى مناسبة	○	○	○	○	○	○
توفر شفاط هواء	○	○	○	○	○	○
متانه مواد انهاء الارضيه	○	○	○	○	○	○
متانه مواد انهاء الحوائط	○	○	○	○	○	○
متانه انهاء الارضيه	○	○	○	○	○	○
متانه انهاء الحوائط	○	○	○	○	○	○
جمالية و مظهرانهاء الارضيه	○	○	○	○	○	○
جمالية و مظهرانهاء الحوائط	○	○	○	○	○	○

35.

19/ وضح سبب رضاك عن الحمامات في بيتك

36.

20/ كم عدد الحمامات من الانواع المذكورة تفضل في بيتك

- ☐ 1/2 حوض ومرحاض
- ☐ 3/4 حوض ومرحاض ودوش
- ☐ كامل

37.

21/ اين مكان غساله الملابس في بيتك

- الحمام
- المطبخ
- الجراج
- حجرة الغسيل
- اخر

38.

22/ ما درجة رضاك عن اماكن الغسيل في بيتك

	1 (غير قابل للتطبيق)	2(غير راضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
درجة رضاك عن اماكن الغسيل في بيتك	○	○	○	○	○	○

39.

23/ وضح سبب رضاك عن اماكن غسيل الملابس في وحدتك

40.

24/ اين تفضل ان تكون اماكن الغسيل في وحدتك

- الحمام
- المطبخ
- الجراج
- غرفة غسيل الملابس
- اخر

41.

25/ كم عدد اماكن التخزين في وحدتك

42.

26/ ما درجة رضاك عن مساحات التخزين في بيتك

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
مستوى الرضا	○	○	○	○	○	○

43.

27/ ماعدد المخازن التي تفضل

- ☐ داخل الوحدة السكنية
- ☐ خارج الوحدة السكنية
- ☐ داخل وخارج الوحدة السكنية
- ☐ أخر

44.

28/ ما نوع موقف السيارات الذي عندك

- ☐ موقف عام للتجمع السكني
- ☐ موقف خاصبالوحدة السكنية (جراج خاص)
- ☐ مساحة خاصة مغطاة
- ☐ مساحة غير مغطاة
- ☐ في الشارع
- ☐ أخر

45.

29/ كم عدد السيارات الخاصة بك

- ☐ سيارة عائلية
- ☐ دراجة نارية

46.

30 / حدد درجة رضاك عن موقف السيارة في سكنك

	1 (غير قابل للتطبيق)	2(غير راضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
مستوى الرضا	○	○	○	○	○	○

47.

31 / وضح سبب رضاك من عدمه

48.

32/ كم عدد مواقف السيارات التي تفضل ان تكون في سكنك

49.

33/ مانوع مواقف السيارات التي تفضل ان تكون في مسكنك المثالي

- ☐ موقف واحد لكل المساكن
- ☐ جراج خاص بكل وحدة سكنية
- ☐ موقف سيارات غير مغطى
- ☐ في الشارع
- ☐ أخرى (يرجى التحديد)

50.

34/ ما نوع الانشطة الخارجية المتوفره في وحدتك السكنية

	6 (مهم جدا)	5(مهم)	4 (معتدل)	3(غير مهم)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
فناء خلفي	○	○	○	○	○	○
فناء امامي	○	○	○	○	○	○
فناء جانبي	○	○	○	○	○	○
شرفات	○	○	○	○	○	○
مساحة مغطاة	○	○	○	○	○	○
فناء مشترك	○	○	○	○	○	○
جلسة امامية مبنية	○	○	○	○	○	○
جلسة امامية مبنية مغطاة	○	○	○	○	○	○
حديقة سطح	○	○	○	○	○	○

أخرى (يرجى التحديد)

51.

35/ ما درجة رضاك عن المساحات الخارجية

	6 (راضي جدا)	5(راضي)	4 (معتدل)	3(غير راضي)	2(غيرراضي جدا)	1 (غير قابل للتطبيق)
فناء خلفي	○	○	○	○	○	○
فناء امامي	○	○	○	○	○	○
فناء جانبي	○	○	○	○	○	○
شرفات	○	○	○	○	○	○
مساحة مغطاة	○	○	○	○	○	○
فناء مشترك	○	○	○	○	○	○
جلسة امامية مبنية	○	○	○	○	○	○
جلسة امامية مبنية مغطاة	○	○	○	○	○	○

أخرى (يرجى التحديد)

52.

36/ وضح سبب درجة رضاك

53.

37/ حدد اهمية توفر الفراغات الخارجية التالية في وحدتك السكنية

	1 (غير قابل للتطبيق)	2(غير راضي جدا)	3(غير مهم)	4 (معتدل)	5(مهم)	6 (مهم جدا)
فناء خلفي	○	○	○	○	○	○
شرفات	○	○	○	○	○	○
فناء امامي	○	○	○	○	○	○
مساحة مغطاة	○	○	○	○	○	○
فناء جانبي	○	○	○	○	○	○
حديقة سطح	○	○	○	○	○	○

أخرى (يرجى التحديد)

54.

38/ حدد نوع نظام التخلص من النفايات المتوفر في وحدتك السكنية

- ○ على مستوى الطابق في نفس المبنى
- ○ في طابق آخر
- ○ قناة جمع القمامة
- ○ خارج المبنى السكني في مساحة خاصة
- ○ أخرى (يرجى التحديد)

55.

39/ حدد نوع جمع القمامة الذي تفضل

- على مستوى الطابق في نفس المبنى
- في طابق آخر
- قناة جمع القمامة
- خارج المبني السكني في مساحة خاصة

56.

42/ اي من هذه الفراغات يعتبر الاهم ليكون متوفر في وحدتك السكنية

57.

الجزء السادس: الاضافات والتحويرات في الوحدات السكنية من السكان

1/ هل قمت باي اضافات او تحويرات لوحدتك السكنية

58.

2/ ما نوع التحوير الذي قمت به

- اغلاق الشرفة واضافتها الي المسكن
- تحوير الشرفة الي مخزن
- تحويل الحمام الي مخزن
- بناء حمام في الفناء الخارجي
- بناء حجرة اخرى في الفناء الخارجي
- بناء مخزن في الفناء الخارجي
- توسيع المطبخ
- توسيع مساحة المعيشة
- أخرى (يرجى التحديد)

-

59.

3/ لماذا قمت بالتحويرات

60.

4/ كم كانت كلفة التحويرات

61.

متي قمت بالتحويرات

62.

الجزء السابع : الراحة الحرارية

/1 هل استعملت وحدة تبريد في الصيف

63.

/2 في حال الاجابه بنعم, كم معدل ساعات استعمال مكيف الهواء

- 0-6
- 6-12
- 12-18
- 18-24

64.

/3 في حال عدم توفر كهرباء في فصل الصيف ماذا تفعل

- تغيير نوع الملابس
- فتح الستائر
- فتح النوافذ
- استعمال مراوح يدوية
- أخرى (يرجى التحديد)

65.

4/ ما درجة رضاك عن الراحة الحرارية في وحدتك دون استعمال اجهزة كهربائية لتعديل الحرارة الداخلية

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
في الصيف	○	○	○	○	○	○
في الخريف	○	○	○	○	○	○
في الشتاء	○	○	○	○	○	○
في الربيع	○	○	○	○	○	○

أخرى (يرجى التحديد)

66.

5/ في حال عدم توفر كهرباء ما الذي تفعله لتلطيف الجو داخل وحدتك في الصيف

67.

6/ في حال عدم توفر كهرباء كيف تدفء وحدتك في الشتاء

- استعمال تدفئة من الفحم او الوقود ○
- اغلاق النوافذ ○
- اغلاق الستائر ○
- اضافة ملابس ○
- استعمال بطانيات ○

68.

7/ اذا كان لديك مقياس حرارة في وحدتك السكنية ما شعورك عن درجة الحرارة في وحدتك الان

بارد جدا

بارد

بارد نوعا ما

طبيعي

حار نوعا ما

حار

حار جدا

69.

8/ اذا كان لديك مقياس حرحرة في وحدتك ما التاريخ والوقت الان

	شهر		يوم		سنة	س		د	ص/م
التاريخ / الوقت		/		/			:		-

70.

9/ هل انت راضي عن الراحة الحرارية في وحدتك الان

- مقبولة
- غير مقبولة

71.

10/ في حال انها غير مقبولة انت تفضل ان تكون

- ابرد
- ادفئ
- كما هي

72.

11/ ما شعورك ورضاك عن حركة الهواء في وحدتك الان

- مقبولة
- غير مقبولة

73.

12/ حاليا انت تفضل ان تكون حركة الهواء حولك في وحدتك

- اسرع
- اقل
- نفس المستوى

74.

13/ هل تشعر ان مستوي الرطوبة في وحدتك الان

- مقبول
- غير مقبول

75.

14/ هل تفضل ان يكون مستوي الرطوبة

- اعلي
- اقل
- نفس المستوى

76.

15/ متي تكرر شعورك بدرجة حرارة عالية

- ابدا لم اشعر
- نادرا
- احيانا
- عادة
- دائما
- أخرى (يرجى التحديد)

77.

16/ متي تكرر شعورك بدرجة برودة عالية في حدتك

- ابدا لم اشعر
- نادرا
- احيانا
- عادة
- دائما
- أخرى (يرجى التحديد)

78.

17/ هل تعتمد علي الاضاءة الصناعية في وحدتك

79.

2/ نحتاج لاخذ قرار حسب توزيع الفراغات في المسكن ولهذا يرجي تحديد اهمية الفراغات (مثلا: تتغاضي عن مساحة الحمام الكبيرة للحصول علي فراغ اكبر للمعيشة)

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير مهم)	4 (معتدل)	5(مهم)	6 (مهم جدا)
الحمام الرئيسي	○	○	○	○	○	○
الحمامات	○	○	○	○	○	○
فراغ المعيشة	○	○	○	○	○	○
فراغ مكتب	○	○	○	○	○	○
مخازن	○	○	○	○	○	○

80.

18/ ما سبب اعتمادك علي الاضاءة الصناعية

- ○ عدم توفر نوافذ
- ○ عدم توفر امكانية فتحها
- ○ تفضل الاضاءة الصناعية
- ○ اضاءة صناعية في النهار
- ○ اضاءة صناعية في النهارو الليل

81.

19/ ما اسباب عدم رضاك عن الراحة الحرارية في بيتك

- ضعف الاضاءة الطبيعية
- البرودة في الشتاء
- السخونة في الصيف
- التغير المفاجي في درجة الحرارة
- صعوبة التحكم في درجة الحرارة

82.

3/ حدد اهمية مكونات المسكن التالية

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير مهم)	4 (محتدل)	5(مهم)	6 (مهم جدا)
نوع المسكن (شقة -بيت)						
عدد الفراغات الداخلية (المساحة والعدد للحجرات)						
درجة الرفاهية (فراغ لغسيل الملابس, اجهزة ...)						
الفراغات الخارجية (مواقف السيارات, افنية , مساحات مفتوحة)						
التماسك الاجتماعي في التجمع						
موقع التجمع السكني (قربه من اماكن العمل , مدارس)						

أخرى (يرجى التحديد)

83.

الجزء الثامن: اسئلة عامه تتعلق بالتصميم

1/ ما رضاك عن تصممصم العناصر التالية:

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
ملائمه وتنوع الفراغات في الوحدة السكنية	○	○	○	○	○	○
فصل واضح بين مساحات الضيوف و العائلة في المسكن	○	○	○	○	○	○
سهولة استعمال الفراغات لكبار السن والمعاقين	○	○	○	○	○	○
توفر حماية مناسبة من الجرائم والسرقات	○	○	○	○	○	○
مناظر محببة خلال النوافذ والشرفات	○	○	○	○	○	○
توفر خصوصية عالية من الجيران	○	○	○	○	○	○

84.

2/ هل هناك اي تشققات في الحوائط

85.

3/ هل هناك تساقط في وحدات السيراميك في جدران الحمامات اوالمطبخ

86.

الجزء التاسع:حالة المبني و الصيانة الدورية

1/ حدد درجة رضاك علي مكونات المبني السكني

	1 (غير قابل للتطبيق)	2(غير راضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
التكامل الانشاءى						
متانة مواد انهاء السقف						
متانة مواد انهاء الحوائط						
متانة مواد انهاء الارضيات						
متانة مواد انهاء الشرفات						
جودة شبكة الكهرباء						
جودة شبكة المجارى						
جودة شبكة تجميع مياه الامطار						
المظهر الخارجي لمواد الانهاء						
العزل الصوتي						
العزل الحرارى						

87.

4/ هل هناك صيانه دورية للمساكن

88.

5/ هل هناك صيانه لتنسيق المساحات الخارجية في المشروع وحول مسكنك

89.

6/ ما نوع الصيانة الدورية لوحدتك السكنية

- مرتين بالسنه
- مرة بالسنه
- كل سنتان
- كل ثلاث سنوات
- كل اربع سنوات

90.

7/ هل هناك اي معالجات للتحويرات والاضافات في وحدتك السكنية

91.

2/ هل سعر الوحدة الان يعكس

- قيمة الوحدة
- سعر السوق
- سمعة المنطقة
- تكلفة الاضافات والتحويرات
- ملاحظات تود اضافتها

92.

الجزء العاشر: سمات الاستدامة المطبقة في وحدتك السكنية

1/ حدد درجة رضاك عن مظاهر الاستدامه المطبقة في وحدتمك السكنية

	1 (غير قابل للتطبيق)	2(غيرراضي جدا)	3(غير راضي)	4 (معتدل)	5(راضي)	6 (راضي جدا)
توفر وكفاءة الاضاءة النهارية	○	○	○	○	○	○
توفر وكفاءة التهوية الطبيعية	○	○	○	○	○	○
توفر كافي لاشعة الشمس في الفراغات المعيشية في الشتاء	○	○	○	○	○	○
التصميم يلبي مع الاحتياجات اليومية والتقليدية	○	○	○	○	○	○
مرونه تكفل امكانية استعمال الفراغ الواحد لعدة وظائف	○	○	○	○	○	○
امكانية موائمة الفراغ لتلبية أي زيادة بالعدد	○	○	○	○	○	○

93.

الجزء العاشر: تكلفة الوحدة السكنية

1/ حدد سعر الوحدة السكنية في الحالات التالية:

سعر الوحدة عندما اشتريتها من امانه الاسكان

سعر الوحدة بناء علي مساحتها و جودتها

سعر الوحدة بناء علي موقعها والخدمات المحيطة بها

سعر الوحدة الان

94.

هل ضايقك ومنعك من القيام بانشطتك اليومية عدم رضاك عن الراحة الحرارية في وحدتك

- ○ لا
- ○ احيانا
- ○ متوسط
- ○ عالي
- ○ أخرى (يرجى التحديد)

396